Becker & Hickl GmbH

Technology Leader in Photon Counting

Product Catalog

Application Specialist Partner in North America:

2019
Technology Leaders in Photon Counting

About bh

Founded in 1993, Becker & Hickl have introduced a proprietary time-correlated single-photon counting principle that made TCSPC more than 100 times faster than the existing devices. Moreover, bh introduced a multi-dimensional TCSPC process that records the photons not only versus the time in the signal period, but also versus other parameters, such as experiment time, wavelength, or spatial coordinates. The bh devices are designed to record multi-dimensional photon distributions, time-resolved images, sequences of photon distributions, or multi-dimensional time-tag data. The bh TCSPC products are complemented by bh picosecond diode lasers, detector modules, multi-spectral detector assemblies, and experiment control modules. Based on these components Becker & Hickl supply their own confocal fluorescence lifetime laser scanning microscope and FLIM upgrade kits for laser scanning microscopes of various manufacturers. Moreover, bh is supplier of TCSPC and lasers for clinical FLIM devices. bh market activities include currently five workshops around the world yearly and the distribution of more than 1500 pages of TCSPC literature.

1993
- Introduction of multidimensional TCSPC. Introduction of fast TAC/ADC conversion. TCSPC becomes 100 times faster than it was before.

1994

1995

1996
- SPC-535 modules. First implementation of TCSPC FLIM. First FLIM applications in laser scanning ophthalmology.

1997

1998
- SPC-730 modules. Introduction of TCSPC FLIM. Scan Sync In and Scan Sync out mode. First applications in FLIM microscopy.

1999
- SPC-130 TCSPC board. SPC-134 four-channel packages for optical tomography. Saturated sustained count rate 32 MHz.

2000
- FLIM upgrade kits for Zeiss LSM 510 NLO microscopes. SPCImage FLIM data analysis software. BHL-600 red and NIR picosecond diode lasers.

2001
- SPC-830 modules. For the first time, FLIM and single-molecule techniques were combined in one instrument.
- DCC-100 detector controller solves the problem of detector overload.

2002
- FLIM systems for Leica, Olympus, and Biorad laser scanning microscopes. First multi-spectral FLIM. First demonstration of double-exponential FRET imaging. BDL-405 UV picosecond diode lasers.

2003

2004
- Simple-Tau 140 and Simple-Tau 830 compact TCSPC systems. First multi-spectral NDD FLIM systems for multiphoton microscopes.
- Macro-time synchronisation of several TCSPC modules. First full correlation down to the picosecond region.

2005
- New PML-16 sixteen channel detector. Internal high-voltage generator, overload shutdown, control via DCC-100.

2006
- High-power CW mode for BDL-SMC picosecond diode lasers.

2007
- SPC-154 package and SPC-150 modules.

2008
- FLIM systems for Zeiss LSM 710 microscopes. NDD FLIM systems for Leica SP2 MP and SP5 MP microscopes. Simple-Tau 152 and -154 two and four channel TCSPC systems.

2009
- HPM-100-40 GaAsP hybrid detectors. 8-channel parallel TCSPC and TCSPC FLIM systems

2010
- Phosphorescence Lifetime imaging (PLIM) in DCS-120 and Zeiss LSM 710 FLIM systems. Fluorescence Lifetime-Transient Scanning (FLITS). DCS-120 Wideband, DCS-120 Multiphoton, and DCS-120 Macro FLIM systems

2011

2012

2013

2014

2015
- Fast Online FLIM, FLIM with Abberior STED microscopes, SPC-160pcie, DCC-100pcie, GVD-120pcie PCI-Express TCSPC, Detector Control, and Scan Control modules. Simple Tau II TCSPC systems with Thunderbolt interface. FLIM for Sutter Instrument MOM microscopes.

2016
- Sub-20 ps (FWHM) IRF width with new PMH-100-06 and -07 hybrid detectors. Spatial Mosaic FLIM with with DCS-120 confocal and multiphoton FLIM systems. Phasor analysis integrated in SPCImage. SPCM Software controls Ti:Sa laser, AOM, and motorised sample stage. 7th edition of bh TCSPC Handbook.

2017
- FASTAC fast-acquisition FLIM system, 25 ps FWHM with fast HPM detectors.

2018
- Metabolic FLIM with multiplexed diode lasers. Parallel detection of NADH and FAD fluorescence.
bh Modular TCSPC Systems - Unsurpassed in Time resolution

**SPC-160**: High performance in all TCSPC applications
- Internal histogramming modes and photon stream (parameter tag) modes
- Multi-detector / multi-wavelength / laser multiplexing operation
- Triggered multichannel scaler (phosphorescence) mode
- High-speed FLIM / PLIM / FLITS for laser scanning microscopes
- Megapixel Technology: Mosaic, Time Series, Z-stack, Multi-spectral FLIM
- High-speed parallel imaging channel
- FCS / FCCS in combination with fluorescence lifetime
- Single-molecule multi-parameter burst analysis
- Unlimited fast sequential recording for fNIRS / DOT systems
- Dead time 80 ns, saturated count rate 12.5 MHz
- Ultra-fast discriminators, 5 GHz input bandwidth
- Extra-low low-frequency timing noise
- Part of bh modular FLIM systems

**New**: SPC-160pcie TCSPC module with PCI Express Interface
- Functions and parameters see SPC-160
- Part of Simple-Tau II system

**SPC-150**: High-end performance at reasonable cost
- Internal histogramming modes and Photon stream (parameter tag) modes
- Multi-detector / multi-wavelength / laser multiplexing operation
- Triggered Multichannel Scaler (phosphorescence) mode
- High-speed FLIM / PLIM / FLITS for laser scanning microscopes
- Megapixel Technology: Mosaic, Time Series, Z-stack, Multi-spectral FLIM
- FCS / FCCS in combination with fluorescence lifetime
- Single-molecule multi-parameter burst analysis
- Unlimited fast sequential recording for DOT systems
- Electrical response 6.8 ps FWHM, electrical timing jitter 3 ps RMS
- Dead time 100 ns, saturated count rate 10 MHz
- Expandable with up to 8 detectors or 16-channel multispectral detection
- Part of bh modular FLIM systems

**SPC-150N**: Improved Timing for Fast Detectors
- Ultra-fast discriminators, 5 GHz input bandwidth
- Extra-low low-frequency timing noise
- Electrical time resolution 6.8 ps FWHM, electrical timing jitter 3 ps RMS
- Minimum time channel width 613 fs
- Expandable with up to 8 detectors or 16-channel multispectral detection

