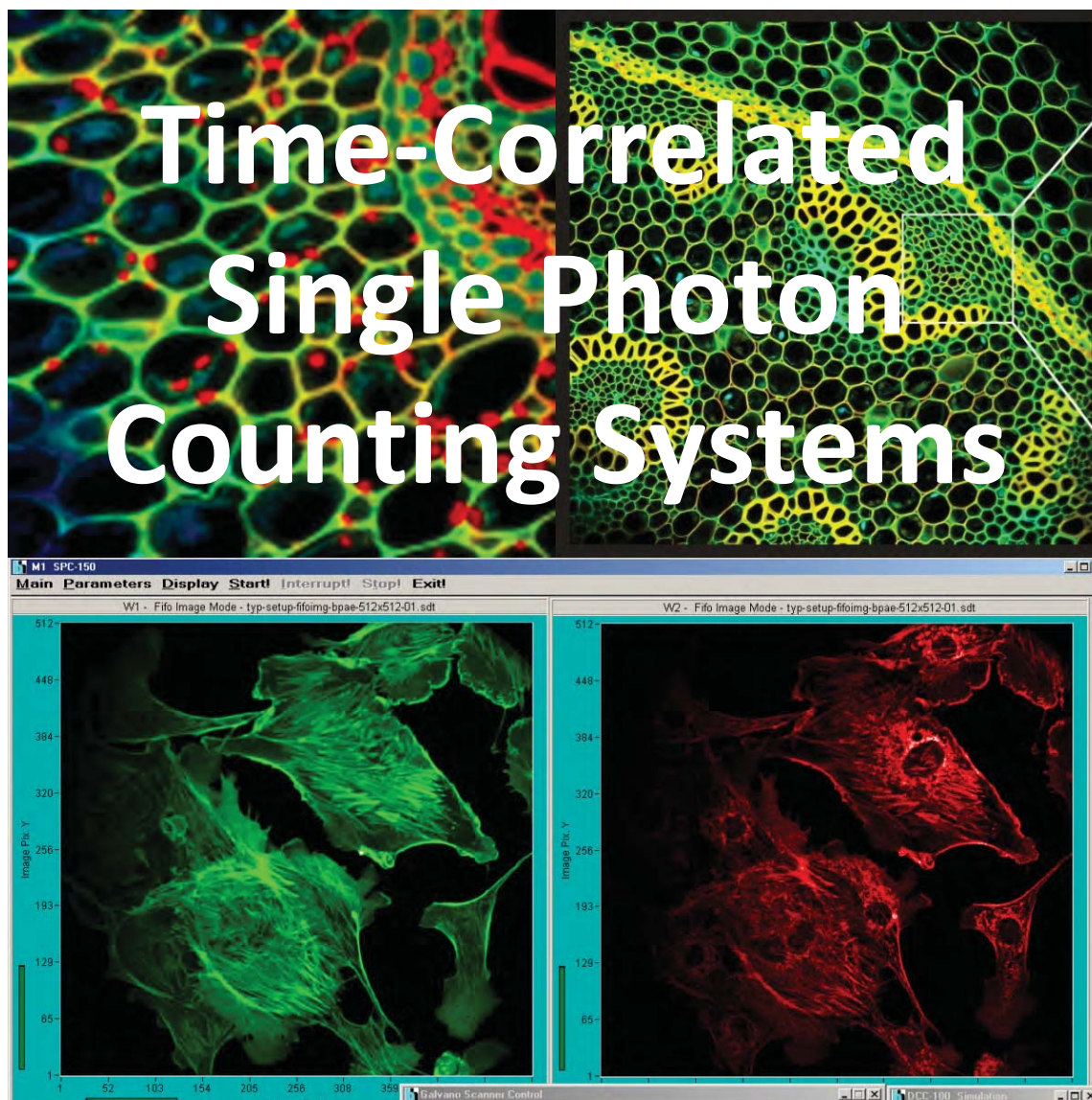




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www.boselec.com tcspc@boselec.com



PC Based
Systems



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12277 Berlin, Germany
Tel: +49 30 787 56 32
Fax: +49 30 787 57 34
www.becker-hickl.de



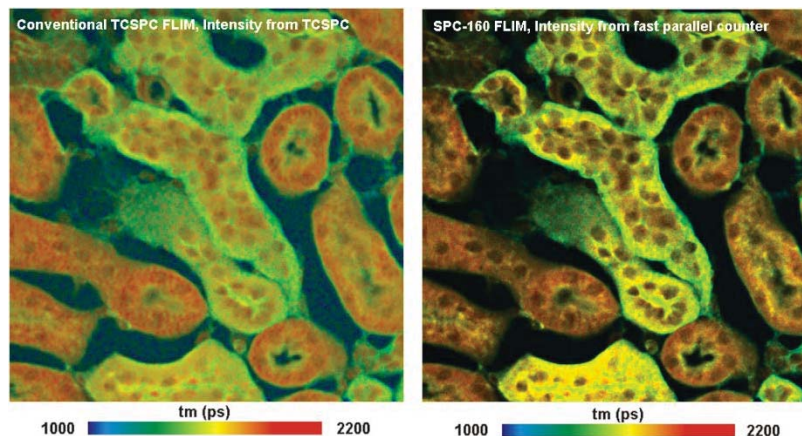
Full Set of FLIM Cards with PCI Express Interface Available

December 2016 - Becker & Hickl have released a full set of PCI Express cards for TCSPC FLIM system. The set consists of one or two SPC-160pcie TCSPC / FLIM modules and a DCC-100pcie detector controller. For the bh DCS-120 scanners or for customer-specific galvanometer scanners a GVD-120pcie scan controller can be added to the system.

The system works with all the commonly used confocal and multiphoton laser scanning microscopes, and with the bh DCS-120 confocal and multiphoton systems. It records single and dual-channel FLIM, FCS, multi-wavelength FLIM, Z-stack FLIM, lateral mosaic FLIM, ultra-fast time-series FLIM and, for the DCS-120 system, simultaneous FLIM/PLIM.

Online FLIM is available up to an image rate of about 10 images per second. The system is using 64-bit data acquisition software. Images as large as 2048x2048 pixels and 256 time channels can be recorded. The electronic time resolution of the SPC-160pcie is 2.5 ps rms, the minimum time channel width is 813 fs.

Attached, for reference is the SPC-160 PCIE data sheet.





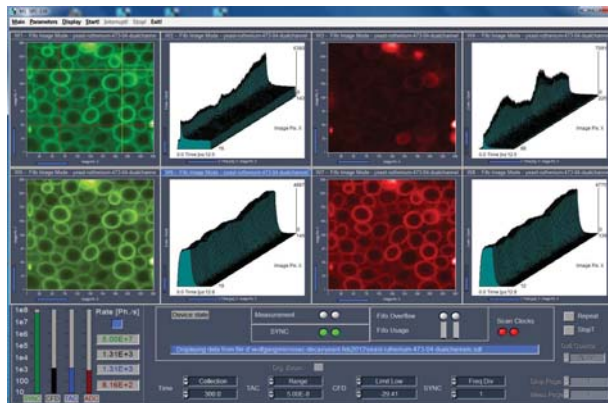
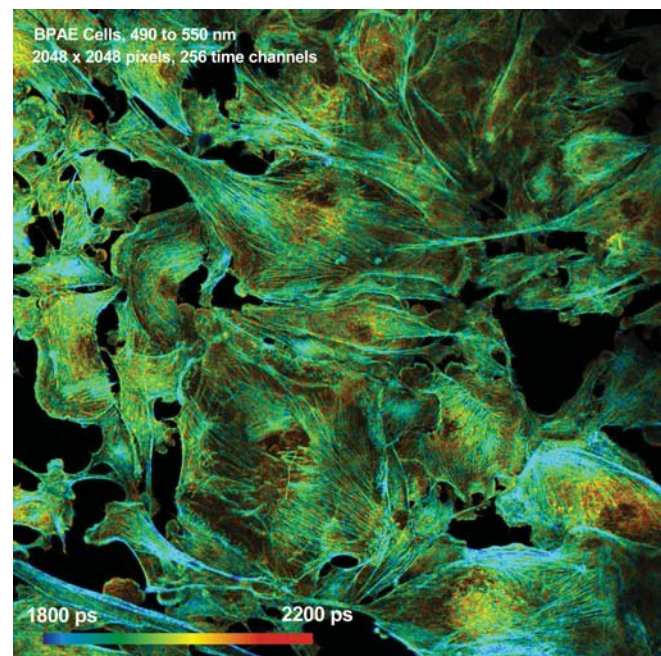
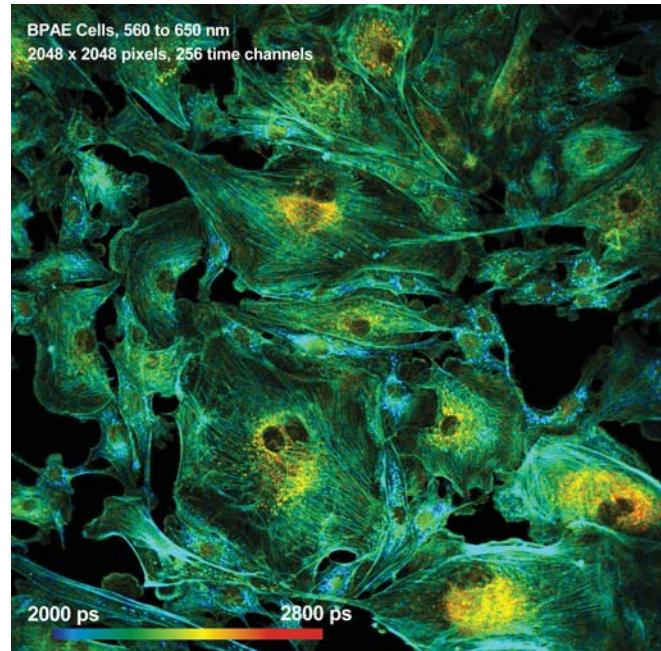
SPC-160 PCIE

TCSPC/ FLIM Module

TCSPC / FLIM Module with PCI Express Interface

Input discriminator bandwidth 4 GHz
 Sub-ps low-frequency timing wobble
 Multi-detector / multi-wavelength capability
 Photon distribution and parameter-tag modes
 FLIM by bh Megapixel Technology
 Mosaic FLIM mode
 Multiscaler imaging mode
 Parallel counter channel for FLIM intensities
 Parallel operation of 2, 3 or 4 modules
 Time channel width down to 813 fs
 Electrical time resolution (Jitter) 2.5 ps rms
 Laser repetition rates up to 150 MHz
 Saturated count rate 12.5 MHz
 TCSPC dead time 80 ns
 Intensity-channel dead time <10 ns

Standard fluorescence lifetime experiments
 Multi-wavelength lifetime experiments
 Recording of transient fluorescence lifetime effects
 Single-wavelength FLIM, multi-wavelength FLIM
 Fast-acquisition FLIM, time-series FLIM
 Mosaic FLIM, lateral, longitudinal, temporal mosaics
 FLITS
 Simultaneous PLIM and FLIM
 Single and double-exponential FRET imaging
 Recording of Ca^{2+} transients
 fNIRS and NIRS experiments
 Single-molecule spectroscopy
 FCS, FCCS, Photon Counting Histograms
 Anti-bunching experiments



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 www.dyna-sense.com





SPC-160 PCIE TCSPC / FLIM Module

Photon Channel

Principle
Discriminator Input Bandwidth
Time Resolution (FWHM / RMS, electr.)
Variance in time of IRF maximum
Optimum Input Voltage Range
Min. Input Pulse Width
Threshold
Zero Cross Adjust

Constant Fraction Discriminator (CFD)
4 GHz
6.6 ps / 2.5 ps
<1 ps over 50 seconds
- 30 mV to - 500 mV
200 ps
0 to - 250 mV
- 100 mV to + 100 mV

Synchronisation Channels

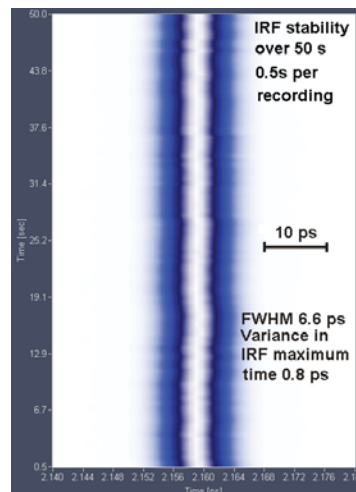
Principle
Discriminator Input Bandwidth
Optimal Input Voltage Range
Min. Input Pulse Width
Threshold
Frequency Range
Frequency Divider
Zero Cross Adjust

Constant Fraction Discriminator (CFD)
4 GHz
- 30 mV to - 500 mV
200 ps
0 to -250 mV
0 to 150 MHz
1-2-4
-100 mV to + 100 mV

Time-to-Amplitude Converters / ADCs

Principle
TAC Range
Biased Amplifier Gain
Biased Amplifier Offset
Time Range incl. Biased Amplifier
min. Time / Channel
ADC Principle
Diff. Nonlinearity, electrical

Ramp Generator / Biased Amplifier
50 ns to 5 us
1 to 15
0 to 50% of TAC Range
3.3 ns to 5 us
813 fs
50 ns Flash ADC with Error Correction
< 0.5% rms, typ. <1% peak-peak



Data Acquisition (Histogram Mode)

Method
Dead Time
Saturated Count Rate
Useful count rate
Channels / Pixel
max. Scanning Area
max. Counts / Time Channel
Overflow Control
Collection Time
Display Interval Time
Repeat Time
Sequential Recording
Synchronisation with Scanning
Count Enable Control
Experiment Trigger

on-board multi-dimensional histogramming process
80ns, independent of computer speed
12.5 MHz
6.25 MHz
4096 1024 256 64 16 4 1
16x16 64x64 128 x 128 256x256 512x512 1024x1024 2048x2048
 $2^{16}-1$
none / stop / repeat and correct
0.1 us to 100,000 s
0.1 us to 100,000 s
0.1 us to 100,000 s
Programmable Hardware Sequencer, unlimited recording by memory swapping, in curve mode and scan mode
pixel, line and frame clocks from scanning device
1 bit TTL
TTL

Data Acquisition (FIFO / Parameter-Tag Mode)

Method
Online display
FCS calculation
Number of counts of decay / waveform recording
Dead Time
Saturated count rate, peak
Sustained count rate (bus-transfer limited)
Output Data Format (ADC / Macrotime / Routing)
FIFO buffer Capacity (photons)
Macro Timer Resolution, internal clock
Macro Timer Resolution, clock from SYNC input
Curve Control (external Routing)
External event markers
Count Enable Control
Experiment trigger

Parameter-tagging of individual photons and continuous writing to disk
Decay function, FCS, Cross-FCS, PCH, MCS traces
Multi-tau algorithm, online calculation and online fit
unlimited
80 ns
12.5 MHz
typ. 4 MHz
12 / 12 / 4
2 M
50ns, 12 bit, overflows marked by MTOF entry in data stream
10ns to 100ns, 12 bit, overflows marked by MTOF entry in data stream
4 bit TTL
4 bit, TTL
1 bit TTL
TTL

Data Acquisition, FIFO / Parameter-Tag Imaging Mode

Method
Online display
Synchronisation with scanner
Dead Time
Detector / Wavelength Channels
Image size in FIFO Imaging Mode (64 bit software)
time channels / pixel
No. of pixels, 1 detector channel
No. of pixels, 16 detector channels (MW FLIM detector)