**SPC-150NX**: Ultra-Fast Timing for Ultra-Fast Detectors
- Ultra-fast discriminators, 5 GHz input bandwidth
- Extra-low timing noise
- Electrical response 3.5 ps FWHM, electrical timing jitter 1.5 ps RMS
- Minimum time channel width 406 fs
- TAC range from 25 ns to 2 µs
- World record in TCSPC time resolution: 17.8 ps FWHM / 7.9 ps RMS with superconducting detector

**SPC-150NxX**: Ultra-High Time Resolution
- Ultra-fast discriminators, 5 GHz input bandwidth
- Extra-low timing noise
- Electrical response 3 ps FWHM, electrical timing jitter 1.2 ps RMS
- Minimum time channel width 203 fs
- TAC Range from 12.5 ns to 100 ns
- New World record in TCSPC time resolution: 4.4 FWHM / 2 ps RMS with superconducting detector

**SPC-130-EM TCSPC Modules**
- Improved SPC-130 with fast bus interface and larger memory
- Standard fluorescence and phosphorescence lifetime, diffuse optical tomography, single-molecule spectroscopy, FCS, photon correlation
- Rugged design
- Photon distribution, parameter-tag, sequential-recording modes
- Also available as SPC-134EM four-channel package
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SPC-154 and SPC-154N Four-Channel TCSPC package
- Four fully parallel TCSPC / FLIM channels
- Multi-dimensional photon distribution mode
- Multi-detector / multi-wavelength operation / laser multiplexing operation
- Photon stream (parameter tag) mode; buffer size 2 M photons
- Triggered MCS (phosphorescence) mode
- Synchronisation of channels for photon correlation
- High-speed FLIM / PLIM / FLITS for laser scanning microscopes
- FCS in combination with fluorescence lifetime
- Single-molecule multi-parameter burst analysis
- Unlimited fast sequential recording: TCSPC module for DOT systems
- Total recordable count rate 20 MHz, saturated count rate 40 MHz
- Each channel expandable for up to 8 detectors

SPC-134 and SPC-134-EM Four-Channel TCSPC packages
- Four fully parallel TCSPC channels
- Multi-dimensional photon distribution mode
- Photon stream (parameter tag) mode; buffer size 8 M photons
- Synchronisation of channels for photon correlation
- FCS in combination with fluorescence lifetime
- Burst-integrated fluorescence lifetime detection
- Unlimited fast sequential recording: TCSPC module for DOT systems
- Fast multiplexing of excitation sources
- Total recordable count rate 20 MHz

Simple-Tau Compact TCSPC and TCSPC-FLIM Systems

New: FASTAC Fast-Acquisition FLIM System
- Photons distributed into four parallel SPC-150N TCSPC Channels
- No compromise in time resolution and time channel width
- IRF width 25 ps FWHM with fast HPM detectors
- Time-channel width down to 405 fs
- Images up to 2048 x 1024 pixels, 1024 time channels
- Acquisition time down to 100 ms for 256 x 256 pixel images
- Fast acquisition FLIM or Precision FLIM
- Temporal and Lateral Mosaic FLIM
- Simultaneous FLIM / PLIM
- Works with DCS-120, DCS-120 MACRO and Zeiss LSM 880

New: Simple-Tau II TCSPC/FLIM systems
- Thunderbolt interface to system computer
- One or two SPC-160pcie TCSPC/FLIM modules
- One DCC-100pcie detector controller

Simple-Tau 150, 150N, and 160 compact TCSPC systems
- One SPC-150, 150N, or 160 TCSPC channel
- One DCC-100 detector controller
- Portable DOT systems
- High-Speed FLIM systems
- Compatible with bh multispectral FLIM detectors
- Part of bh DCS-120 confocal scanning FLIM systems
- Part of bh FLIM systems for Zeiss LSM 510 and LSM 710 family
- Part of bh NDD FLIM systems for Leica SP2 and SP5 MP
- Can be upgraded with additional SPC-150 or measurement control cards

Simple-Tau 152, 152N, and 162 compact TCSPC systems
- Two parallel SPC-150, 150N, or 160 TCSPC channels
- One DCC-100 detector controller
- Portable DOT systems
- High-Speed FLIM systems
- Part of bh DCS-120 confocal scanning FLIM systems
- Part of bh FLIM systems for Zeiss LSM 510 and LSM 710 family
- Can be upgraded with additional SPC-150 or measurement control cards

Simple-Tau 154, 154N, and 164 compact TCSPC systems
- Four parallel SPC-150, 150N, or 160 TCSPC channels
- Portable DOT systems
- Ultra-High-Speed parallel multispectral FLIM systems

Simple-Tau 130 compact TCSPC systems
Simple-Tau 130 EM compact TCSPC systems
- One SPC-130 or SPC-130 EM TCSPC channel
- One DCC-100 detector controller
- Standard fluorescence lifetime applications
- Anti-bunching measurements
- Can be upgraded with additional SPC-130 or measurement control cards
More than 2000 TCSPC Systems Worldwide

Simple-Tau ‘Big’ Versions
Up to seven TCSPC and measurement control cards
User-specific hardware and software configuration
High speed parallel FLIM systems
Portable DOT systems

Simple-Tau ‘Large Screen’ Versions
Combines large screen area with small size of TCSPC system
FLIM and other TCSPC Imaging applications
High-resolution FLIM in combination with 64 bit SPCM software

Multi-Tau 8-Channel TCSPC systems
Eight SPC-150 or SPC-130 TCSPC modules controlled from a standard Pentium PC
Portable DOT systems
Ultra-High-Speed FLIM systems

Power-Tau TCSPC systems
Up to six TCSPC or measurement control cards in high performance PC
Highly modular systems
User-specific hardware and software configuration
Large system memory for megapixel FLIM applications and DOT
High data transfer rate
High on-line computation power

Picosecond Photon Correlators

DPC-230 16 Channel Picosecond Photon Correlator
Recording of absolute photon times in 16 channels
Fluorescence correlation down to ps times
FCS combined with fluorescence decay
3-channel reversed-start-stop TCSPC mode for PMT inputs
15-channel reversed start-stop mode for LVTTL SPAD inputs
15-channel multiscaler mode
TCSPC FLIM Mode
Multiscaler FLIM mode
Auto correlation / Cross correlation within 16 LVTTL or 4 CFD channels

Simple-Tau DPC System
Laptop based compact system
DPC-230 16 Channel Picosecond Photon Correlator
Optional:
DCC-100 detector controller card
GVD-120 scan controller card
Multichannel Scalers

PMS-400 Gated Photon Counter and Multichannel Scaler
- Dated detection of optical signals
- Luminescence decay in the µs and ms range
- Chemiluminescence
- Two parallel recording channels
- Gating down to 1 ns
- Multiscaler operation down to 300 ns per channel

MSA-300 Multichannel Scaler
- Recording of luminescence decay functions in the ns, and µs range
- Time-of-flight mass spectroscopy
- Lidar
- Time resolution 5 ns per time channel
- Maximum count rate 100 MHz
- Compact Simple-Tau MSA systems available

Simple-Tau MSA systems
- Lap-top based compact MSA-300 systems
- 1, 2, or 3 MSA-300 modules
- DCC-100 detector controller
- Recording of luminescence decay functions in the ns, and µs range
- Time-of-flight mass spectroscopy
- Lidar

SPC-130EM, SPC-150, SPC-160, SPC-830 TCSPC Systems
- All SPC-130EM, SPC-150, SPC-160, SPC-160pcie and SPC-830 TCSPC Systems have a multichannel-scaler function implemented. The MCS function works simultaneously with the TCSPC process.
- Applications:
  - Recording of photon bursts from single molecules
  - Single-molecule spectroscopy
  - FCS
  - Simultaneous phosphorescence and fluorescence decay recording
  - Simultaneous FLIM and PLIM

Please see bh TCSPC Handbook, available on www.becker-hickl.com
More than 2000 TCSPC Systems Worldwide

Detectors and Detector Assemblies

bh guarantee that their TCSPC devices work with any photon counting detector

**HPM-100-40 and -50 hybrid detector modules**
Based on Hamamatsu R10467 hybrid detector tubes
GaAsP versions: 40% detection efficiency throughout visible spectrum
GaAs versions: 15% detection efficiency up to 850 nm
GaAsP versions: 130 ps IRF width
No afterpulsing
Internal high-voltage generator, controlled via bh DCC-100
C-Mount adapter
Adapter to bh DCS-120 confocal scanning FLIM system
Adapter to NDD and BIG port of Zeiss LSM 710 NLO microscopes
Adapter to RLD port of Leica SP2 MP and SP5 MP microscopes
SMA and FC multi-mode fibre adapters

**HPM-100-40C and -50C cooled hybrid detector modules**
Based on Hamamatsu R10467 hybrid detector tubes
GaAsP versions: 40% detection efficiency throughout visible spectrum
GaAs versions: 15% detection efficiency up to 850 nm
GaAsP versions: 130 ps IRF width
No afterpulsing
Reduced dark count rate by cooling
Internal high-voltage generator, power supply and control via bh DCC-100
Active area 3 mm and 5 mm diameter
C-Mount adapter
Adapter to bh DCS-120 confocal scanning FLIM system
Adapter to BIG port of Zeiss LSM 710 NLO microscopes
Adapter to RLD port of Leica SP2 MP and SP5 MP microscopes
SMA and FC multi-mode fibre adapters

**HPM-100-06 and -06C ultra-fast hybrid detector modules**
Based on Hamamatsu R10467-06 hybrid detector tubes
Bi-alkali cathode, 300 to 600nm
Clean TCSPC response, no tails and bumps
< 20 ps IRF width with SPC-150NX
No afterpulsing
Cooled version: HPM-100-06C

**HPM-100-07 and -07C ultra-fast hybrid detector modules**
Based on Hamamatsu R10467-07 hybrid detector tubes
Multialkali cathode, 250 to 800nm
Clean TCSPC response, no tails and bumps
< 20 ps IRF width with SPC-150NX
No afterpulsing
Cooled version: HPM-100-07C

**PMC-150 cooled PMT modules**
Cathode versions for UV to NIR region
Internal PMT voltage generation
IRF width 110 to 130 ps
Ultra-stable IRF up to recorded count rates of 5 MHz
Internal preamplifier
Overload shutdown
Power supply and control via DCC-100 detector controller
Adapters for Zeiss LSM NDD ports, Zeiss LSM confocal ports, Leica SP2 and SP5 RLD Ports, TMC-120 confocal FLIM system
Replaces older PMC-100 detector

**PMZ-100 PMT modules for FLIM Systems of Zeiss**
LSM 710 / 780 / 880 Family Microscopes
Adapter for Confocal (DC) port
Adapter for non-descanned detection (NDD) port
Adapter to Sutter MOM microscopes
Internal PMT voltage generation
IRF width 150 ps
Ultra-stable IRF up to recorded count rates of 5 MHz
Internal preamplifier
Overload shutdown
Power supply and control via DCC-100 detector controller
Technology Leaders in Photon Counting

PML-16 C 16-Channel TCSPC detectors
16-channel detector with routing electronics and internal HV power supply
Based on Hamamatsu R9500-L16 multi-anode PMT
Simultaneous detection in 16 channels
Connects directly to all bh SPC modules
Power supply and control via DCC-100 detector controller
IRF width 150 to 200 ps
Part of bh multispectral TCSPC FLIM detectors

PML-16 GaAsP 16-Channel TCSPC detectors
16-channel detector with high-sensitivity GaAsP cathode
Based on Hamamatsu GaAsP multi-anode PMT
Simultaneous detection in 16 channels
Internal Routing electronics and HV power supply
Connects directly to all bh SPC modules
Power supply and control via DCC-100 detector controller
IRF width 150 to 200 ps
Part of bh multispectral TCSPC FLIM detectors

Single-photon avalanche photodiode modules (SPADs)
Manufacturer: id Quantique
Direct-coupled and fibre-coupled versions
Active area d=20µm and d=50µm
Ultra-high efficiency in visible region
IRF width 40 ps
Active areas of 20µm, 50µm
Stable IRF over count rate
Dark count rates 45 s⁻¹ (id100-20 ULN) and <20 s⁻¹ (id100-50 ULN)
Detector count rates up to 8 MHz, recorded count rates up to 5 MHz
Direct-coupled and fibre-coupled versions
Focusing and alignment adapters

id-220 InGaAs IR SPAD Detectors
Manufacturer: ID Quantique
Detection from 900nm to 1700nm
Quantum efficiency up to 20%
Continuous operation - no gating required
Compatible with all bh TCSPC devices
IRF width 220 ps FWHM
Fibre coupling, FC connector
Fluorescence and phosphorescence decay recording
Fluorescence correlation
FLIM, PLIM

id-230 InGaAs IR SPAD Detectors
Manufacturer: ID Quantique
Detection from 900nm to 1700nm
Quantum efficiency up to 25%
Extremely low dark count rate - down to 250 counts / s
Continuous operation - no gating required
Compatible with all bh TCSPC devices
IRF width <80 ps FWHM
Fibre coupling, FC connector
Fluorescence and phosphorescence decay recording
Fluorescence correlation
FLIM, PLIM