Buildup of images from time- and wavelength tagged data
up to 8 gated intensity images or up to 8 lifetime images
via Frame Clock, Line Clock, and Pixel Clock pulses
TCSPC: 80 ns, Intensity Channel: <10 ns
1 to 16

	64	256	1024	4096	4096	4096
No. of pixels, 1 detector channel	4096 x 4096	2048 x 2048	1024 x 1024	512 x 512	256 x 256	128 x 128
No. of pixels, 16 detector channels (MW FLIM detector)	1024 x 1024	512 x 512	256 x 256	128 x 128	128 x 128	128 x 128

Operation Environment

Computer System
Bus Connectors
Used PCI Slots
Total power Consumption
Dimensions

PC Pentium, multi-core, >8GB RAM and 64 bit operating system recommended
PCI
1
approx. 12 W from +5V, 0.7 W from +12V
312 mm x 130 mm x 15 mm

Related Products

SPC-160 TCSPC / FLIM modules
SPC-150 and SPC-150N TCSPC modules
Simple-Tau compact TCSPC systems
FLIM systems for laser scanning microscopes

DCS-120 confocal scanning FLIM system
HPM-100 GaAsP and GaAs hybrid detectors
PML-SPEC and MW-FLIM multi-wavelength detectors
id-100, id-220 Si and InGaAs SPAD detector modules

BDL-SMN and BDS ps diode lasers
DCC-100 detector controller
GVD-120 scan controller
DB-32 USB-controlled delay module

Related Literature

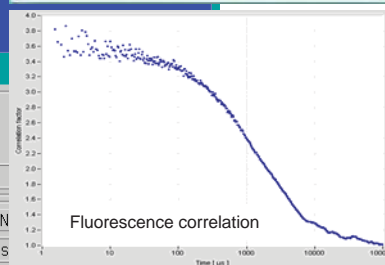
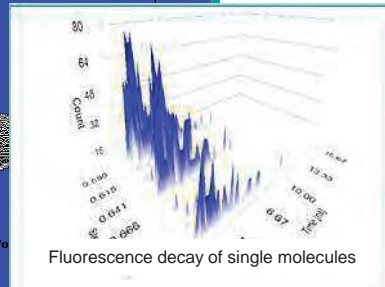
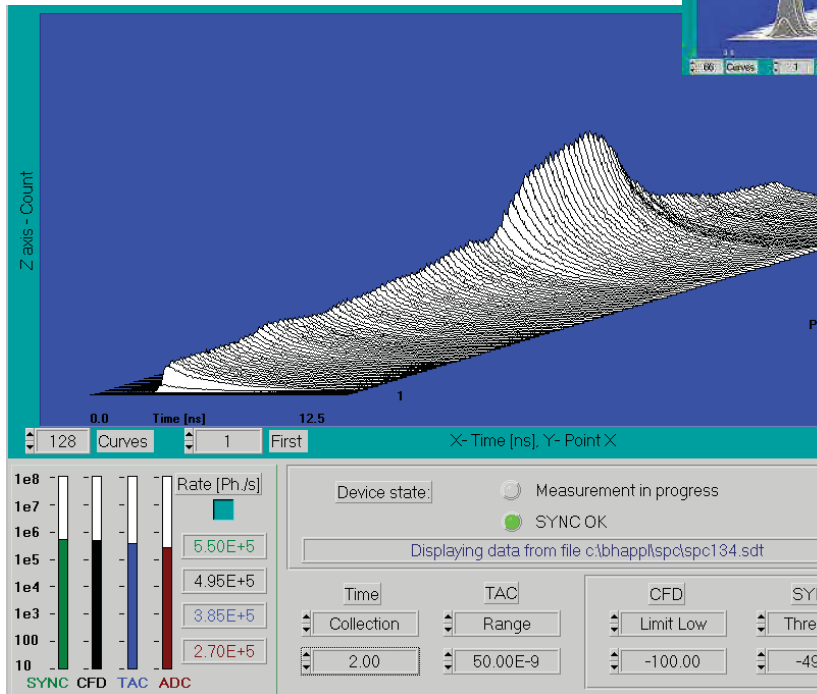
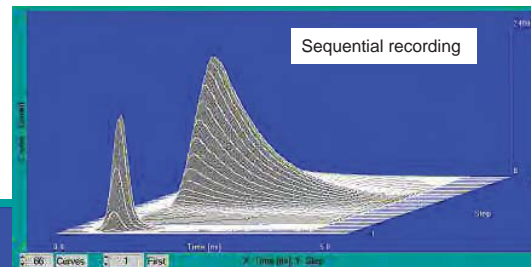
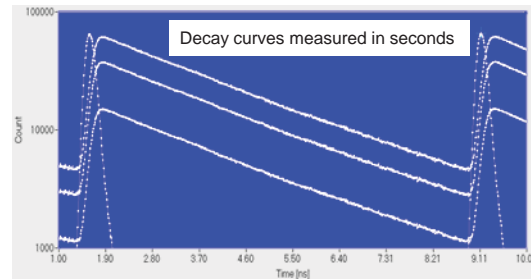
W. Becker, Advanced time-correlated single photon counting techniques. Springer 2005. Please contact bh for availability.
W. Becker (ed.), Advanced time-correlated single photon counting applications. Springer 2015. Please contact bh for availability.
W. Becker, The bh TCSPC Handbook, 6th edition, 2015. 768 pages, 1007 references. Available on www.becker-hickl.com. Contact bh for printed copies.
DCS-120 Confocal Scanning FLIM Systems, handbook. Available on www.becker-hickl.com.
Modular FLIM systems for Zeiss LSM 510 and LSM 710 laser scanning microscopes, handbook. Available on www.becker-hickl.com.
PML-16-C and PML-16 GaAsP 16-channel TCSPC / FLIM detectors, PML-SPEC and MW-FLIM multi-wavelength detectors. User handbook, 20016. Available on www.becker-hickl.com
BDL-SMN picosecond diode lasers, handbook. Available on www.becker-hickl.com
Please see also www.becker-hickl.com, 'Literature', 'Application notes'



More than 20 years experience in multi-dimensional TCSPC. More than 1500 TCSPC systems worldwide.

Time-Correlated Single Photon Counting Module

Saturated Count Rate 10 MHz
 Dead Time 100ns
 Dual Memory Architecture: Readout during Measurement
 Reversed Start/Stop: Repetition Rates up to 200 MHz
 Electrical Time Resolution down to 8 ps FWHM / 5 ps rms
 Channel Resolution down to 813 fs
 Up to 4096 Time Channels / Curve
 Measurement Times down to 0.1 ms
 Instrument Software for Windows 2000 / NT / XP / VISTA
 Direct Interfacing to most Detector Types
 Single Decay Curve Mode
 Oscilloscope Mode
 Sequential Recording Mode
 Spectrum Scan Mode with 8 Independent Time Windows
 Continuous Flow Mode
 FIFO / Time Tag Mode for FCS, FIDA, FILDA, BIFL



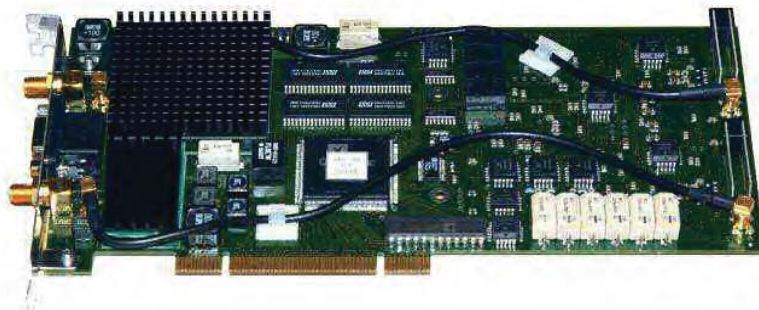
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Covered by patents DE 43 39 784 and DE 43 39 787

SPC-130

Photon Channel

Principle
Time Resolution (FWHM / RMS, electr.)
Opt. Input Voltage Range
Min. Input Pulse Width
Lower Threshold
Upper Threshold
Zero Cross Adjust

Constant Fraction Discriminator (CFD)
8 ps / 5 ps
- 50 mV to - 1 V
400 ps
- 20 mV to - 500 mV
-
- 100 mV to + 100 mV

Synchronisation Channel

Principle
Opt. Input Voltage Range
Min. Input Pulse Width
Threshold
Frequency Range
Frequency Divider
Zero Cross Adjust

Constant Fraction Discriminator (CFD)
- 50 mV to - 1 V
400 ps
- 20 mV to - 500 mV
0 to 200 MHz
1-2-4
-100 mV to + 100 mV

Time-to-Amplitude Converter / ADC

Principle
TAC Range
Biased Amplifier Gain
Biased Amplifier Offset
Time Range incl. Biased Amplifier
min. Time / Channel
ADC Principle
Diff. Nonlinearity

Ramp Generator / Biased Amplifier
50 ns to 2 us
1 to 15
0 to 100% of TAC Range
3.3 ns to 2 us
813 fs
40 ns Flash ADC with Error Correction
< 0.8% rms, typ. <2% peak-peak

Data Acquisition

Method
Dead Time
max. Number of Curves in Memory
Number of Time Channels / Curve
max. Counts / Channel
Overflow Control
Collection Time
Display Interval Time
Repeat Time
Curve Control (internal)
Count Enable Control
Experiment Trigger

on-board 2-dimensional histogramming process
100 ns, independent of computer speed
4096 1024 256 64
64 256 1024 4096
 $2^{16}-1$
none / stop / repeat and correct
0.1 us to 10000 s
10ms to 1000 s
0.1 us to 1000 s
Programmable Hardware Sequencer
1 bit TTL
TTL

Data Acquisition (FIFO / Time-Tag Mode)

Method
Dead Time
Output Data Format (ADC / Macrotimer / Routing)
FIFO buffer Capacity (photons)
Macro Timer Resolution, internal clock
Macro Timer Resolution, clock from SYNC input
Curve Control (external Routing)
Count Enable Control

Time-tagging of individual photons and continuous writing to disk
100 ns
12 / 12 / 3
128 k
50ns, 12 bit
10ns to 100ns, 12 bit
3 bit TTL
1 bit TTL

Operation Environment

Computer System
Bus Connectors
Used PCI Slots
Power Consumption
Dimensions

PC Pentium
PCI
1
approx. 45 W at +5V, 2 W at +12V
225 mm x 115 mm x 25 mm

Related Products and Accessories

Detectors (MCPs, PMTs), multichannel detector heads, routing devices for multi-detector operation, detector controllers, detector / shutter assemblies, preamplifiers, PIN and avalanche photodiode modules, ps diode lasers with multiplexing capability. Also available: SPC-134, SPC-144, SPC-154, SPC-630, and SPC-830 time-correlated single photon counting modules, gated photon counters and multiscalers. Please call for individual data sheets and manuals.

Please see www.becker-hickl.com for free download of bh TCSPC handbook, device software and application literature.



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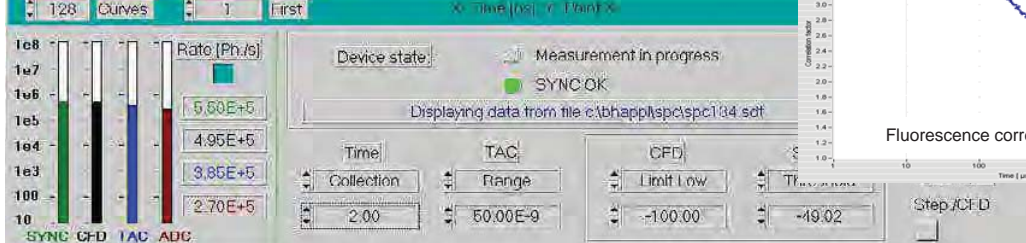
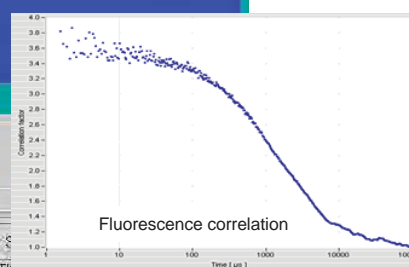
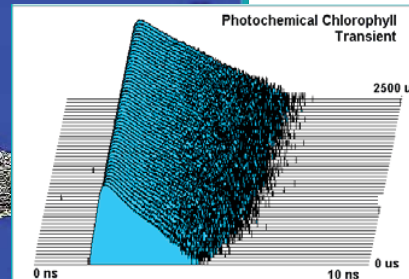
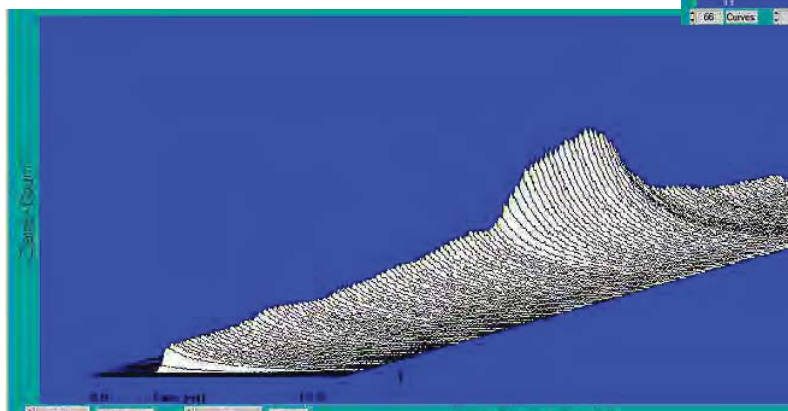
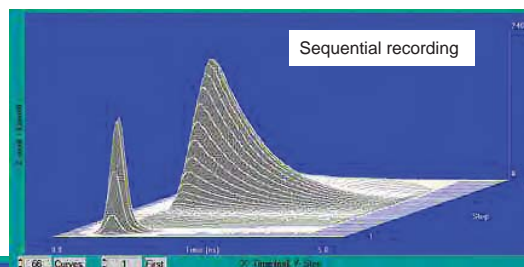
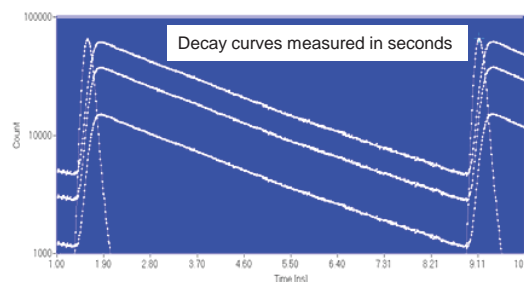
TCSPC Module

SPC-130 EM

General-Purpose Time-Correlated Single Photon Counting Module

Picosecond resolution
Ultra-high sensitivity
Multi-detector / multi-wavelength capability
High-speed on-board data acquisition
Photon distribution and time-tag modes
Unlimited sequential recording of curves or images
Time channel width down to 813 fs
Electrical time resolution (jitter) 6.6 ps fwhm / 2.5 ps rms
Reversed start/stop: Laser repetition rates up to 150 MHz
Saturated count rate 10 MHz
Total useful recorded count rate up to 5 MHz
Dead time 100 ns

Standard fluorescence lifetime experiments
Multi-wavelength lifetime experiments
Transient fluorescence lifetime effects
Fluorescence correlation
Anti-bunching experiments
Single-molecule spectroscopy