SCONTEL Superconducting NbN Detectors
Manufacturer: SCONTEL, Moscow
Detection from 400nm to 1700nm
IRF width down to 17.8 ps FWHM with SPC-150NX
Timing Jitter with SPC-150NX 7.8 ps rms
More than 2000 TCSPC Systems Worldwide

Multi-Spectral TCSPC / FLIM Detectors

PML-SPEC and PML-SPEC GaAsP multi-wavelength detection modules
- Simultaneous fluorescence decay detection in 16 wavelength channels
- SMA 905 or FC fibre adapter
- Fibre diameter up to 1 mm
- Multi-spectral FLIM for confocal laser scanning microscopes
- IRF width 200 ps
- Works with all bh TCSPC modules
- Internal high-voltage power supply
- Internal routing electronics
- Overload shutdown
- Full control via DCC-100 card
- Part of the bh multi-wavelength FLIM systems for laser scanning microscopes
- Adapter for DCS-120 confocal scanning FLIM system

MW FLIM multi-spectral FLIM detection modules for multiphoton microscopes
- Multi-spectral FLIM in 16 wavelength channels
- Fibre bundle for large area detection and area transformation
- Non-descanned (NDD) detection or confocal detection
- Adapters for Zeiss, Leica, Olympus, Nikon, bh DCS-120
- IRF width 150 ps FWHM
- Works with all bh TCSPC modules
- Internal high-voltage power supply
- Internal routing electronics
- Protected by overload shutdown
- Shutter for input protection available
- Full control via DCC-100 card
- Part of the bh multi-wavelength FLIM systems for laser scanning microscopes

New! MW FLIM GaAsP multi-spectral NDD FLIM detection systems for multiphoton microscopes
- Multi-spectral FLIM in 16 wavelength channels
- High-efficiency GaAsP cathode
- Fibre bundle for large area detection and area transformation
- Non-descanned (direct) detection or confocal detection
- Adapters for Zeiss, Leica, Olympus, bh DCS-120
- IRF width 200 ps FWHM
- Works with all bh TCSPC modules
- Internal high-voltage power supply
- Internal routing electronics
- Protected by overload shutdown
- Shutter for input protection available
- Full control via DCC-100 card
- Part of the bh multi-wavelength FLIM systems for laser scanning microscopes

Opto-Mechanical Detector Components

Detector / Shutter Assemblies for Various PMTs
- For NDD ports of multiphoton laser scanning microscopes
- Shutter operation via DCC-100 detector controller
- Overload shutdown of PMT
- Input field lens
- For bh PMC-100 and HPM-100 modules, Hamamatsu R3809U, Hamamatsu H7422
- Part of bh modular FLIM systems

Beamsplitter / detector assemblies
- For HPM-100, PMC-100, R3809U and H7422 detectors
- Dichroic beamsplitters, polarising beamsplitters
- Input filter, bandpass filters in front of detectors
- Compatible with NDD ports of multiphoton laser scanning microscopes
- Part of bh modular FLIM systems

Detectors and Detector Assemblies with Fibre Adapters
- For HPM-100, PMC-100, R3809U and H7422 detectors
- Input filter, bandpass filters in front of detectors
Detector Electronics

**DCC-100 detector controller**

*New:* DCC-100 PCIe detector controller with PCI express interface

- Power supply for two detectors
- Power supply of thermoelectric coolers of detectors
- Detector gain control
- Detector overload shutdown
- Control of shutters or actuators
- Control of bh detector / shutter assemblies
- Intensity control of bh BDL and BDS ps diode lasers
- Integrated in SPCM TCSPC software package
- Part of the bh modular FLIM, modular DOT systems
- Part of bh Simple-Tau TCSPC systems

**HVM-3000 High-Voltage module for PMTs and MCP-PMTs**

Small size, attaches directly to PMT or MCP

- SHV connector, connects to Hamamatsu R3809U MCP PMTs and Photek FGN 392-1000 wide-field TCSPC detector
- +12 V power supply via bh DCC-100 detector controller
- Output voltage -400 to -3000 V, controlled via DCC-100 detector controller

**HRT-41 four-channel router**

Connects up to four PMC-100, H7422 or R3809U detectors to one TCSPC channel

All detectors are detecting simultaneously

**HRT-81 eight-channel router**

Connects up to eight PMC-100, H7422 or R3809U detectors to one TCSPC channel

All detectors are detecting simultaneously

**HRT-82 eight-channel router**

Connects up to eight SPAD modules to one TCSPC channel

All detectors are detecting simultaneously

**HFAC-26 Preamplifiers**

For R3809U MCP PMT, H7422 modules, and other PMTs

- Power supply from SPC or DCC module
- Overload shutdown in conjunction with DCC-100 controller
- Overload thresholds 0.1 µA, 0.3 µA, 1 µA, 2 µA, 5 µA, 10 µA, 100 µA

**HFAH-26 Preamplifiers**

Low-noise

For R3809U MCP PMT, H7422 modules, and other PMTs

- Power supply from SPC or DCC module
- Overload shutdown in conjunction with DCC-100 controller

**HPM-CON-02 Frequency-to-Analog Converter for PMT Pulses**

Converts single-photon-pulse signals of photon-counting detectors into an intensity-proportional analog signal

- Analog output independent of single-photon pulse amplitude
- Inserts directly in detector output pulse line
- Provides photon pulses to TCSPC modules and intensity signal to analog electronics
- Input pulse amplitude -30 mV to -200 mV, input pulse width down to 500 ps
- Input pulse rate up to 10^7 pulses per second
- Output voltage range 0 to +4.9 V
- Power supply ±5V from bh SPC or DCC module

*New!* **APS-100 TCSPC Synchronisation Module**

For synchronisation of TCSPC experiments with Ti:Sapphire lasers

- Output amplitude widely independent of laser intensity and laser wavelength
- Intensity range 1:10^6
- Power supply from SPC or DCC module

**PHD-400 PIN Photodiode Modules**

For synchronisation of TCSPC experiments with lasers

- Power supply from SPC or DCC module
- Detector area 0.25 mm^2
- Current indicator for easy alignment
Picosecond Diode Lasers

**BDS-SM series picosecond diode lasers**
- Small-size OEM Module, single-mode output
- Dimensions 40 mm x 40 mm x 120 mm
- Wavelengths 375, 405, 440, 473, 488, 510, 640, 685, 785, 1064, 1300 nm
- Single-Mode free-beam or single-mode fibre output
- Pulse width down to 40 ps
- Pulse repetition rate 80 MHz, 50 MHz and 20 MHz and CW
- CW equivalent power up to 5 mW
- CW mode with up to 50 mW power
- Fast on / off / multiplexing capability
- Sync input, Sync output
- All electronics integrated
- Operation from simple +12 V power supply

**New! BDS-SMY series green / yellow picosecond diode lasers**
- Small-size OEM Module, single mode output
- Wavelength 532 nm, 561 nm and 594 nm
- Pulse width down to 50 ps
- Pulse repetition rate 50 MHz
- CW equivalent power up to 0.7 mW
- Operation from simple +12 V power supply

**New! BDS-MM series picosecond diode lasers**
- Small-size OEM Module, multi-mode output
- Dimensions 40 mm x 40 mm x 120 mm
- Wavelengths 445, 510, 640, 685, 785, 830, 980, 1064 nm
- Multi-Mode free-beam or multi-mode fibre output
- Pulse width down to 90 ps
- Pulse repetition rate 50 MHz and 20 MHz
- CW equivalent power up to 50 mW
- Fast on / off / multiplexing capability
- Sync input, Sync output
- All electronics integrated
- Operation from simple +12 V power supply

**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
- Beam corrector removes astigmatism and makes beam circular
- Interfaces with all commonly used fibre couplers
- Repetition rate 20, 40, 80 MHz
- High-Power CW mode
- Pulse width typically 40 to 80 ps for 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
- Part of the bh modular FLIM systems for laser scanning microscopes
- The BDL-SMN lasers were designed in cooperation with Lasos GmbH, Jena

**Free-beam versions**
- Highly corrected beam
- Circular cross-section and low astigmatism

**Fibre-coupled versions**
- Fibre coupling with up to 70% coupling efficiency
- Fibres with FC output or with collimated output
- Part of DCS-120 Confocal Scanning FLIM Systems

**Fibre-pigtails**
- Single-mode fibre pigtail
- Single-mode fibre permanently attached to laser
- No fibre alignment required
- Designed and manufactured in cooperation with Lasos GmbH, Jena, Germany

**All lasers operate from single +12V power supply**
- All bh laser have the electronics integrated in the laser head
- No external controller unit
- Operation from single +12V power supply
- All Lasers interface directly with DCC-100 detector controller, GVD-100 scan controller, or DCS-120 controller box.
Experiment Control and Connecting Electronics

DDG-210 Digital Delay Generator
- Multiplexing of lasers and routing to TCSPC Modules
- Multiplexing rate up to 1 MHz
- Laser on/off modulation for PLIM
- Non-overlapping laser multiplexing
- On-times programmable individually
- Part of bh modular DOT systems
- Part of bh FLIM / PLIM systems for Zeiss LSM 710 / 780 / 880 family
  Integrated in bh SPCM TCSPC instrument control software

GVD-120 Scan Controller Card
New: GVD-120 PCIe Scan Controller Card
- Generation of scan signals for galvanometer scanners and piezo stages
- Dual-axis control
- Frame scan, line scan, high-stability point operation
- Laser on/off modulation for PLIM
- Linear x scan with cycloid flyback
New: Sinusoidal x scan option
- Extremely high scan rates
- Controls also two bh BDL-SMC, BDL-SMN, or BDS ps diode lasers
- Laser beam blanking
- Laser multiplexing, Laser on/off modulation for PLIM
- Fully digital signal generation
- Independent of software response times
- Pixel times down to 0.5 µs
- Pixel numbers up to 4048x4048
- Fully integrated in bh SPCM TCSPC software
- Part of bh DCS-120 confocal scanning systems

DCC-100 and DCC-100 PCIe detector controllers
- Control of two bh TCSPC detectors
- Intensity control of bh picosecond diode lasers
- For details please see 'Detector Electronics'

DB-32 Delay Switch Box
- 32 step passive delay line
- Delay from 0 to 31.5 ns in 0.5 ns steps
  New! Selection of one of two signal sources
- Transmits any signal waveform
- Signal bandwidth 1 GHz
  No noise, no jitter
- No external power supply needed
- Settings persist when box is disconnected from USB
- Easy adjustment of TCSPC SYNC path length
- Control integrated in bh SPCM TCSPC operating software

BOB-104 Signal Distribution Box
- Distributes scan clock signals to four SPC modules
- Combines routing signals and other control signals into 15-pin control inputs of four SPC-130, -150, and -160 modules
  Auxiliary +12V input for power supply of amplifiers, routers, detectors

BOB-101 Signal Distribution Box
- Combines routing signals and other control signals into 15-pin control inputs of one SPC-130, -150, and -160 modules
  Auxiliary +12V input for power supply of amplifiers, routers, detectors

DCS Connection Box
- Power supply and control of two bh BDL-SMC or BDL-SMN ps diode lasers
- Connects scan clocks and laser multiplexing signals of GVD-120 scan controller into two SPC-150 or SPC-830 modules and two BDL-SMC or BDL-SMN diode lasers
- Connects routing signals of two bh multi-spectral FLIM detectors into SPC modules
- Configurable by SPCM software

Cables and Adapters
- A-PPI-D passive pulse inverters
- 1:3, 1:4 power splitters and combiners
- Attenuators
- SMA cables
- SMA-to SMA adapters
- SMA-to BNC adapters
- Power supply cables for detectors
- Interface cables for bh FLIM systems for various laser scanning microscopes
  A reasonable set of cables and adapters is delivered with each bh SPC module or Simple-Tau system
More than 2000 TCSPC Systems Worldwide