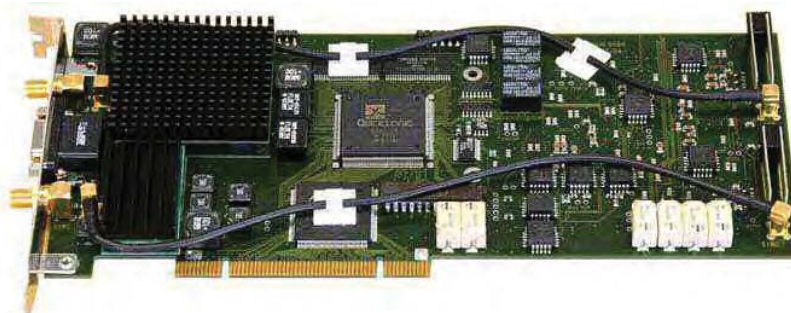
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UK Representative:
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www.psplc.com



Covered by patents DE 43 39 784 and DE 43 39 787

SPC-130 EM

Photon Channel (Start Input)

Principle
Time Resolution (Jitter, FWHM / RMS, electrical)
Optimum Input Voltage Range
Min. Input Pulse Width
Threshold
Zero Cross Adjust

Synchronisation Channel (Stop Input)

Principle
Optimum Input Voltage Range
Min. Input Pulse Width
Threshold
Frequency Range
Frequency Divider
Zero Cross Adjust

Time-to-Amplitude Converter / ADC

Principle
TAC Range
Biased Amplifier Gain
Biased Amplifier Offset
Time Range incl. Biased Amplifier
min. Time / Channel
ADC Principle
Diff. Nonlinearity

Data Acquisition (Histogram Mode)

Method
Online display
Dead Time
Saturated count rate
Sustained count rate
Maximum useful count rate (50% loss)
max. Number of Curves in Memory
Number of Time Channels / Curve
max. Counts / Channel
Overflow Control
Collection Time
Display Interval Time
Repeat Time
Curve Control (Internal sequencing)
Curve Control (Routing)
Count Enable Control
External event markers
Experiment Trigger

Data Acquisition (FIFO / Time-Tag Mode)

Method
Online display
FCS calculation
Number of counts of decay/waveform recording
Dead Time
Saturated count rate, peak
Sustained count rate (bus transfer limited)
Output Data Format (ADC / Macrotime / Routing)
FIFO buffer Capacity (photons)
Macro Timer Resolution, internal clock
Macro Timer Resolution, clock from SYNC input
Curve Control (external Routing)
Count Enable Control
Experiment trigger

Operation Environment

Computer System
Bus Connectors
Used PCI Slots
Power Consumption
Dimensions

Related Products

SPC-134 EM 4-channel TCSPC modules
SPC-150 TCSPC modules
SPC-154 4-channel TCSPC modules
SPC-830 TCSPC modules
Simple-Tau 130 compact TCSPC systems
Simple-Tau 150 compact TCSPC systems
Simple-Tau 134 compact 4-channel TCSPC systems
Simple-Tau 154 compact 4-channel TCSPC systems
Simple-Tau 830 TCSPC compact systems
DPC-230 16-channel ps photon correlator module

Constant Fraction Discriminator (CFD)

6.6 ps / 2.5 ps
- 30 mV to - 1 V
400 ps
- 20 mV to - 500 mV
- 100 mV to + 100 mV

Constant Fraction Discriminator (CFD)

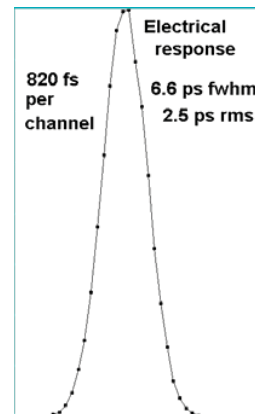
- 30 mV to - 1 V
400 ps
- 20 mV to - 500 mV
0 to 200 MHz
1-2-4
-100 mV to + 100 mV

Ramp Generator / Biased Amplifier

50 ns to 5 us
1 to 15
0 to 100% of TAC Range
3.3 ns to 5 us
813 fs

40 ns Flash ADC with Error Correction

< 0.5% rms, typ. <1% peak-peak



on-board 2-dimensional histogramming process

Decay curves (waveforms)

100 ns, independent of computer speed

10 MHz
10 MHz
5 MHz

65536	16384	4096	1024	256	64
4	16	64	256	1024	4096

2^{16-1}

none / stop / repeat and correct

0.1 us to 100,000 s

0.1 us to 100,000 s

0.1 us to 100,000 s

Programmable Hardware Sequencer

4 bit, TTL

1 bit, TTL

4 bit, TTL

TTL

Time and wavelength tagging of individual photons and continuous writing to disk

Decay function, FCS, Cross-FCS, PCH, MCS traces

Multi-tau algorithm, online calculation and online fit

unlimited

100 ns

10 MHz

typ. 4 MHz

12 / 12 / 4

2 M

50ns, 12 bit, overflows marked by MTOF entry in data stream

10ns to 100ns, 12 bit, overflows marked by MTOF entry in data stream

4 bit TTL

1 bit TTL

TTL

PC Pentium, multi-core CPU recommended

PCI

1

approx. 45 W at +5V, 2 W at +12V

225 mm x 115 mm x 25 mm

PMC-100 cooled PMT modules

HPM-100 GaAsP and GaAs hybrid detectors

PML-SPEC and MW-FLIM multi-wavelength detectors

R3809U MCP PMTs, with HVM-100 power supply module

id-100 SPAD detector modules

DCG-100 detector controller

HRT-41, HRT-81, HRT-82 routing modules

HFAH and HFAH preamplifiers

A-PPI-D pulse inverters

Detector / shutter assemblies

BDL-SMC picosecond diode lasers

BHL-600 picosecond diode lasers

BHLP-700 picosecond diode lasers

DDG-200 laser multiplexing controller

GVD-100 scan controller

Pin-photodiode modules for sync to laser

SPCImage decay analysis

Optispec decay analysis

Related Literature

W. Becker, Advanced time-correlated single photon counting techniques. Springer 2005.

W. Becker, The bh TCSPC Handbook, 3rd edition. 466 pages, 503 references. Available on www.becker-hickl.com

PML-16-C 16 channel detector head for time-correlated single photon counting. User handbook. Available on www.becker-hickl.com

Becker & Hickl GmbH, SPCImage Data Analysis Software for Fluorescence Lifetime Imaging Microscopy, handbook. Available on www.becker-hickl.com

BDL-375-SMC, BDL-405-SPC, BDL-440-SMC, BDL-473-SMC UV and blue picosecond diode lasers, handbook. Available on www.becker-hickl.com

Please see also www.becker-hickl.com, 'Literature', 'Application notes'

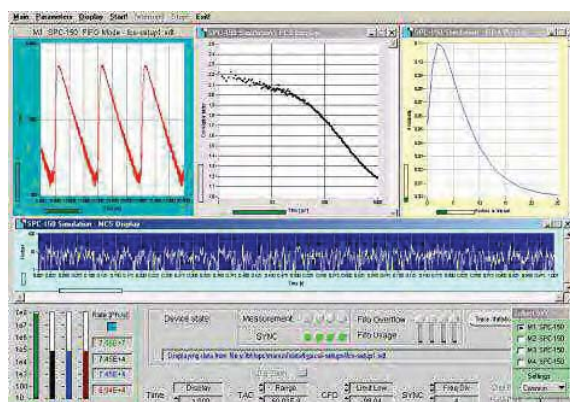
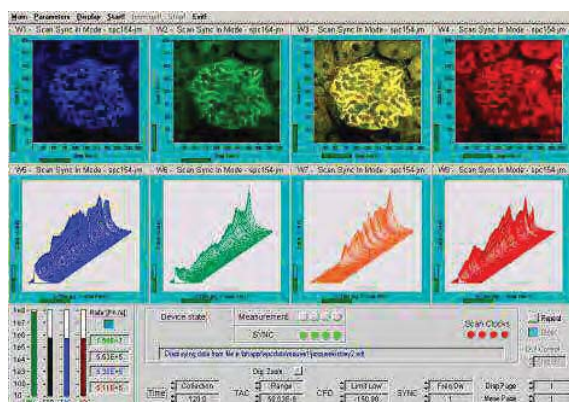
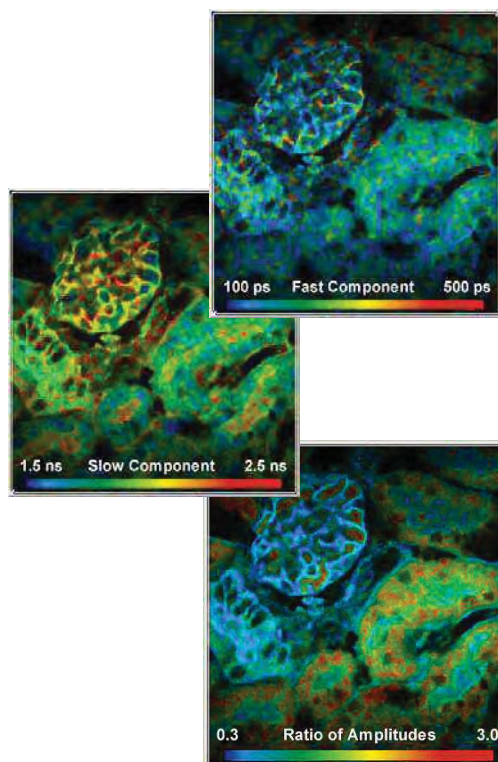


More than 15 years experience in multi-dimensional TCSPC. More than 700 TCSPC systems worldwide.

TCSPC Module for Imaging Applications

Picosecond resolution
 Ultra-high sensitivity
 Multi-detector / multi-wavelength capability
 High-speed on-board data acquisition
 Photon distribution and time-tag modes
 Image acquisition by synchronisation with ext. scanner
 Unlimited sequential recording of curves or images
 Imaging in histogram mode and in time-tag mode
 Works at any scan rate of CLSMs or MPLSMs
 Time channel width down to 813 fs
 Electrical time resolution down to 8 ps fwhm / 4 ps rms
 Reversed start/stop: Laser repetition rates up to 150 MHz
 Saturated count rate 10 MHz
 Total useful recorded count rate up to 5 MHz
 Dead time 100 ns

Multi-wavelength FLIM
 Double-exponential FLIM
 Fast-Acquisition FLIM
 Fast Sequential FLIM
 Single and double-exponential FRET imaging
 FCS, FCCS, FIDA, FILDA, BIFL
 FCS Imaging
 Transient fluorescence lifetime effects



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Covered by patents DE 43 39 784 and DE 43 39 787

SPC-150

Photon Channel

Principle
Time Resolution (FWHM / RMS, electr.)
Optimal Input Voltage Range
Min. Input Pulse Width
Threshold
Zero Cross Adjust

Constant Fraction Discriminator (CFD)
8 ps / 5 ps
- 50 mV to - 1 V
400 ps
- 20 mV to - 500 mV
- 100 mV to + 100 mV

Synchronisation Channels

Principle
Optimal Input Voltage Range
Min. Input Pulse Width
Threshold
Frequency Range
Frequency Divider
Zero Cross Adjust

Constant Fraction Discriminator (CFD)
- 50 mV to - 1 V
400 ps
- 20 mV to - 500 mV
0 to 200 MHz
1-2-4
-100 mV to + 100 mV

Time-to-Amplitude Converters / ADCs

Principle
TAC Range
Biased Amplifier Gain
Biased Amplifier Offset
Time Range incl. Biased Amplifier
min. Time / Channel
ADC Principle
Diff. Nonlinearity

Ramp Generator / Biased Amplifier
50 ns to 2 us
1 to 15
0 to 100% of TAC Range
3.3 ns to 2 us
813 fs
50 ns Flash ADC with Error Correction
< 0.5% rms, typ. <1% peak-peak

Data Acquisition (Histogram Mode)

Method
Dead Time
Saturated Count Rate, per TCSPC channel / total
Useful count rate, per TCSPC channel / total
Channels / Pixel
max. Scanning Area per TCSPC channel
max. Counts / Time Channel
Overflow Control
Collection Time
Display Interval Time
Repeat Time
Sequential Recording

on-board multi-dimensional histogramming process
100ns, independent of computer speed
10 MHz / 40 MHz
5 MHz / 20 MHz
4096 1024 256 64 16 4 1
16x16 64x64 128 x 128 256x256 512x512 1024x1024 2048x2048
 2^{16-1}
none / stop / repeat and correct
0.1 us to 10000 s
10ms to 1000 s
0.1 us to 1000 s
Programmable Hardware Sequencer
Unlimited recording by memory swapping, in curve mode and scan mode
pixel, line and frame clocks from scanning device
1 bit TTL
TTL

Data Acquisition (FIFO / Time-Tag Mode)

Method
Online Display
Dead Time
Output Data Format (ADC / Macrotime / Routing)
Output Data Format for Scan Clock Markers (pxl, line, frame)
FIFO Buffer Capacity (photons and clock markers)
Macro Timer Resolution, internal clock
Macro Timer Resolution, clock from SYNC input
Curve Control (external Routing)
Count Enable Control

Time-tagging of individual photons, continuous writing to disk
Decay function, FCS, Cross-FCS, PCH, MCS traces
100 ns
12 bit ADC / 12 bit macro time / 4 bit routing
12 bit macro time / pxl, line, frame
2 M
25 ns, 12 bit
10 ns to 100 ns, 12 bit
4 bit TTL
1 bit TTL

Data Acquisition, FIFO / Time-Tag Imaging Mode

Method
Online Display
Synchronisation with scanner
Detector / Wavelength Channels
Time Channels / Pixel
max. Scan Area (one detector / wavelength channel)

Buildup of Images from Time-Tag data
Images of all wavelength channels
via Frame Clock, Line Clock, and Pixel Clock pulses
1 to 16
4096 1024 256 64 16
128 x 128 256x256 512x512 1024x1024 2048x2048

Operation Environment

Computer System
Bus Connectors
Used PCI Slots
Total power Consumption
Dimensions

PC Pentium
PCI
1
approx. 12 W from +5V, 0.7 W from +12V
240 mm x 130 mm x 15 mm

Product Literature

W. Becker, The bh TCSPC Handbook. Available on www.becker-hickl.com.



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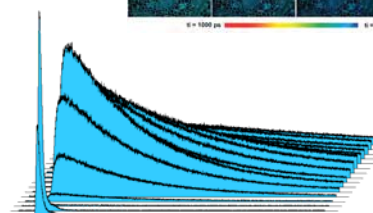
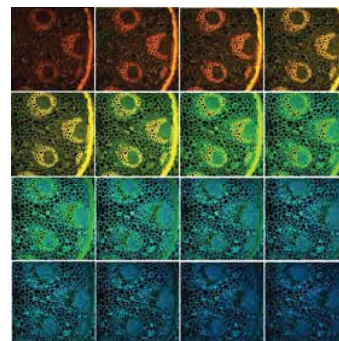


TCSPC Module

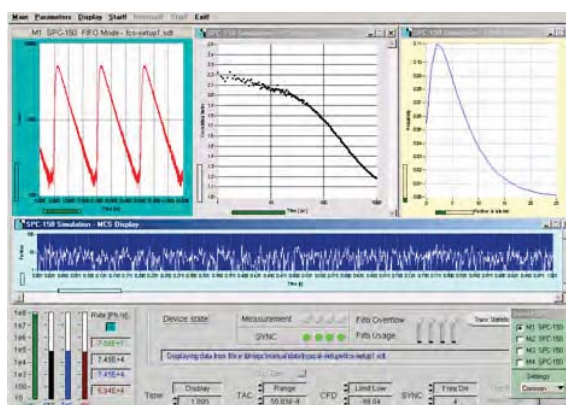
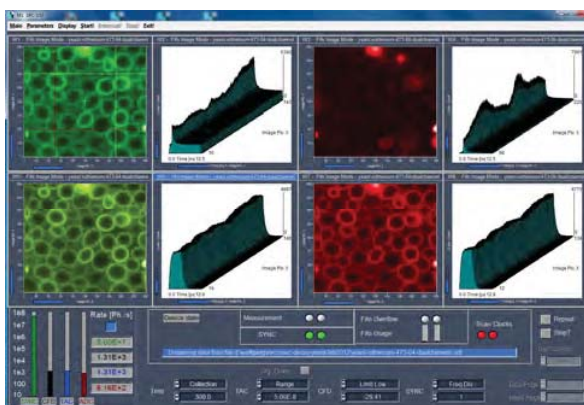
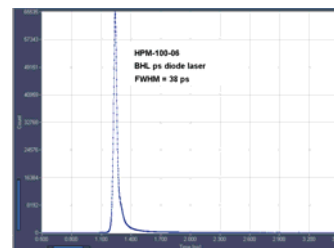
SPC-150N

Time-Correlated Single Photon Counting Imaging and FCS Module for Laser Scanning Microscopes

Improved version of SPC-150 TCSPC module
 Input discriminator bandwidth 4 GHz
 Reduced low-frequency timing wobble
 Multi-detector / multi-wavelength capability
 High-speed on-board data acquisition
 Photon distribution and parameter-tag modes
 Image acquisition by synchronisation with ext. scanner
 Imaging in histogram mode and in parameter-tag mode
 Megapixel image sizes
 Parallel operation of 2, 3 or 4 modules
 Works at any scan rate of CLSMs or MPLSMs
 Time channel width down to 813 fs
 Electrical time resolution (Jitter) 6.6 ps fwhm / 2.5 ps rms
 Reversed start/stop: Laser repetition rates up to 150 MHz
 Saturated count rate 10 MHz
 Total useful recorded count rate up to 5 MHz
 Dead time 100 ns



Standard fluorescence lifetime experiments
 Multi-wavelength lifetime experiments
 Recording of transient fluorescence lifetime effects
 Fluorescence lifetime imaging (FLIM)
 Multi-wavelength FLIM
 Fast-Acquisition FLIM, fast Sequential FLIM
 Fluorescence lifetime-transient scanning (FLITS)
 Combined fluorescence and phosphorescence lifetime imaging (PLIM)
 Single-molecule spectroscopy
 Anti-bunching experiments



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SPC-150N

Photon Channel

Principle
Discriminator Input Bandwidth
Time Resolution (FWHM / RMS, electr.)
Variance in time of IRF maximum
Optimum Input Voltage Range
Min. Input Pulse Width
Threshold
Zero Cross Adjust

Constant Fraction Discriminator (CFD)
4 GHz
6.6 ps / 2.5 ps
<1 ps over 50 seconds
- 30 mV to - 500 mV
200 ps
0 to - 250 mV
- 100 mV to + 100 mV

Synchronisation Channels

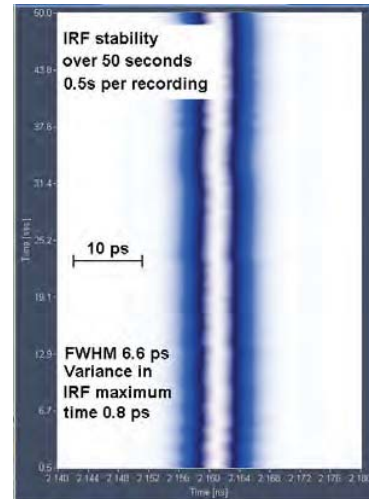
Principle
Discriminator Input Bandwidth
Optimal Input Voltage Range
Min. Input Pulse Width
Threshold
Frequency Range
Frequency Divider
Zero Cross Adjust

Constant Fraction Discriminator (CFD)
4 GHz
- 30 mV to - 500 mV
200 ps
0 to -250 mV
0 to 150 MHz
1-2-4
-100 mV to + 100 mV

Time-to-Amplitude Converters / ADCs

Principle
TAC Range
Biased Amplifier Gain
Biased Amplifier Offset
Time Range incl. Biased Amplifier
min. Time / Channel
ADC Principle
Diff. Nonlinearity, electrical

Ramp Generator / Biased Amplifier
50 ns to 5 us
1 to 15
0 to 100% of TAC Range
3.3 ns to 5 us
813 fs
50 ns Flash ADC with Error Correction
< 0.5% rms, typ. <1% peak-peak



Data Acquisition (Histogram Mode)

Method
Dead Time
Saturated Count Rate
Useful count rate
Channels / Pixel
max. Scanning Area
max. Counts / Time Channel
Overflow Control
Collection Time
Display Interval Time
Repeat Time
Sequential Recording
Synchronisation with Scanning
Count Enable Control
Experiment Trigger

on-board multi-dimensional histogramming process
100ns, independent of computer speed
10 MHz
5 MHz
4096 1024 256 64 16 4 1
16x16 64x64 128 x 128 256x256 512x512 1024x1024 2048x2048
2¹⁶-1
none / stop / repeat and correct
0.1 us to 100,000 s
0.1 us to 100,000 s
0.1 us to 100,000 s
Programmable Hardware Sequencer, unlimited recording by memory swapping, in curve mode and scan mode
pixel, line and frame clocks from scanning device
1 bit TTL
TTL

Data Acquisition (FIFO / Parameter-Tag Mode)

Method
Online display
FCS calculation
Number of counts of decay / waveform recording
Dead Time
Saturated count rate, peak
Sustained count rate (bus-transfer limited)
Output Data Format (ADC / Macrotime / Routing)
FIFO buffer Capacity (photons)
Macro Timer Resolution, internal clock
Macro Timer Resolution, clock from SYNC input
Curve Control (external Routing)
External event markers
Count Enable Control
Experiment trigger

Parameter-tagging of individual photons and continuous writing to disk
Decay function, FCS, Cross-FCS, PCH, MCS traces
Multi-tau algorithm, online calculation and online fit
unlimited
100 ns
10 MHz
typ. 4 MHz
12 / 12 / 4
2 M
50ns, 12 bit, overflows marked by MTOF entry in data stream
10ns to 100ns, 12 bit, overflows marked by MTOF entry in data stream
4 bit TTL
4 bit, TTL
1 bit TTL
TTL

Data Acquisition, FIFO / Parameter-Tag Imaging Mode

Method
Online display
Synchronisation with scanner
Detector / Wavelength Channels
Image size in FIFO Imaging Mode (64 bit software)
time channels / pixel
1 detector channel
16 detector channels (MW FLIM detector)

Buildup of images from time- and wavelength tagged data
up to 8 images in different time and wavelength windows
via Frame Clock, Line Clock, and Pixel Clock pulses
1 to 16
64 256 1024 4096 4096 4096
4096 x 4096 2048 x 2048 1024 x 1024 512 x 512 256 x 256 128 x 128
1024 x 1024 512 x 512 256 x 256 128 x 128 128 x 128 128 x 128

Operation Environment

Computer System
Bus Connectors
Used PCI Slots
Total power Consumption
Dimensions

PC Pentium, multi-core, >8GB RAM and 64 bit operating system recommended
PCI
1
approx. 12 W from +5V, 0.7 W from +12V
240 mm x 130 mm x 15 mm

Related Products

SPC-150 TCSPC modules
SPC-154 4-channel TCSPC modules
Simple-Tau compact TCSPC systems
FLIM systems for laser scanning microscopes
DCS-120 confocal scanning FLIM system

HPM-100 GaAsP and GaAs hybrid detectors
PML-SPEC and MW-FLIM multi-wavelength detectors
PMC-100 cooled PMT modules
id-100 SPAD detector modules

DCC-100 detector controller
GVD-120 scan controller

BDL-SMN ps diode lasers

Related Literature

W. Becker, Advanced time-correlated single photon counting techniques. Springer 2005. Please contact bh for availability.
W. Becker, The bh TCSPC Handbook, 5th edition. 690 pages, 823 references. Available on www.becker-hickl.com. Contact bh for printed copies.
PML-16-C 16 channel detector head for time-correlated single photon counting. User handbook. Available on www.becker-hickl.com
DCS-120 Confocal Scanning FLIM Systems, handbook. Available on www.becker-hickl.com
Modular FLIM systems for Zeiss LSM 510 and LSM 710 laser scanning microscopes, handbook. Available on www.becker-hickl.com. Contact bh for printed copies.
BDL-SMN picosecond diode lasers, handbook. Available on www.becker-hickl.com
Please see also www.becker-hickl.com, 'Literature', 'Application notes'



More than 20 years experience in multi-dimensional TCSPC. More than 1500 TCSPC systems worldwide.



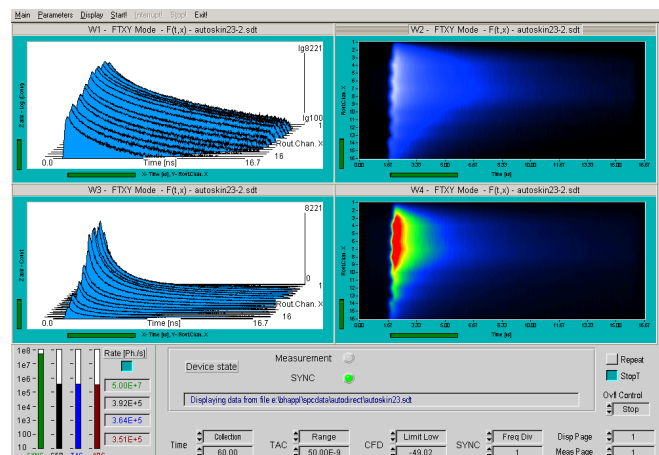
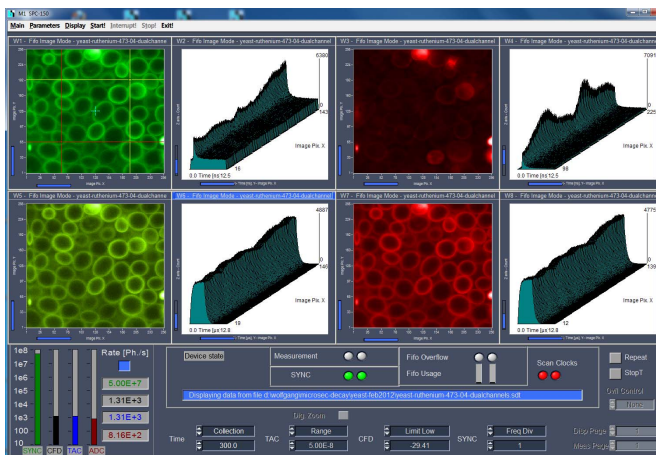
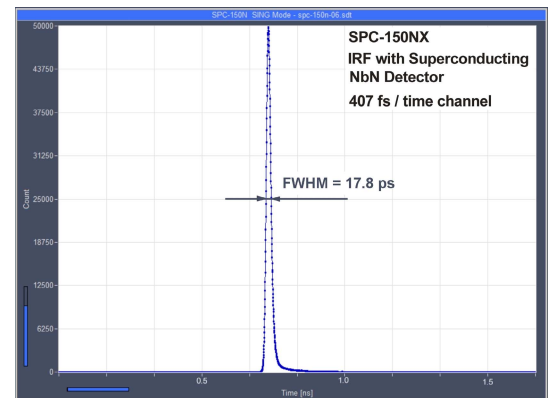
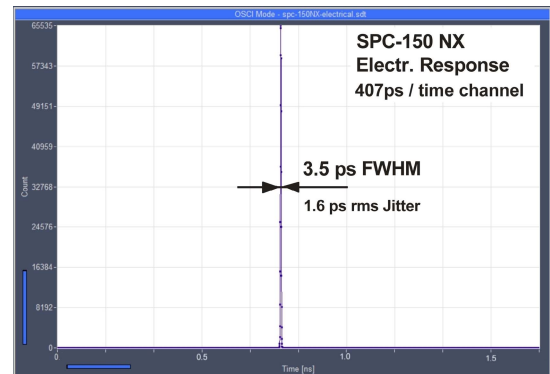
SPC-150NX

TCSPC / FLIM Module

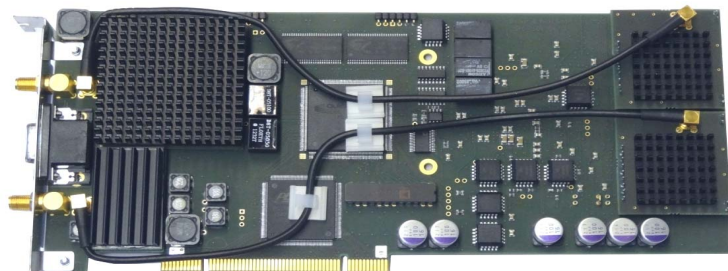
Time-Correlated Single Photon Counting Module for Ultra-Fast Detectors

High-resolution version of SPC-150N TCSPC module
 Improved resolution for ultra-fast detectors
 Internal timing jitter 1.6 ps rms (3.5 ps fwhm)
 Minimum time channel width 407 fs
 Input discriminator bandwidth 4 GHz
 Sub-ps low-frequency timing wobble
 Photon distribution and parameter-tag modes
 Multi-detector / multi-wavelength capability
 FLIM by bh Megapixel Technology
 Mosaic FLIM mode
 Multiscaler imaging mode
 Parallel operation of 2, 3 or 4 modules
 Reversed start/stop: Laser repetition rates up to 150 MHz
 Dead time 100 ns
 Saturated count rate 10 MHz

Ultra-fast fluorescence lifetime experiments
 Anti-bunching experiments
 Multi-wavelength lifetime experiments
 Recording of transient fluorescence lifetime effects
 Single-wavelength FLIM, multi-wavelength FLIM
 Fast-acquisition FLIM, time-series FLIM
 Mosaic FLIM, lateral, longitudinal, temporal mosaics
 FLITS
 Simultaneous PLIM and FLIM
 Double-exponential FRET imaging
 Recording of Ca^{2+} transients
 fNIRS and NIRS experiments
 Single-molecule spectroscopy
 FCS, FCCS, PCH



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www.becker-hickl.com



More than 20 years experience in multi-dimensional TCSPC. More than 1500 TCSPC systems worldwide.