Fluorescence Lifetime Microscopy

DCS-120 Confocal Scanning FLIM Systems
Based on bh’s 64-bit megapixel FLIM technology
FLIM with up to 2048 x 2048 pixels
Complete Confocal Laser Scanning FLIM microscopes
FLIM upgrade for existing conventional microscopes
Scanning by fast galvanometer mirrors
Two fully confocal detection channels
One or two BDL-SMC or BDL-SMN picosecond diode lasers
Laser wavelengths 375, 405, 440, 473, 488, 510, 640, 685, 785 nm
Tuneable excitation by super-continuum laser with AOTF
One or two confocal detection channels, parallel acquisition
Channel separation by dichroic or polarising beamsplitters
Individually selectable pinholes, individually selectable filters
GaAsP hybrid detectors for visible range, GaAs hybrid detectors for NIR range
16-channel multi-wavelength GaAsP detector module
Z-stack FLIM acquisition with Zeiss Axio Observer Z1
Spatial Mosaic FLIM via motorised sample stage (optional)
Simultaneous fluorescence and phosphorescence lifetime imaging (PLIM)
Fluorescence lifetime-transient scanning (FLITS)
Ultrafast time-series recording by temporal mosaic FLIM function
Wideband (WB) view, compatible with tuneable lasers
Electronic pinhole alignment

DCS-120 MP Multiphoton FLIM System
Multiphoton version of DCS-120 scanning system
Excitation by Ti:Sa laser
IRF width 20 ps FWHM with HPM-100-06 detectors
Laser control integrated in SPCM data acquisition software
Laser intensity control and PLIM laser modulation by AOM
One or two non-descanned detection channels
Clear Images from deep tissue layers
Excellent spatial and temporal resolution
Images up to 2048 x 2048 pixels, 256 time channels
Full field of view of microscope lens scanned
Optional 16-channel multi-wavelength GaAsP detector module
Z-stack FLIM acquisition with Zeiss Axio Observer Z1
Spatial Mosaic FLIM via motorised sample stage (optional)
Simultaneous fluorescence and phosphorescence lifetime imaging (PLIM)
Fluorescence lifetime-transient scanning (FLITS)
Ultrafast time-series recording by temporal mosaic FLIM function

DCS-120 Macro System
FLIM of macroscopic objects
Scan field up to 15 mm diameter
FLIM with up to 2048 x 2048 pixels
Scanning by fast galvanometers
Two fully confocal detection channels
One or two BDL-SMC or BDL-SMN picosecond diode lasers
Laser wavelengths 375, 405, 440, 473, 488, 510, 640, 685, 785 nm
Tuneable excitation by super-continuum laser with AOTF
One or two confocal detection channels, parallel acquisition
Channel separation by dichroic or polarising beamsplitters
Individually selectable pinholes, individually selectable filters
GaAsP hybrid detectors for visible range, GaAs hybrid detectors for NIR range
Optional 16-channel multi-wavelength GaAsP detector module
Spatial Mosaic FLIM via motorised sample stage (optional)
Simultaneous fluorescence and phosphorescence lifetime imaging (PLIM)
Fluorescence lifetime-transient scanning (FLITS)
Ultrafast time-series recording by temporal mosaic FLIM function
Wideband (WB) view, compatible with tuneable lasers
Electronic pinhole alignment

Please see handbook:
Overview brochure DCS-120 Confocal Scanning Systems

FLIM Systems for Zeiss LSM 710 / 780 / 880 Microscopes
LSM 710 / 780 / 880 NLO, LSM 7MP Multiphoton Microscopes
LSM 710, LSM 780, LSM 880 Confocal Microscopes
LSM 710, LSM 780, LSM 880 In Tune systems
Based on bh’s 64-bit megapixel FLIM technology
FLIM with up to 2048 x 2048 pixels
Multiphoton FLIM, PLIM, multispectral FLIM, FCS
Confocal FLIM, PLIM, multispectral FLIM, FCS
Fluorescence lifetime transient FLIM
Fluorescence lifetime-transient scanning (FLITS) fully integrated
Ultrafast time-series recording by temporal mosaic FLIM function
Confocal NIR-FLIM up to 900 nm detection wavelength
Two-Photon OPO FLIM up to 900nm detection wavelength

Please see handbook
Modular FLIM Systems for Zeiss LSM 710 / 780 / 880 Family Laser Scanning Microscopes
and Overview brochure
Technology Leaders in Photon Counting

Still available: FLIM Systems for Zeiss LSM 510 NLO Multiphoton Microscopes
- FLIM with up to 2048 x 2048 pixels
- Multiphoton excitation with non-descanned detection
- Detectors connected to Zeiss NDD switch box
- Single-wavelength NDD FLIM
- Dual-wavelength NDD FLIM
- Multi-spectral NDD FLIM
- Fast preview mode
- Mosaic FLIM
- Z Stack FLIM
- Fast time-series FLIM
- HPM-100-40 hybrid detectors
- One or two parallel SPC-150 TCSPC channels
- PC-based systems or Simple-Tau TCSPC systems

Non-Descanned FLIM Systems for Leica SP2 MP, SP5 MP, SP8 MP Microscopes
- 64-bit megapixel FLIM technology
- Non-descanned detection via Leica RLD port
- 1 detector coupled directly to RLD port
- 2 detectors via external beamsplitter
- Simple-Tau 150 or 152 TCSPC systems
- Acquisition in 1 or 2 parallel TCSPC FLIM channels
- bh HPM-100-40 hybrid detectors or Leica HYD detectors
- Multi-spectral FLIM with 16-channel GaAsP detector
- Works at any scan rate of SP2 and SP5
- Fast acquisition, fast preview mode
- Megapixel FLIM, 2048 x 2048 pixels
- Fluorescence lifetime transient scanning (FLITS)
- Ultra-fast time series by temporal mosaic FLIM
- Simultaneous FLIM / PLIM

FLIM Systems for Olympus FV1000 and FV300 Confocals
- 64-bit megapixel FLIM technology
- Excitation by bh BDL-405 SMC or BDL-473 SMC picosecond diode laser
- High efficiency by direct coupling of detectors
- Single-wavelength detection: PMT, MCP-PMT, or Hybrid PMT
- Multi-wavelength detection: bh PML-SPEC detector
- Full overload protection of detectors
- ROI and Zoom functions of FV1000 or FV300 available
- Works at any scan rate
- FCS capability
- Megapixel FLIM
- Fluorescence lifetime transient scanning (FLITS)