SPC-150NX

TCSPC / FLIM Module

Photon Channel

Principle
Discriminator Input Bandwidth
Time Resolution (FWHM / RMS, electr.)
Variance in time of IRF maximum
Optimum Input Voltage Range
Min. Input Pulse Width
Threshold
Zero Cross Adjust

Constant Fraction Discriminator (CFD)
4 GHz
3.3 ps / 1.6 ps
<1 ps over 50 seconds
- 30 mV to - 500 mV
200 ps
0 to - 250 mV
- 100 mV to + 100 mV

Synchronisation Channels

Principle
Discriminator Input Bandwidth
Optimal Input Voltage Range
Min. Input Pulse Width
Threshold
Frequency Range
SYNC Frequency Divider
Zero Cross Adjust

Constant Fraction Discriminator (CFD)
4 GHz
- 30 mV to - 500 mV
200 ps
0 to -250 mV
0 to 150 MHz
1 - 2 - 4
-100 mV to + 100 mV

Time-to-Amplitude Converters / ADCs

Principle
TAC Range
Biased Amplifier Gain
Biased Amplifier Offset
Time Range incl. Biased Amplifier
min. Time / Channel
ADC Principle
Diff. Nonlinearity, electrical

Ramp Generator / Biased Amplifier
25 ns to 2.5 us
1 to 15
0 to 50% of TAC Range
1.67 ns to 2.5 us
407 fs
50 ns Flash ADC with Error Correction
< 0.5% rms, typ. <1% peak-peak

Data Acquisition (Histogram Modes)

Method
Dead Time
Saturated Count Rate
Useful count rate
max. Counts / Time Channel (counting depth)
Overflow Control
Collection Time
Display Interval Time
Repeat Time
Sequential Recording
Synchronisation with Scanning
Routing
Experiment Trigger

on-board multi-dimensional hardware histogramming process
100 ns, independent of computer speed
10 MHz
5 MHz
2¹⁶-1
none / stop / repeat and correct
0.1 us to 100,000 s
0.1 us to 100,000 s
0.1 us to 100,000 s
Programmable Hardware Sequencer, unlimited recording by memory swapping, in curve mode and scan mode
pixel, line and frame clocks from scanning device
7 bit TTL
TTL

Data Acquisition (FIFO / Parameter-Tag Mode)

Method
Online display
FCS calculation
Number of counts of decay / waveform recording
Dead Time
Saturated count rate, peak
Sustained count rate (bus-transfer limited)
max. counts / time cChannel (counting depth)
Output Data Format (ADC / Macrotime / Routing)
FIFO buffer Capacity (photons)
Macro Timer Resolution, internal clock
Macro Timer Resolution, clock from SYNC input
Routing
External event markers
Experiment trigger

Parameter-tagging of individual photons and continuous writing to disk
Decay function, FCS, Cross-FCS, PCH, MCS traces
Multi-tau algorithm, online calculation and online fit
unlimited
100 ns
10 MHz
typ. 4 MHz
unlimited
12 / 12 / 4 bit
2 · 10⁶
50 ns, 12 bit, overflows marked by MTOF entry in data stream
10 ns to 100 ns, 12 bit, overflows marked by MTOF entry in data stream
4 bit TTL
4 bit, TTL
TTL

Data Acquisition, FIFO / Parameter-Tag Imaging Mode

Method
Online display
Synchronisation with scanner
Detector / Wavelength Channels
Image resolution, 64-bit SPCM software
No of time channels
No. of pixels, 1 detector channel
No. of pixels, 16 detector channels

Buildup of images from time- and wavelength tagged data
up to 8 images in different time and wavelength windows
via Frame Clock, Line Clock, and Pixel Clock pulses
1 to 16

64	256	1024	4096
4096 x 4096	2048 x 2048	1024 x 1024	512 x 512
1024 x 1024	512 x 512	256 x 256	128 x 128

Operation Environment

Computer System
Bus Connectors
Used PCI Slots
Total power Consumption
Dimensions

PC Pentium, multi-core, >8GB RAM and 64 bit operating system recommended
PCI
1
approx. 12 W from +5V, 0.7 W from +12V
240 mm x 130 mm x 15 mm

Related Products

SPC-150N TCSPC modules
Simple-Tau 150 compact TCSPC systems
Simple-Tau 154 compact 4-channel TCSPC systems
DCS-120 confocal scanning FLIM system

HPM-100 GaAsP and GaAs hybrid detectors
PML-SPEC and MW-FLIM multi-wavelength detectors
PMC-100 cooled PMT modules
id-100 SPAD detector modules

DCC-100 detector controller
BDL-SMN ps diode lasers
BDS-SM, -SMY, -MM picosecond diode lasers

Related Literature

World Record in TCSPC Time Resolution: Combination of bh SPC-150NX with SCONTEL NbN Detector yields 17.8 ps FWHM. Application note, please see www.becker-hickl.com
W. Becker, Advanced time-correlated single photon counting techniques. Springer 2005. Please contact bh for availability.
W. Becker, The bh TCSPC Handbook, 6th edition (2015). Available on www.becker-hickl.com. Contact bh for printed copies.

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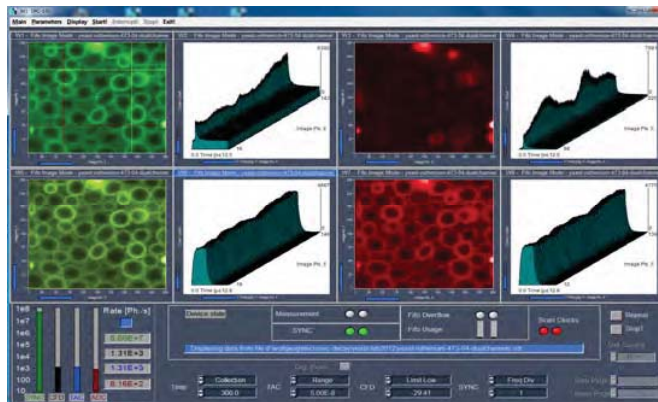
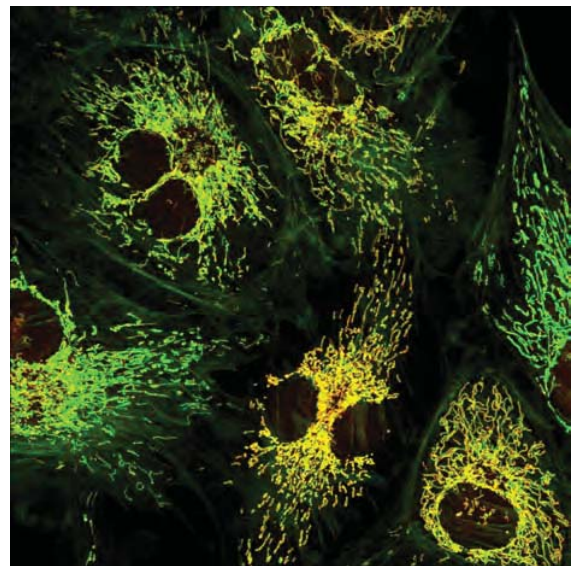
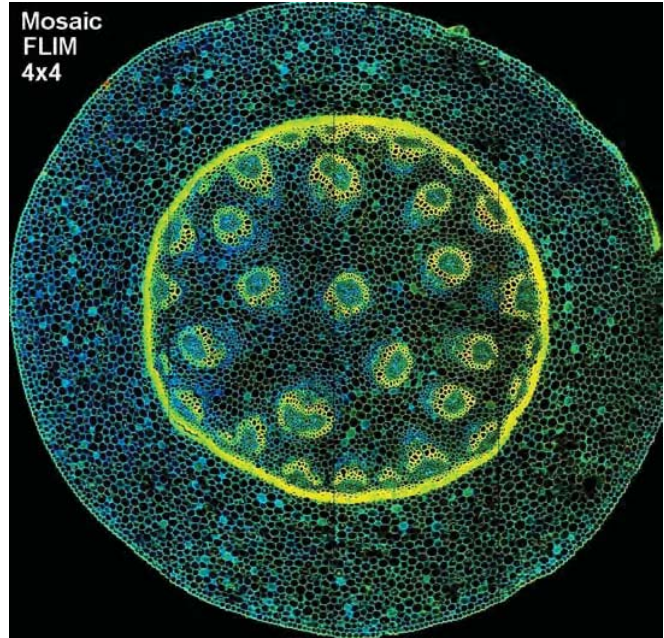
TCSPC Module

SPC-160

Time-Correlated Single Photon Counting Imaging and FCS Module for Laser Scanning Microscopes

Input discriminator bandwidth 4 GHz
Reduced low-frequency timing wobble
Multi-detector / multi-wavelength capability
Photon distribution and parameter-tag modes
FLIM with galvanometer and resonance scanners
FLIM in histogram mode and in parameter-tag mode
Mosaic FLIM mode
Multiscaler imaging mode
Parallel Counter channel for FLIM intensities
Megapixel image sizes
Parallel operation of 2, 3 or 4 modules
Time channel width down to 813 fs
Electrical time resolution (Jitter) 2.5 ps rms
Laser repetition rates up to 150 MHz
Saturated count rate 12.5 MHz
Total useful recorded count rate up to 6.25 MHz
Dead time 80 ns

Standard fluorescence lifetime experiments
Multi-wavelength lifetime experiments
Fluorescence lifetime imaging (FLIM)
Multi-wavelength FLIM
Fast-Acquisition FLIM, fast Sequential FLIM
Fluorescence lifetime-transient scanning (FLITS)
Combined FLIM and PLIM
Single-molecule spectroscopy
Online FCS
Anti-bunching experiments



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www.boselec.com



UK Representative:
Photonic Solutions PLC
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www.psplc.com



SPC-160

Photon Channel

Principle
Discriminator Input Bandwidth
Time Resolution (FWHM / RMS, electr.)
Variance in time of IRF maximum
Optimum Input Voltage Range
Min. Input Pulse Width
Threshold
Zero Cross Adjust

Constant Fraction Discriminator (CFD)
4 GHz
6.6 ps / 2.5 ps
<1 ps over 50 seconds
- 30 mV to - 500 mV
200 ps
0 to - 250 mV
- 100 mV to + 100 mV

Synchronisation Channels

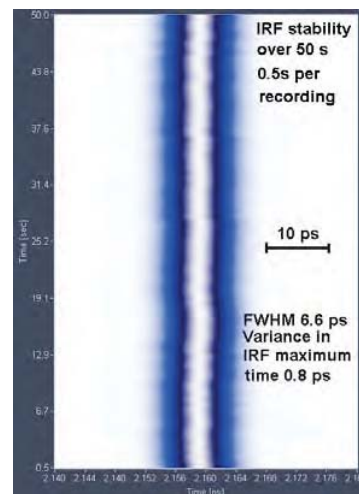
Principle
Discriminator Input Bandwidth
Optimal Input Voltage Range
Min. Input Pulse Width
Threshold
Frequency Range
Frequency Divider
Zero Cross Adjust

Constant Fraction Discriminator (CFD)
4 GHz
- 30 mV to - 500 mV
200 ps
0 to -250 mV
0 to 150 MHz
1-2-4
-100 mV to + 100 mV

Time-to-Amplitude Converters / ADCs

Principle
TAC Range
Biased Amplifier Gain
Biased Amplifier Offset
Time Range incl. Biased Amplifier
min. Time / Channel
ADC Principle
Diff. Nonlinearity, electrical

Ramp Generator / Biased Amplifier
50 ns to 5 us
1 to 15
0 to 50% of TAC Range
3.3 ns to 5 us
813 fs
50 ns Flash ADC with Error Correction
< 0.5% rms, typ. <1% peak-peak



Data Acquisition (Histogram Mode)

Method
Dead Time
Saturated Count Rate
Useful count rate
Channels / Pixel
max. Scanning Area
max. Counts / Time Channel
Overflow Control
Collection Time
Display Interval Time
Repeat Time
Sequential Recording
Synchronisation with Scanning
Count Enable Control
Experiment Trigger

on-board multi-dimensional histogramming process
80ns, independent of computer speed
12.5 MHz
6.25 MHz
4096 1024 256 64 16 4 1
16x16 64x64 128 x 128 256x256 512x512 1024x1024 2048x2048
 2^{16-1}
none / stop / repeat and correct
0.1 us to 100,000 s
0.1 us to 100,000 s
0.1 us to 100,000 s
Programmable Hardware Sequencer, unlimited recording by memory swapping, in curve mode and scan mode
pixel, line and frame clocks from scanning device
1 bit TTL
TTL

Data Acquisition (FIFO / Parameter-Tag Mode)

Method
Online display
FCS calculation
Number of counts of decay / waveform recording
Dead Time
Saturated count rate, peak
Sustained count rate (bus-transfer limited)
Output Data Format (ADC / Macrotimer / Routing)
FIFO buffer Capacity (photons)
Macro Timer Resolution, internal clock
Macro Timer Resolution, clock from SYNC input
Curve Control (external Routing)
External event markers
Count Enable Control
Experiment trigger

Parameter-tagging of individual photons and continuous writing to disk
Decay function, FCS, Cross-FCS, PCH, MCS traces
Multi-tau algorithm, online calculation and online fit
unlimited
100 ns
10 MHz
typ. 4 MHz
12 / 12 / 4
2 M
50ns, 12 bit, overflows marked by MTOF entry in data stream
10ns to 100ns, 12 bit, overflows marked by MTOF entry in data stream
4 bit TTL
4 bit, TTL
1 bit TTL
TTL

Data Acquisition, FIFO / Parameter-Tag Imaging Mode

Method
Online display
Synchronisation with scanner
Detector / Wavelength Channels
Image size in FIFO Imaging Mode (64 bit software)
time channels / pixel
1 detector channel
16 detector channels (MW FLIM detector)

Buildup of images from time- and wavelength tagged data
up to 8 images in different time and wavelength windows
via Frame Clock, Line Clock, and Pixel Clock pulses
1 to 16

64	256	1024	4096	4096	4096
4096 x 4096	2048 x 2048	1024 x 1024	512 x 512	256 x 256	128 x 128
1024 x 1024	512 x 512	256 x 256	128 x 128	128 x 128	128 x 128

Operation Environment

Computer System
Bus Connectors
Used PCI Slots
Total power Consumption
Dimensions

PC Pentium, multi-core, >8GB RAM and 64 bit operating system recommended
PCI
1
approx. 12 W from +5V, 0.7 W from +12V
312 mm x 130 mm x 15 mm

Related Products

SPC-150 and SPC-150N TCSPC modules
SPC-154 4-channel TCSPC modules
Simple-Tau compact TCSPC systems
FLIM systems for laser scanning microscopes
DCS-120 confocal scanning FLIM system

HPM-100 GaAsP and GaAs hybrid detectors
PML-SPEC and MW-FLIM multi-wavelength detectors
PMC-100 cooled PMT modules
id-100 SPAD detector modules
BDL-SMN and BDS ps diode lasers

DCC-100 detector controller
GVD-120 scan controller
DB-32 USB-controlled delay module

Related Literature

W. Becker, Advanced time-correlated single photon counting techniques. Springer 2005. Please contact bh for availability.
W. Becker, The bh TCSPC Handbook, 5th edition. 690 pages, 823 references. Available on www.becker-hickl.com. Contact bh for printed copies.
PML-16-C 16 channel detector head for time-correlated single photon counting. User handbook. Available on www.becker-hickl.com
DCS-120 Confocal Scanning FLIM Systems, handbook. Available on www.becker-hickl.com
Modular FLIM systems for Zeiss LSM 510 and LSM 710 laser scanning microscopes, handbook. Available on www.becker-hickl.com
BDL-SMN picosecond diode lasers, handbook. Available on www.becker-hickl.com
Please see also www.becker-hickl.com, 'Literature', 'Application notes'



More than 20 years experience in multi-dimensional TCSPC. More than 1500 TCSPC systems worldwide.



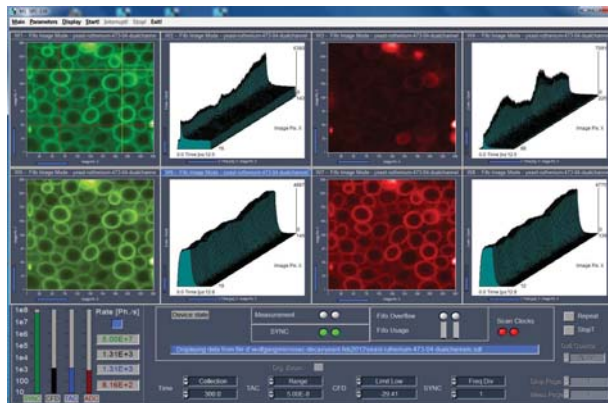
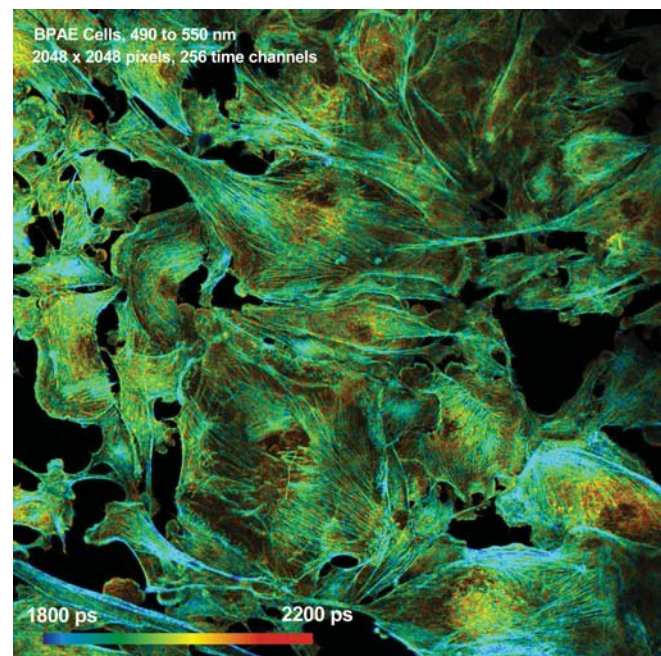
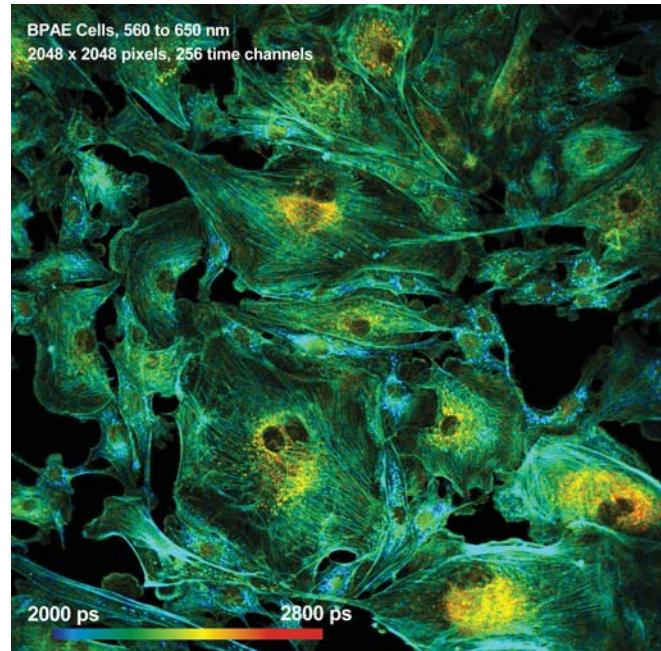
SPC-160 PCIE

TCSPC/ FLIM Module

TCSPC / FLIM Module with PCI Express Interface

Input discriminator bandwidth 4 GHz
 Sub-ps low-frequency timing wobble
 Multi-detector / multi-wavelength capability
 Photon distribution and parameter-tag modes
 FLIM by bh Megapixel Technology
 Mosaic FLIM mode
 Multiscaler imaging mode
 Parallel counter channel for FLIM intensities
 Parallel operation of 2, 3 or 4 modules
 Time channel width down to 813 fs
 Electrical time resolution (Jitter) 2.5 ps rms
 Laser repetition rates up to 150 MHz
 Saturated count rate 12.5 MHz
 TCSPC dead time 80 ns
 Intensity-channel dead time <10 ns

Standard fluorescence lifetime experiments
 Multi-wavelength lifetime experiments
 Recording of transient fluorescence lifetime effects
 Single-wavelength FLIM, multi-wavelength FLIM
 Fast-acquisition FLIM, time-series FLIM
 Mosaic FLIM, lateral, longitudinal, temporal mosaics
 FLITS
 Simultaneous PLIM and FLIM
 Single and double-exponential FRET imaging
 Recording of Ca^{2+} transients
 fNIRS and NIRS experiments
 Single-molecule spectroscopy
 FCS, FCCS, Photon Counting Histograms
 Anti-bunching experiments



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 www.dyna-sense.com





SPC-160 PCIE TCSPC / FLIM Module

Photon Channel

Principle
Discriminator Input Bandwidth
Time Resolution (FWHM / RMS, electr.)
Variance in time of IRF maximum
Optimum Input Voltage Range
Min. Input Pulse Width
Threshold
Zero Cross Adjust

Constant Fraction Discriminator (CFD)
4 GHz
6.6 ps / 2.5 ps
<1 ps over 50 seconds
- 30 mV to - 500 mV
200 ps
0 to - 250 mV
- 100 mV to + 100 mV

Synchronisation Channels

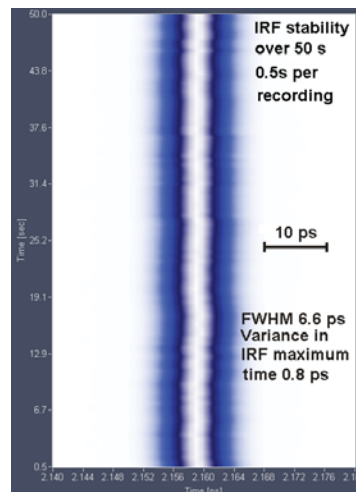
Principle
Discriminator Input Bandwidth
Optimal Input Voltage Range
Min. Input Pulse Width
Threshold
Frequency Range
Frequency Divider
Zero Cross Adjust

Constant Fraction Discriminator (CFD)
4 GHz
- 30 mV to - 500 mV
200 ps
0 to -250 mV
0 to 150 MHz
1-2-4
-100 mV to + 100 mV

Time-to-Amplitude Converters / ADCs

Principle
TAC Range
Biased Amplifier Gain
Biased Amplifier Offset
Time Range incl. Biased Amplifier
min. Time / Channel
ADC Principle
Diff. Nonlinearity, electrical

Ramp Generator / Biased Amplifier
50 ns to 5 us
1 to 15
0 to 50% of TAC Range
3.3 ns to 5 us
813 fs
50 ns Flash ADC with Error Correction
< 0.5% rms, typ. <1% peak-peak



Data Acquisition (Histogram Mode)

Method
Dead Time
Saturated Count Rate
Useful count rate
Channels / Pixel
max. Scanning Area
max. Counts / Time Channel
Overflow Control
Collection Time
Display Interval Time
Repeat Time
Sequential Recording
Synchronisation with Scanning
Count Enable Control
Experiment Trigger

on-board multi-dimensional histogramming process
80ns, independent of computer speed
12.5 MHz
6.25 MHz
4096 1024 256 64 16 4 1
16x16 64x64 128 x 128 256x256 512x512 1024x1024 2048x2048
 $2^{16}-1$
none / stop / repeat and correct
0.1 us to 100,000 s
0.1 us to 100,000 s
0.1 us to 100,000 s
Programmable Hardware Sequencer, unlimited recording by memory swapping, in curve mode and scan mode
pixel, line and frame clocks from scanning device
1 bit TTL
TTL

Data Acquisition (FIFO / Parameter-Tag Mode)

Method
Online display
FCS calculation
Number of counts of decay / waveform recording
Dead Time
Saturated count rate, peak
Sustained count rate (bus-transfer limited)
Output Data Format (ADC / Macrotime / Routing)
FIFO buffer Capacity (photons)
Macro Timer Resolution, internal clock
Macro Timer Resolution, clock from SYNC input
Curve Control (external Routing)
External event markers
Count Enable Control
Experiment trigger

Parameter-tagging of individual photons and continuous writing to disk
Decay function, FCS, Cross-FCS, PCH, MCS traces
Multi-tau algorithm, online calculation and online fit
unlimited
80 ns
12.5 MHz
typ. 4 MHz
12 / 12 / 4
2 M
50ns, 12 bit, overflows marked by MTOF entry in data stream
10ns to 100ns, 12 bit, overflows marked by MTOF entry in data stream
4 bit TTL
4 bit, TTL
1 bit TTL
TTL

Data Acquisition, FIFO / Parameter-Tag Imaging Mode

Method
Online display
Synchronisation with scanner
Dead Time
Detector / Wavelength Channels
Image size in FIFO Imaging Mode (64 bit software)
time channels / pixel
No. of pixels, 1 detector channel
No. of pixels, 16 detector channels (MW FLIM detector)

Buildup of images from time- and wavelength tagged data
up to 8 gated intensity images or up to 8 lifetime images
via Frame Clock, Line Clock, and Pixel Clock pulses
TCSPC: 80 ns, Intensity Channel: <10 ns
1 to 16

	64	256	1024	4096	4096	4096
No. of pixels, 1 detector channel	4096 x 4096	2048 x 2048	1024 x 1024	512 x 512	256 x 256	128 x 128
No. of pixels, 16 detector channels (MW FLIM detector)	1024 x 1024	512 x 512	256 x 256	128 x 128	128 x 128	128 x 128

Operation Environment

Computer System
Bus Connectors
Used PCI Slots
Total power Consumption
Dimensions

PC Pentium, multi-core, >8GB RAM and 64 bit operating system recommended
PCI
1
approx. 12 W from +5V, 0.7 W from +12V
312 mm x 130 mm x 15 mm

Related Products

SPC-160 TCSPC / FLIM modules
SPC-150 and SPC-150N TCSPC modules
Simple-Tau compact TCSPC systems
FLIM systems for laser scanning microscopes

DCS-120 confocal scanning FLIM system
HPM-100 GaAsP and GaAs hybrid detectors
PML-SPEC and MW-FLIM multi-wavelength detectors
id-100, id-220 Si and InGaAs SPAD detector modules

BDL-SMN and BDS ps diode lasers
DCC-100 detector controller
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W. Becker, The bh TCSPC Handbook, 6th edition, 2015. 768 pages, 1007 references. Available on www.becker-hickl.com. Contact bh for printed copies.
DCS-120 Confocal Scanning FLIM Systems, handbook. Available on www.becker-hickl.com.
Modular FLIM systems for Zeiss LSM 510 and LSM 710 laser scanning microscopes, handbook. Available on www.becker-hickl.com.
PML-16-C and PML-16 GaAsP 16-channel TCSPC / FLIM detectors, PML-SPEC and MW-FLIM multi-wavelength detectors. User handbook, 20016. Available on www.becker-hickl.com.
BDL-SMN picosecond diode lasers, handbook. Available on www.becker-hickl.com.
Please see also www.becker-hickl.com, 'Literature', 'Application notes'



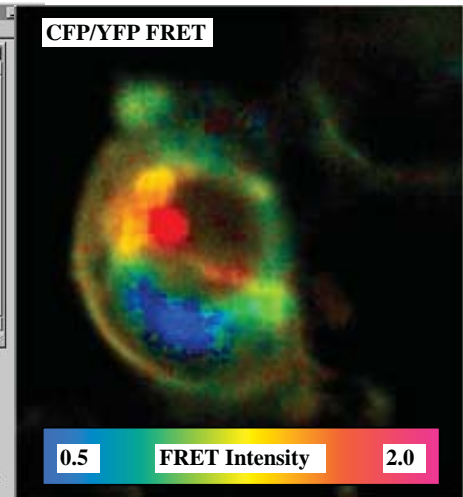
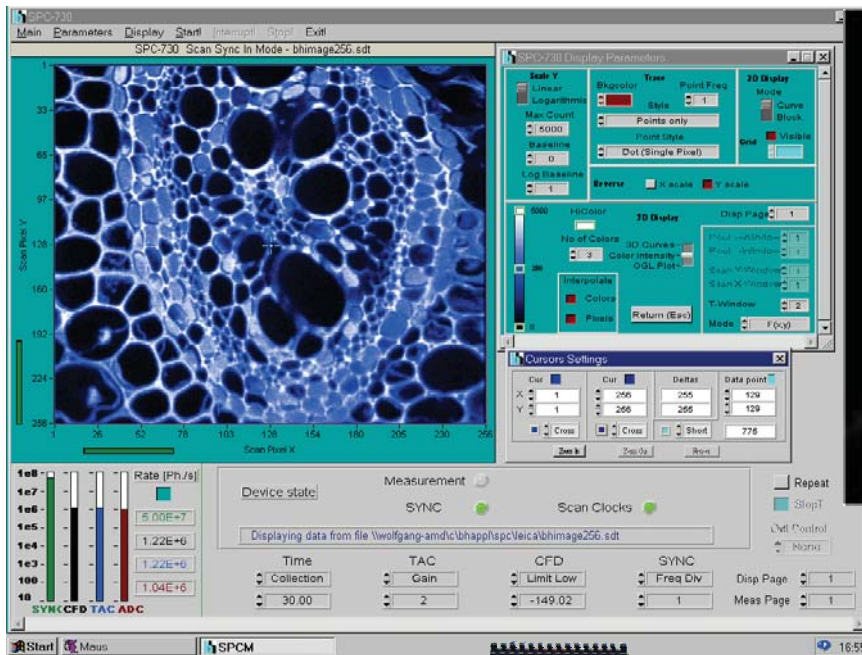
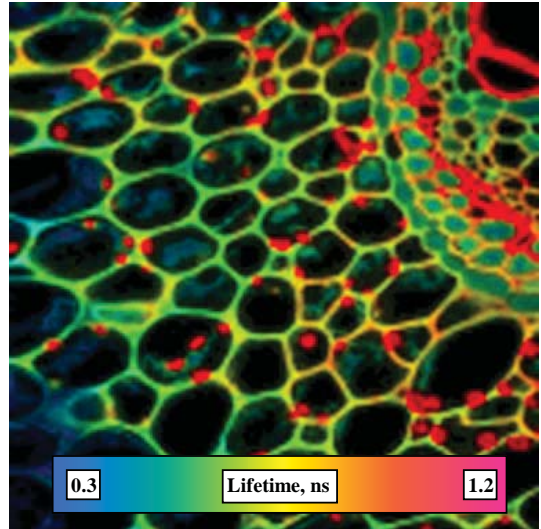
More than 20 years experience in multi-dimensional TCSPC. More than 1500 TCSPC systems worldwide.