Non-descanned FLIM Systems for Olympus FV1000 and FV300 Multiphoton Microscopes
- 64-bit megapixel FLIM technology
- Multiphoton FV1000 and FV300 systems with inverted microscopes
- High efficiency by non-descanned FLIM detection
- Deep-tissue imaging capability
- Single-wavelength detection: PMT, MCP-PMT, or Hybrid PMT
- Multi-spectral FLIM with 16-channel GaAsP detector
- Full overload protection of FLIM detectors
- ROI and Zoom functions of FV1000 or FV300 available
- Works at any scan rate
- New! Megapixel FLIM
- New! Fluorescence lifetime transient scanning (FLITS)

FLIM Systems for Nikon A1 Microscopes
- 64-bit megapixel FLIM technology
- New! Nikon-integrated version available
- One FLIM channel or two parallel FLIM channels
- High efficiency PMH-100 hybrid detectors
- Non-descanned detection for multiphoton microscopes
- Confocal detection for one-photon microscopes
- Multi-spectral FLIM with 16-channel GaAsP detector
- Works at any scan rate
- Megapixel FLIM
- Fluorescence lifetime transient scanning (FLITS)
- Ultra-fast time series by temporal mosaic FLIM
- Simultaneous FLIM / PLIM
FLIM Systems for Sutter Instrument MOM Microscopes

- Up to four parallel FLIM channels
- Multiphoton excitation by Ti:Sapphire laser
- Non-descanned detection for deep-tissue imaging
- Overload protection of FLIM detectors
- Up to 1024 x 1024 pixels, 1024 time channels
- High efficiency
- Fast acquisition
- SPCM Online FLIM function available
- Simultaneous FLIM / PLIM

PZ-FLIM-110 Stage-Scanning FLIM System

- Sample scanning by piezo scan stage
- Excitation by BDL or BDS series ps diode lasers
- Confocal detection
- HPM-100 hybrid detector
- Optional PML-SPEC GaAsP multi-spectral detector
- Excellent contrast and resolution
- Fully controlled by bh SPCM TCSPC/FLIM data acquisition software
- Compact electronics, integrated in bh Simple Tau system
- Megapixel FLIM technology - images up to 2048 x 2048 pixels
- Lateral (x-y) and vertical (z) scanning
- Simultaneous FLIM / PLIM

FLIM for NSOM Systems

For NSOM systems of Nanonics and NT-MDT

- Combines atomic-force and fluorescence lifetime information
- High sensitivity by HPM-100 hybrid detectors
- Fluorescence and phosphorescence lifetime imaging
- Single-point transient-lifetime recording
- Please see bh TCSPC Handbook or contact bh

FLIM Systems for Clinical Imaging

- 64-bit megapixel FLIM technology
- FLIM systems for ophthalmology
- FLIM systems for dermatology
- FLIM systems for tissue imaging
- FLIM through endoscopes
- Time-resolved NIRS and fNIRS Imaging
- Online FLIM at rates of up to 10 images per second
- Please see bh TCSPC Handbook or contact bh

FLIM for other Scanning Systems

bh FLIM systems can be configured for almost any conceivable laser scanning system. They work with galvanometer scanners, polygon scanners, resonance scanners, and motor-driven and piezo-driven scan stages.

Left: FLIM recorded with Lucid Vivascope, ultra-fast polygon scanner
Right: STED FLIM recorded with STED microscope of Abberior Systems, Goettingen

Please see bh TCSPC Handbook or contact bh.
Technology Leaders in Photon Counting

TCSPC Systems for Time-Domain Diffuse Optical Tomography

**Modular DOT systems**
- Up to 8 parallel TCSPC channels
- Up to 32 detector channels
- Up to 8 BDS-MM lasers with wavelength multiplexing
- Up to 8 wavelengths multiplexed with supercontinuum laser
- Recording with multiplexed source position
- Time-of-flight distributions for all combinations of wavelength, source, and detection channels
- Diffuse correlation in 16 channels
- Recording by SPC-134, SPC-134EM, SPC-154, or SPC-164 TCSPC packages
- Laser control by DDG-200 digital delay generator
- Detector control via DCC-100 cards
- Saturated count rates up to 40 MHz
- Multiplexing periods of lasers individually programmable
- Unlimited sequential recording by continuous flow mode
- Acquisition rate up to 20 time-of-flight distributions per second

**New:** Non-contact scanning by galvanometer scanner controlled by GVD-120 card

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Fibre-Based Fluorescence-Lifetime Systems for *in-vivo* Applications

**Fibre-based TCSPC system for in-vivo application**
- Implantable fibre tip, removable from fibre system
- Single mode excitation, multi-mode detection
- Excitation by BDL or BDS ps diode lasers
- Detection by hybrid detectors or SPAD detectors
- Multi-wavelength detector option
- Excellent sensitivity
- Excellent time resolution
- Low background fluorescence
- Detection of NADH, FAD, or exogenous fluorophores
- Ca**2+** detection in neuronal tissue
- *pO2* measurement in live tissue

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Systems for Recording Optical Emission from Barrier Discharges

**Recording of full spatio-temporal pulse profiles**
- Multi-dimensional TCSPC process
- Sinusoidal discharge voltage, 5 to 15 kHz
- Fast galvanometer scanning along discharge gap
- Control by GVD-120 scan controller
- Fully integrated in SPCM software
- Detection of optical signals by one or two detectors
- Optional 16-wavelength detector
- Recording by one or two parallel SPC-150 TCSPC modules
- Online display of data

Please see bh TCSPC Handbook, 6th edition
More than 2000 TCSPC Systems Worldwide

TCSPC Instrument Software

SPCM Data Acquisition Software for all bh TCSPC Modules and DPC-230 Photon Correlator

True 64 bit software for Windows 7, 8, 10
Megapixel FLIM Technology

Same software for all bh TCSPC modules and DPC-230 card
One software for all operation modes
Configurable for different instrument configurations
Parallel operation of up to four SPC or DPC modules
Online display of images and curves
Online calculation of FCS, PCH, and MCS traces
Online fit of FCS curves
Cycle function
Page stepping
Autosave functions
Oscilloscope mode
Multi-wavelength fluorescence decay recording
Single and repeat mode
Sequential modes
Imaging modes
Single photon parameter-tag mode
Hardware-accumulation FLIM mode
Software-accumulation (parameter tag) FLIM mode
Multi-wavelength FLIM
Spatial Mosaic FLIM
Temporal mosaic FLIM for accumulation of ultrafast time series
Fluorescence lifetime transient scanning (FLITS)
Simultaneous recording of FLIM and PLIM
Integrated scanner control
Integrated detector control
Integrated laser control for FLIM
Integrated control of Ti:Sapphire laser and AOM
Integrated control of motorised sample stage
Integrated control of Zeiss Axio Observer Z1 microscope
2D and 3D display modes
Online display of lifetime images
Image display with software gating
Display of multi-wavelength FLIM images
3D Curve mode, colour-intensity display of multi-dimensional data
Saving, loading, and conversion of photon distributions, images, and time-tag data
Loading of instrument configuration via predefined setups
Automatic interaction with SPCImage FLIM data analysis
Runs under Windows 7, Windows 8, Windows 10