The SPC-830 remains available but the SPC-160 is recommended

The TCSPC Microscopy Solution SPC-830

High Resolution Time-Correlated Single Photon Counting Imaging and FCS Module for Laser Scanning Microscopes

- ◆ Complete picosecond imaging system on single PC board
- ◆ Picosecond resolution
- ◆ Ultra-high sensitivity
- ◆ Multi detector capability
- ◆ High-speed on-board data acquisition
- ◆ Works at any scanning speed of microscope
- ◆ High resolution picosecond lifetime imaging
- ◆ FRET imaging
- ◆ High-resolution steady state imaging
- ◆ Single-point time-lapse lifetime analysis
- ◆ Single-point FCS / lifetime data
- ◆ Time channel width down to 813 fs
- ◆ Image size up to 4096 x 4096 pixels
- ◆ Electrical time resolution down to 8 ps fwhm / 4 ps rms
- ◆ Reversed start/stop: Laser repetition rates up to 200 MHz
- ◆ Useful count rate up to 4 MHz - dead time 125 ns
- ◆ Active and passive scanning control
- ◆ Software versions for windows 95 / 98 / 2000 / NT



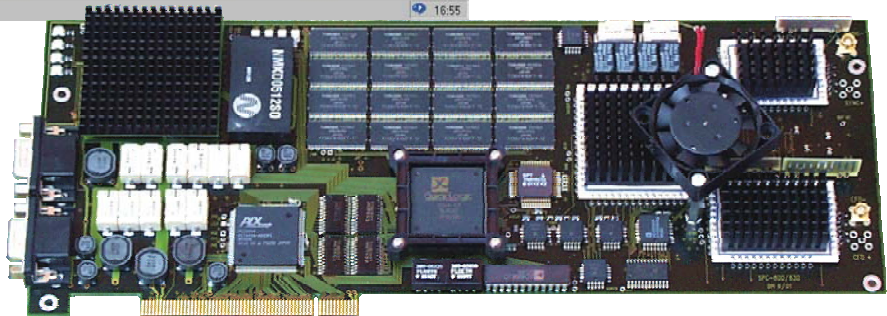
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Covered by patents DE 43 39 784 A1 and DE 43 39 787

The SPC-830 remains available but the SPC-160 is recommended

The TCSPC Microscopy Solution SPC-830

Photon Channel

Principle

Time Resolution (FWHM / RMS, electr.)

Opt. Input Voltage Range

Min. Input Pulse Width

Lower Threshold

Zero Cross Adjust

Constant Fraction Discriminator

7 ps / 4 ps

- 50 mV to - 1 V

400 ps

- 20 mV to - 500 mV

- 100 mV to + 100 mV

Synchronisation Channel

Principle

Opt. Input Voltage Range

Min. Input Pulse Width

Threshold

Frequency Range

Frequency Divider

Zero Cross Adjust

Constant Fraction Discriminator

- 50 mV to - 1 V

400 ps

- 20 mV to -500 mV

0 to 200 MHz

1-2-4-8-16

-100 mV to + 100 mV

Time-to-Amplitude Converter / ADC

Principle

TAC Range

Biased Amplifier Gain

Biased Amplifier Offset

Time Range incl. Biased Amplifier

min. Time / Channel

TAC Window Discriminator

ADC Principle

Diff. Nonlinearity (dith width 1/8, 90% of TAC range)

Ramp Generator / Biased Amplifier

50 ns to 2 us

1 to 15

0 to 100% of TAC Range

3.3 ns to 2 us

813 fs

Any Window inside TAC Range

50 ns 12 bit Flash ADC with Error Correction

< 0.5% rms, typically <1% peak-peak

Data Acquisition, Histogram Modes

Method

on-board 4-dimensional histogramming process over t, x, y, and detector channel number

Dead Time

125ns, independent of computer speed

Saturated Count Rate / Useful Count Rate

8 MHz / 4 MHz

Number of Time Channels / Pixel

1

4

16

64

256

1024

4096

Image Resolution (pixels), 1 Detector Channel

4096 x 4096

2048 x 2048

1024 x 1024

512 x 512

256 x 256

128 x 128

64 x 64

Image Resolution (pixels), 4 Detector Channels

2048 x 2048

1024 x 1024

512 x 512

256 x 256

128 x 128

64 x 64

32 x 32

Image Resolution (pixels), 16 Detector Channels

1024 x 1024

512 x 512

256 x 256

128 x 128

64 x 64

32 x 32

16 x 16

Counts / Time Channel

$2^{16}-1$

$2^{32}-1$

Counts / Time Channel ('Single' mode, repeat and acquire)

Overflow Control

none / stop / repeat and acquire

Collection Time (per curve or per pixel)

100 ns to 1000 s

Display Interval Time

10ms to 1000 s

Repeat Time

0.1 ms to 1000 s

Curve Control (Internal Routing / Scan Sync In Mode)

up to 262,144 decay curves

Routing Control / Detector Channels

14 bit TTL / 16384

Count Enable Control

1 bit TTL

Control Signal Latch Delay

0 to 255 ns

Experiment Trigger

TTL

Data Acquisition, FIFO/BIFL Modes

Method

Time-tagging of individual photons and continuous writing to disk

Macro Time Resolution

50 ns

ADC Resolution / No. of Time Channels

12 bit / 4096

Dead Time

150 ns

Output Data Format (ADC / Macrotime / Routing)

12 / 12 / 4

FIFO buffer Capacity (photons)

8 million photons

Multi Module Systems

Number of modules operable parallel

4

Operation Environment

Computer System

PC Pentium

Bus Connector

PCI

Power Consumption

approx. 20 W at +5V, 0.7 W at +12V

Dimensions

312 mm x 122 mm x 28 mm

Related Products and Accessories

Detector Heads (MCPs, PMTs), Multichannel Detector Heads, Routing Devices for Multichannel Measurements, Step Motor Controllers, Preamplifiers, PIN and Avalanche Photodiode Modules, ps Diode Lasers, Adapter Cables for Scanning Microscopes. SPC-600/630 TCSPC modules for single molecule and correlation spectroscopy, SPC-700/730 for imaging and SPC-134 for optical tomography. Please download or call for individual data sheets. To control detectors and shutters please see DCC-100 detector controller.

Please visit our web site to download the manual, the device software and application notes.



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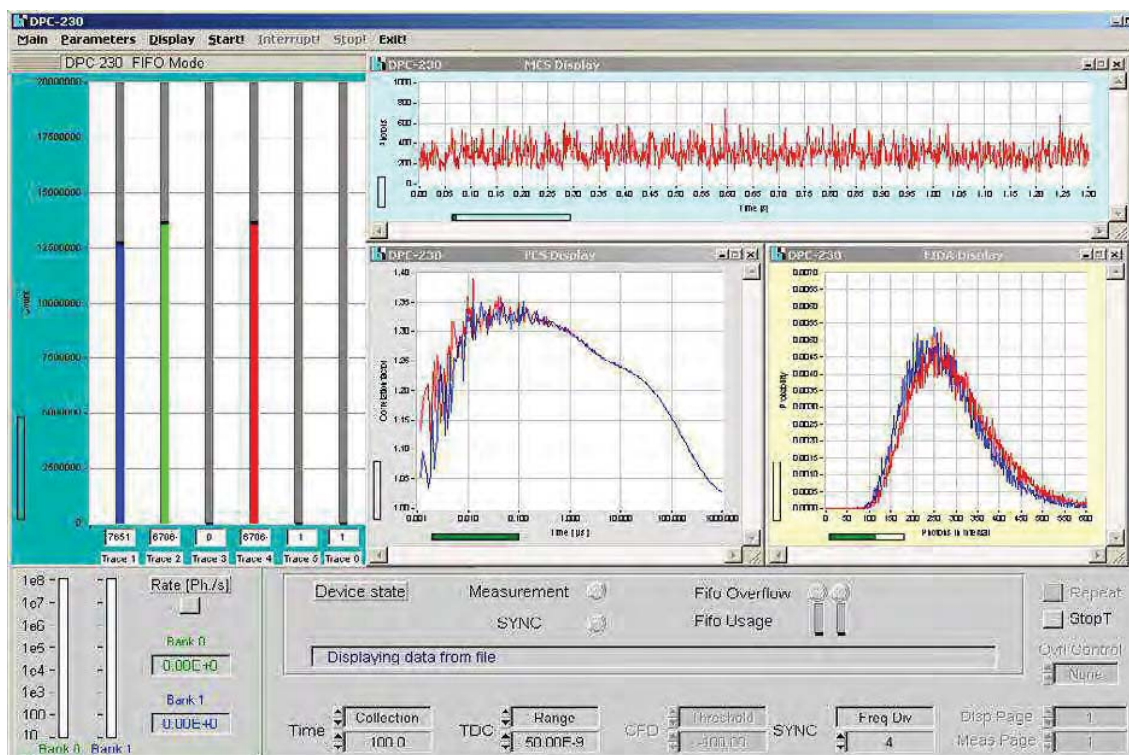
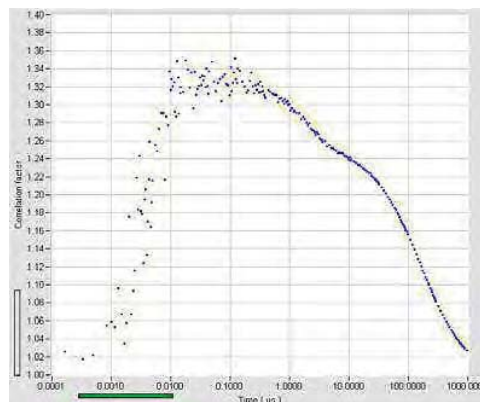
DPC-230

16 Channel Photon Correlator

Photon correlation down to the ps range

16 LVTTTL inputs for SPADs or 4 CFD inputs for PMTs
Recording of absolute photon times
Autocorrelation within 16 LVTTTL or 4 CFD channels
Cross-correlation between any pairs of LVTTTL or CFD channels
3-channel TCSPC mode with 165 ps time channel width
Multiscaler operation of 15 LVTTTL or 3 CFD channels
Single-slot PCI module
Operating software for Windows 2000, NT and XP

Fluorescence correlation experiments down to the ps range
Antibunching experiments
Fluorescence correlation and antibunching from one experiment
Luminescence lifetime measurements



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DPC-230

16 Channel Photon Correlator

LVTTTL Inputs

No. of channels	16
Input Voltage	LVTTTL
Threshold	1.4 V
Min. Input Pulse Width	2 ns
Min. Pulse Distance	5.5 ns
Connectors	MCX, on board

CFD Inputs

No of channels	4
Threshold	- 20 mV to - 500 mV
Zero Cross Adjust	- 100 mV to + 100 mV
Connectors	SMA, front panel

Experiment Trigger Input

Input Voltage	LVTTTL
Threshold	1.4 V

Data Acquisition, Correlation Mode

Method	Time-tag recording, absolute photon times
Correlation of photons	Multi tau or linear tau algorithm, online or offline
Autocorrelation	all channels
Cross-correlation	any pairs of channels
Time increment	164.61 ps
Dead Time	< 10 ns
No of parallel channels	16 LVTTTL or 4 CFD channels
On-board FIFO Buffer size	4 10 ⁶ photons
Readout	continuous readout during measurement
Sustained readout rate (typ., depends on computer)	7 10 ⁶ photons

Data Acquisition, TCSPC Mode

Method	Time-tag recording, reversed start-stop
Correlation of photons	Start-stop histogram, online or offline
Start (photon) channels	3 CFD inputs
Dead Time	< 10 ns
Stop channel	1 CFD input
Stop input rate	max 150 MHz
Stop frequency divider	1 - 2 - 4
Time channel width	164.61 ps
On-board FIFO Buffer size	4 10 ⁶ photons
Readout	continuous readout during measurement
Sustained readout rate (typ., depends on computer)	7 10 ⁶ photons

Data Acquisition, Multiscaler Mode

Method	Time-tag recording, direct start-multistop
Correlation of photons	Start-stop histogram, online or offline
Start (reference) channel	1 CFD input or 1 LVTTTL input
Stop (photon) channels	3 CFD inputs or 15 LVTTTL inputs
Dead Time	< 10 ns
Time channel width	164.61 ps
On-board FIFO Buffer size	4 10 ⁶ photons
Readout	continuous readout during measurement
Sustained readout rate (typ., depends on computer)	7 10 ⁶ photons

Operation Environment

Computer System	Pentium PC
Recommended configuration	>1024 Mb RAM, >100 Gb HD
Bus Connector	PCI
Power Consumption	approx. 12 W from +5V
Dimensions	312 mm x 124 mm x 20 mm

Related Products

SPC-830, SPC-630, SPC-134, SPC-144, SPC-154 TCSPC modules, MSA-1000 and MSA-300 multiscalers, DCC-100 Detector controller, BDL-375, -405, -440, -473 picosecond / CW diode lasers, id-100 SPAD modules, PMT detector modules, detector / shutter assemblies. Please download or call for individual data sheets and manuals.



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MSA-300

5ns Photon Counter / Multiscaler

Ultra-fast accumulation

High repetition rate

No dead time between sweeps

No dead time between channels

Fast on-board discriminators

Input pulse width down to 800 ps

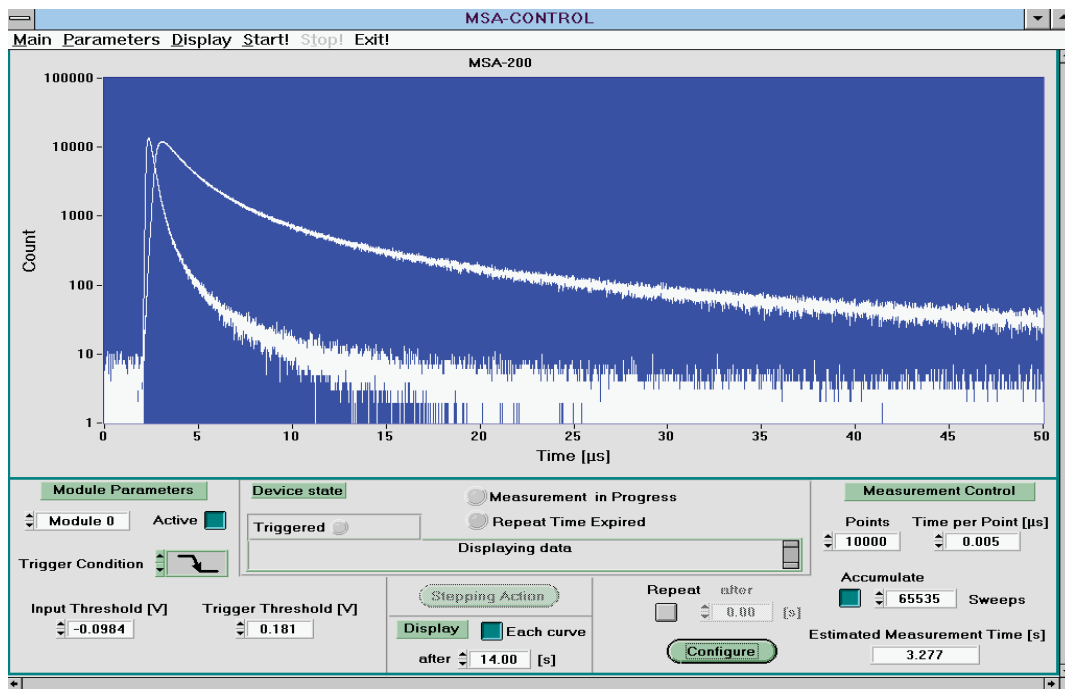
Time / channel down to 5 ns

Count rate up to 100 MHz

Up to 512 k points / curve

Software for Windows 95 / 98 / 2000 / NT

The MSA-300 is a fast multiscaler for photon counting, time-of-flight measurements or other fast particle detection applications. By using a 128 bit memory structure a dead-time-free accumulation of subsequent sweeps is achieved. This makes the MSA-300 exceptionally useful for a wide variety of high-repetition rate signal recording applications.



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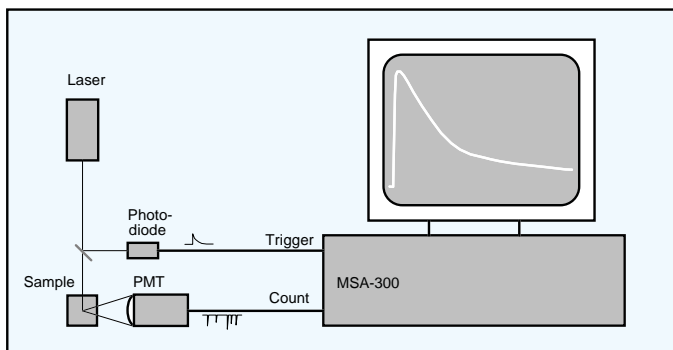
MSA-300

Specification

Time per Channel	min. 5 ns
Count Rate	up to 100 MHz
No of Points / Curve	up to 512 k
Overall Recording Length	up to 2.62 ms
Accumulation (up to 256 events/point)	Hardware, no dead time between recording cycles
Accumulation (> 256 events/point)	Software
Count Input Impedance	50 Ω
Count Input Amplitude	± 20 mV to ± 1 V
Count Input Threshold	0 to ± 200 mV, ± 8 bit resolution
Min.Count Input Pulse Width	800 ps
Trigger Input Impedance	50 Ω
Count and Trigger Input Connectors	MCX
Trigger Input Amplitude	± 20 mV to ± 1 V
Trigger Input Threshold	0 to ± 1 V, ± 8 bit resolution
Min. Trigger Pulse Width	800 ps
Data Readout	subsequent data points are read by subsequent input instructions
Typical readout rate (Pentium 166 MHz)	1 μ s/point (C ⁺⁺ , read 1 point and store into a data array)

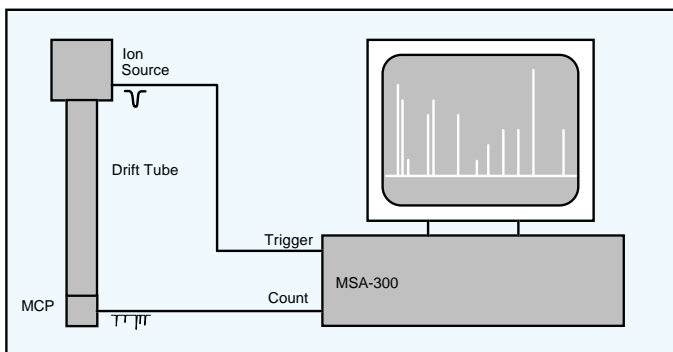
Luminescence Decay Measurements

The sample is excited by laser pulses and the luminescence signal is detected by a PMT in the photon counting mode. Due to the deep memory a time scale from ns to ms can be covered in one measurement.



Time-of-Flight Measurements

Packages of ions are released by a pulsed source, sent through a drift tube and detected by an MCP. Due to the high accumulation speed of the MSA-300 very high repetition rates and short overall measurement times are achieved.



Accessories: PMTs, PMT detector heads with internal HV supply, preamplifiers, diode lasers, pulse generators for experiment control, step motor controllers. Please see individual data sheets.

Please visit our web site to download the manual, the device software and application notes.



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PMS-400A

800 MHz Gated Photon Counter / Multiscaler

2 Counter Channels

800 MHz Count Rate, 32 bit Resolution

Direct Interfacing to most Detectors

Multiscaler Mode: Up to 64k Time Channels, min. 250ns / Channel

Gated Photon Counting: 1.5 ns min. Gate Pulse Width

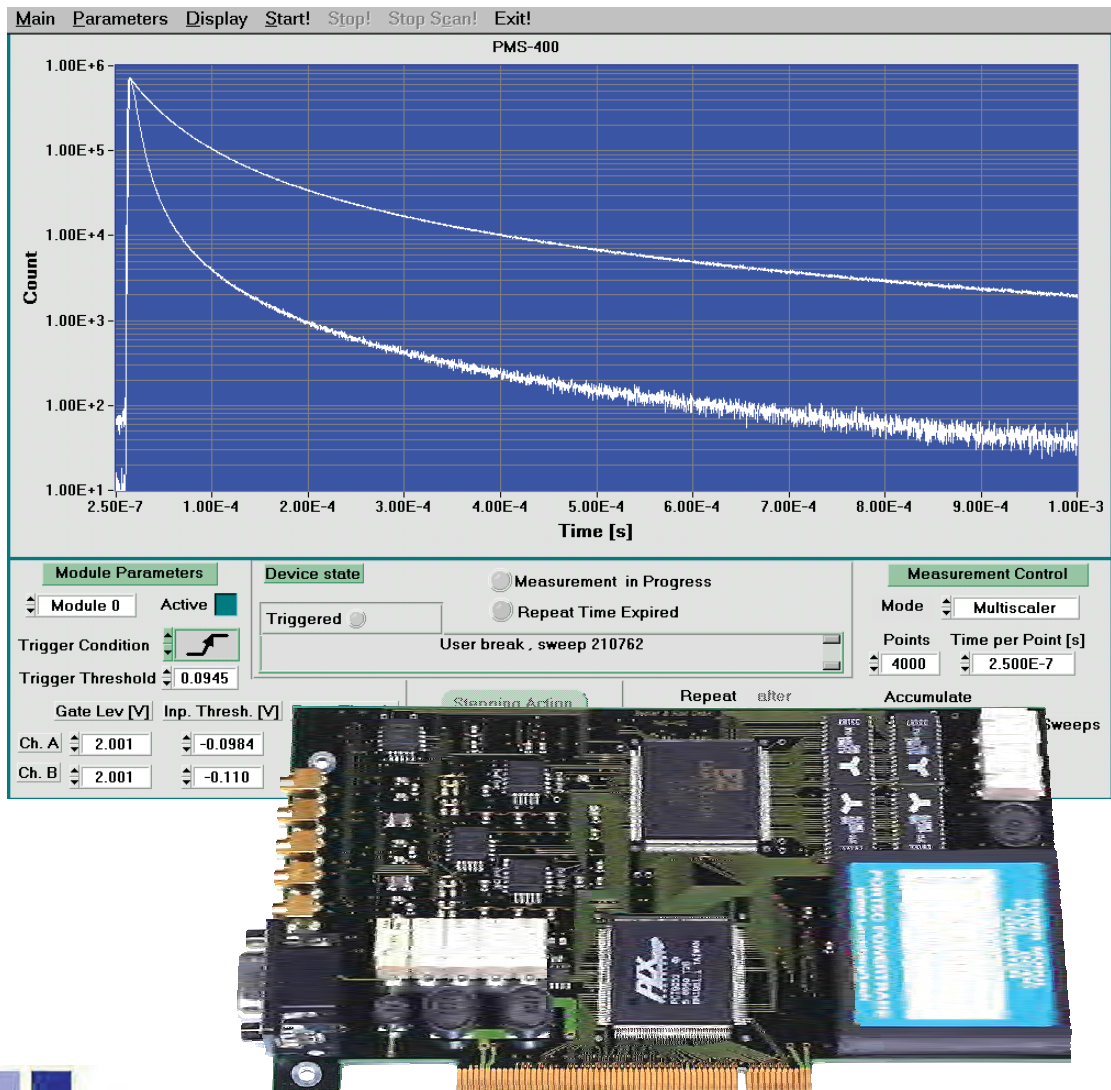
Event Recording Mode: Up to 32 k Events

new 32 bit Accumulation Counter for ultra-fast Accumulation

On-Board Discriminators, Timing and Control Logics

new PCI Board with fast DMA (Bus Master),

Software for Windows 98, NT, 2k and XP, Parallel Operation of Several Modules Supported



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Optical Transient Waveform Recording

The waveform of the light is measured with a resolution down to 250ns. Two signals can be recorded simultaneously. Applicable to luminescence decay of inorganic samples, phosphorescence, delayed fluorescence, chemoluminescence, LIDAR.

New: The PMS-400A provides a 32 bit accumulation counter which enables accumulation with virtually no dead time between sweeps (< 100 ns).

Recording of Luminescence Spectra

The luminescence and the excitation light are recorded simultaneously. Corrected excitation spectra are obtained by calculating B/A.

Single Molecule Detection

Recording of photon bursts. If the count rate inside a programmed time interval exceeds a programmed value, the number of photons and the time of the event is stored.

Gated Detection

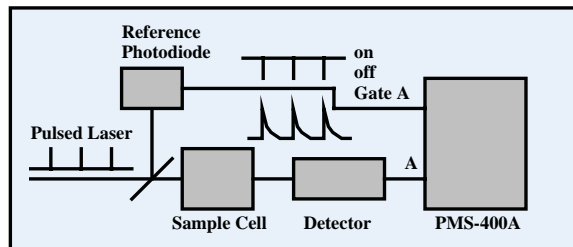
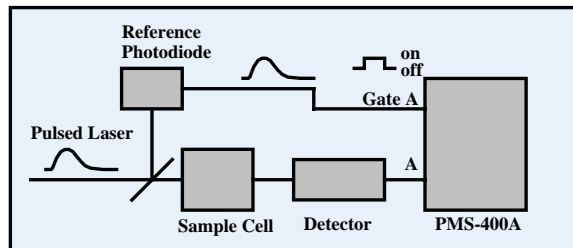
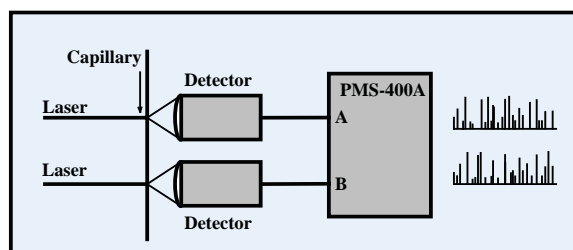
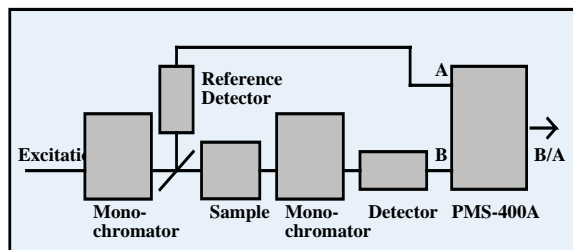
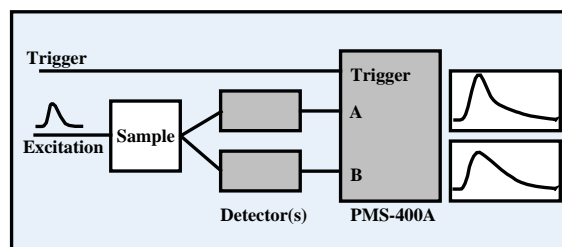
The gate is opened during the laser pulse only. Events outside the laser pulses are suppressed. Exceptionally low background count rate.

Gating off Scattering Pulses

The gate is closed during the laser pulses. Scattered photons during the laser pulses are suppressed, the luminescence photons outside the laser pulses are recorded.

Specification (Typical Values)

Counter Channels	2
Count Rate (Input Amplitude 50mV, peak-peak)	800 MHz
min. Count Pulse Width	800 ps
min. Gate Width (Input Amplitude 200mV, peak-peak)	1 ns
min Trigger Pulse Width	1 ns
Discriminator Threshold (Count Inputs)	-1 V to +1 V in steps of 4 mV
Discriminator Threshold (Gate Inputs)	-2 V to +2 V in steps of 16 mV
Discriminator Threshold (Trigger Input)	-2 V to +2 V in steps of 16 mV
Input Connectors	MCX, 50
Counter Width	32 bit
Accumulation Counter	32 bit
Dead time between sweeps	< 100ns
No. of Time Bins	64 k for each counter channel
Time / Bin	250 ns to 100 000 s
Hardware Environment	Pentium PC
Software Environment	Windows 95, 98, 2000 or NT
Dimensions	180 mm x 108 mm x 15 mm

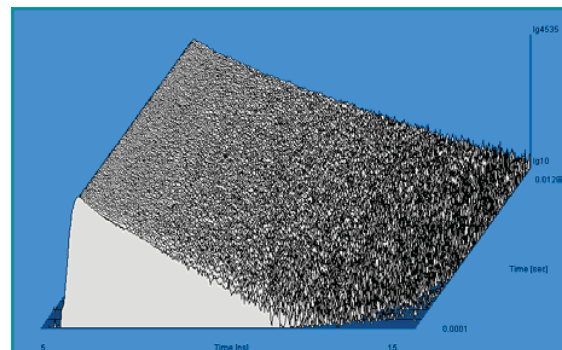
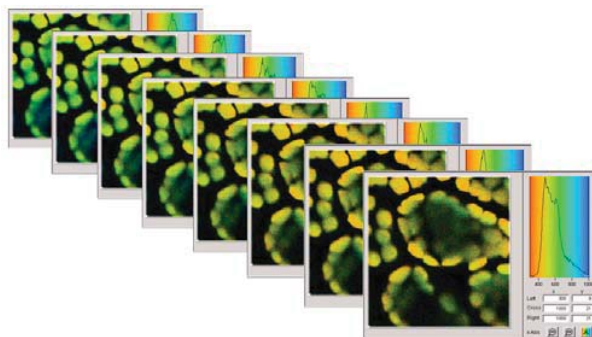
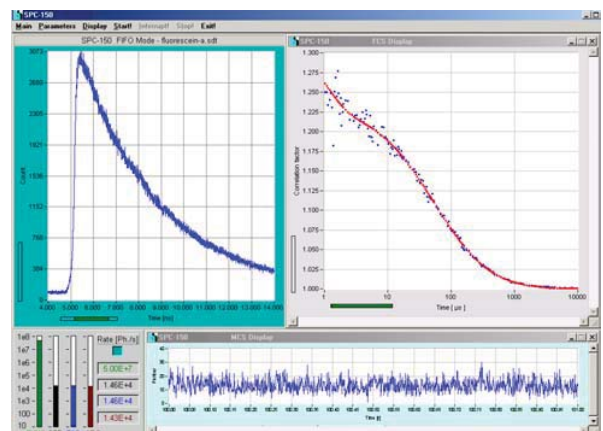
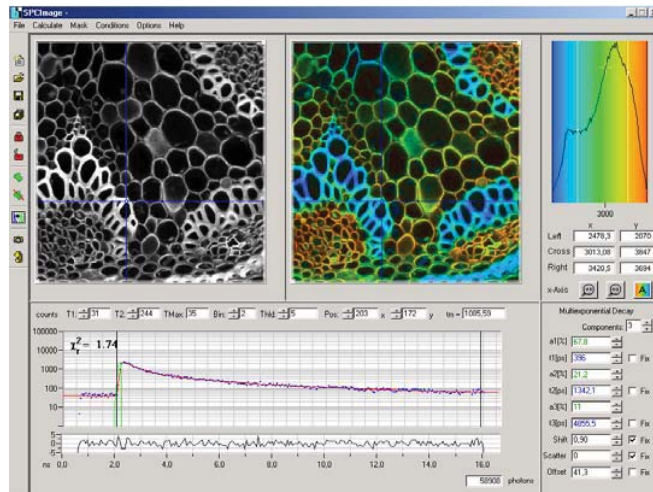


Simple-Tau 164 Table-Top TCSPC Systems

Four-channel single photon counting systems in lap-top format

Four fully parallel SPC-160 TCSPC Channels

Laptop computer with extension box
Coupled via fast bus extension interface
Four parallel SPC-160 TCSPC modules
Picosecond resolution
Time channel width down to 813 fs
Electronic IRF 8 ps FWHM
Unprecedented count rate
Unprecedented timing stability
Photon distribution and time-tag modes
Standard fluorescence decay recording
Fast triggered sequential recording
Unlimited sequential recording by memory swapping
FLIM in histogram and time-tag modes
Fast FLIM series in memory-swapping mode
Multi-spectral FLIM
FCS recording
Works under windows XP, Vista, 7, 8, 10



Covered by patents DE 43 39 784 and DE 43 39 787



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by Wolfgang Becker

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

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