Technology Leaders in Photon Counting

SPCM Data Acquisition Software for bh TCSPC Modules and DPC-230 Photon Correlator

One Software - Multiple Applications
TCSPC Data FLIM Analysis Software

SPCImage FLIM Data Analysis Software

- Analysis of FLIM data
- Analysis of PLIM data
- Analysis of single FLIM or PLIM channels
- Analysis of multiple FLIM or PLIM channels
- Analysis of single-curve fluorescence data
- Analysis of single-curve phosphorescence data
- Analysis by iterative convolution and fit procedure
- Analysis by first moment of photon distribution
- Multi-thread calculation procedure
- Single, double, and triple-exponential decay models
- Incomplete decay models
- Baseline correction
- Free or fixed lifetimes of decay components
- Pseudo-global analysis
- Synthetic, measured or manually defined IRF
- Extraction of IRF from SHG components in FLIM image
- Region-of-interest selection
- Single and double-exponential FRET
- Display of lifetime images
- Display of FRET images
- Display of lifetimes, amplitudes, intensities or ratios of parameters
- Calculation of FRET efficiencies
- Histograms of lifetimes, amplitudes, intensities or ratios of these parameters
- Export of lifetime data
- Export of images
- Direct interaction with SPCM software
- Automatic transfer of SPCM data to SPCImage
- Transfer of data of selected channels or of all channels
- Processing of Megapixel FLIM data
- Batch processing of multiple FLIM files
- Batch processing of multi-wavelength FLIM data
- Batch export of FLIM images and decay data

**New!** Multiple region of interest definition

**New!** Two-dimensional histograms of decay parameters
- Histograms of pixel frequency over two selected parameters of the fluorescence decay
- Colored annotation of pixels in 2D histograms
- Back-annotation of 2D parameter ranges in FLIM images

**New!** Phasor plot
- Fourier transform of decay data
- Histograms of amplitude and phase of decay data in frequency space
- Colored annotation of pixels in phasor plot
- Back-annotation of parameter ranges in FLIM images
Technology Leaders in Photon Counting

TCSPC Single-Molecule Burst-Analysis Software

Single-Molecule Burst-Analysis Software
Identification of single-molecule photon bursts in parameter-tag data
Analysis of fluorescence intensity within photon bursts
Analysis of fluorescence lifetime within photon bursts
One- and two-dimensional histograms of burst parameters
Filtered histograms of burst parameters
Discrimination of different fluorescent species
Determination of FRET efficiencies
Discrimination of different FRET states
Calculation of FCS and cross-FCS
FCS fit with user-defined model functions
Exclusion of artefacts in intensity traces
Time-gating
Selection of excitation channels in PIE data

DLL Libraries for TCSPC and Multiscaler Modules

DLL libraries are available for most bh data acquisition and experiment control modules. Please contact bh for details.

Lab View Library for TCSPC / FLIM Modules

LabView modules for basic functions of bh TCSPC / FLIM modules
Measurement and measurement control functions
Parameter setup functions
Display functions
Load and save functions
Example programs
More than 2000 TCSPC Systems Worldwide

TCSPC Literature from the Technology Leader

Wolfgang Becker
Advanced Time-Correlated Single Photon Counting Techniques
400 pages, 349 figures, 557 references
Please contact bh for your personal copy

Wolfgang Becker
The bh TCSPC Handbook
7th Edition, September 2017,
891 pages, 1155 references, 1034 figures
Available from www.becker-hickl.com
Please contact bh for printed copies

DCS-120 Confocal and Multiphoton FLIM Systems
7th Edition, December 2017
391 pages, 519 references, 502 figures
Available from www.becker-hickl.com
Please contact bh for printed copies

Modular FLIM Systems for
Zeiss LSM 710 / 780 / 880 Family
Laser Scanning Microscopes
with appendix for LSM 510 systems
7th edition, November 2017
357 pages, 531 references, 458 figures,
Available from www.becker-hickl.com
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DCS-120 Confocal Scanning Systems
Overview brochure
40 pages, 62 references, 55 figures
Available from www.becker-hickl.com

FLIM for Zeiss LSM 710 / 780 / 880 Family
Laser Scanning Microscopes
Overview brochure
60 pages, 206 references, 67 figures
Available from www.becker-hickl.com

BDL-SMN Series Picosecond Diode Lasers
User Handbook
Available from www.becker-hickl.com

DPC-230 16 Channel Photon Correlator
User Handbook
April 2008
66 pages, 89 figures, 31 references
Available from www.becker-hickl.com

PML-16-C 16 and PML-16 GaAsP 16 Channel
TCSPC / FLIM Detectors
PML-SPEC and MW FLIM Multi-Wavelength Detectors
User Handbook
61 pages, 75 figures, 99 references
Available from www.becker-hickl.com

Wolfgang Becker, ed.
Advanced time-correlated Single-Photon Counting Applications
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A Strong Partnership

bh and Dorazil form an alliance since 1993. Located in the same building, our companies closely cooperate at all stages through schematics design, hybrid circuit design, board layout, and computer-aided manufacturing and testing. Continuous quality management through the complete design and manufacturing flow results in high reliability and short delivery time both for prototypes and large order quantities.

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Other Regions:
Please feel free to contact bh directly
Fast, Sensitive IR Detectors  
Quantum Cascade Lasers (QCLs)  
Photon Counting Solutions  
Gas and Temperature IR Detectors  
IR Emitters, IR LEDs, & Calibrated Blackbodies  
Thermal Imaging Arrays  
High Performance IRFPA Cameras  
SiC UV Detectors and Sensors  
UVC Light Emitting Diodes - LEDs  
THz Imaging and Detection  
Digital Lock-In  
Artificial Solar Illumination