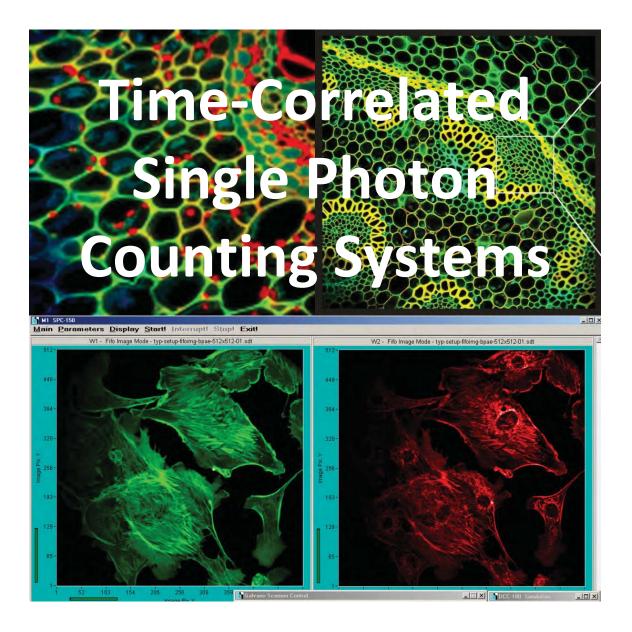


Boston 91 Boylston Street, Brookline, MA 02445 tel: (617)566-3821 fax: (617)731-0935 www.boselec.com tcspc@boselec.com



PC Based **Systems**



Becker & Hickl GmbH Nahmitzer Damm 30 12277 Berlin, Gemany 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

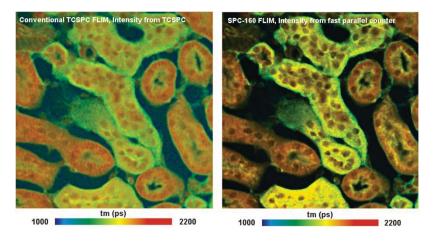
December 2016 - Becker & Hickl have released a full set of PCI Express cards for TCSPC FLIM system. The set consists of one or two SPC-160pcie TCSPC / FLIM modules and a DCC-100pcie detector controller. For the bh DCS-120 scanners or for customer-specific galvanometer scanners a GVD-120pcie scan controller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





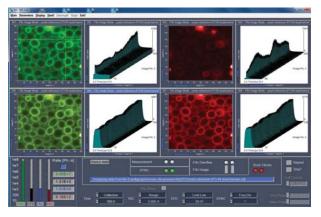
SPC-160 PCIE TCSPC/ FLIM Module

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 Ca²⁺ transients

fNIRS and NIRS experiments Single-molecule spectroscopy FCS, FCCS, Photon Counting Histograms Anti-bunching experiments





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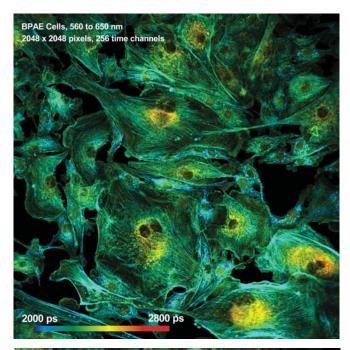
UK Representative: Photonic Solutions PLC sales@psplc.com www.psplc.com

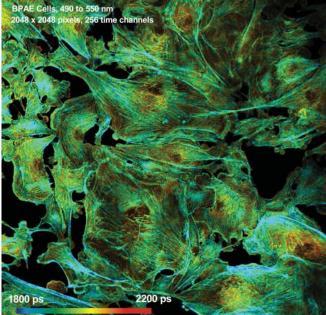
TII TOKYO INSTRUMENTS, INC.

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Dyna Sense

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







SPC-160 PCIE TCSPC / FLIM Module

Principle Discriminator Input Bandwidth Time Resolution (FWHM / RMS, electr.) Variance in time of IRF maximum Optimum Input Voltage Range Min. Input Voltage Range Min. Input Pulse Width Threshold Zero Cross Adjust	<1 -	Fraction Discrimin 4 GHz 6.6 ps / 2.5 ps ps over 50 seco 30 mV to - 500 n 200 ps 0 to - 250 mV 100 mV to + 100	nds nV		50.0- 43.8- 37.6-		IRF stability over 50 s 0.5s per recording
ynchronisation Channels		100 1117 10 + 100	iii v				
Principle Discriminator Input Bandwidth	Constant	Fraction Discrimir 4 GHz	nator (CFD)		31.4-		
Optimal Input Voltage Range Min. Input Pulse Width	-	30 mV to - 500 n 200 ps	۱V		100		10 ps
Threshold		0 to -250 mV			25.2-		HO PS
Frequency Range Frequency Divider		0 to 150 MHz 1-2-4					
Zero Cross Adjust	-1	00 mV to + 100 r	nV		19.1 -		FWHM 6.6 ps
me-to-Amplitude Converters / ADCs Principle	Ramp G	enerator / Biased	Amplifier		12.9-		Variance in IRF maximur
TAC Range Biased Amplifier Gain		50 ns to 5 us 1 to 15					time 0.8 ps
Biased Amplifier Offset Time Range incl. Biased Amplifier	0 t	o 50% of TAC Ra 3.3 ns to 5 us	inge		6.7-		
min. Time / Channel		813 fs					
ADC Principle Diff. Nonlinearity, electrical		sh ADC with Error rms, typ. <1% pe			0.5-	, aire aire aire aire :	nie nie nie nie
ata Acquisition (Histogram Mode)						4 2.148 2.152 2.196 2.160 ; Time [ns]	2.164 2.168 2.172 2.176
Method Dead Time				ional histogrammi ent of computer sp			
Saturated Count Rate Useful count rate			12	2.5 MHz 25 MHz			
Channels / Pixel		024 256	64	16	4	1	
max. Scanning Area max. Counts / Time Channel	16x16 64	4x64 128 x 1		56 512x512 2 ¹⁶ -1	1024x10)24 2048x204	8
Overflow Control Collection Time				repeat and correct to 100,000 s	ct		
Display Interval Time			0.1 us	to 100,000 s			
Repeat Time Sequential Recording	Programmable Har	dware Sequencer		to 100,000 s rding by memory :	swapping, in cu	urve mode and scan	mode
Synchronisation with Scanning	- 3	pixel,	line and frame c	locks from scann	ing device		
Count Enable Control Experiment Trigger			1	bit TTL TTL			
ata Acquisition (FIFO / Parameter-Tag Mode) Method		Doromotor toggi	og of individual r	abatana and aanti	nuovo viriting t	a diak	
Online display		Decay	unction, FCS, C	photons and conti cross-FCS, PCH,	MCS traces	U UISK	
FCS calculation Number of counts of decay / waveform recording		Multi-ta		line calculation ar nlimited	id online fit		
Dead Time				80 ns			
Saturated count rate, peak Sustained count rate (bus-transfer limited)			typ	2.5 MHz o. 4 MHz			
Output Data Format (ADC / Macrotime / Routing) FIFO buffer Capacity (photons)			12	2/12/4 2M			
Macro Timer Resolution, internal clock Macro Timer Resolution, clock from SYNC input				ed by MTOF entr marked by MTOF			
Curve Control (external Routing)			4	bit TTL	entry in data s	sileani	
External event markers Count Enable Control				bit, TTL bit TTL			
Experiment trigger				TTL			
ata Acquisition, FIFO / Parameter-Tag Imaging Mode Method		Buildup of	images from tim	ne- and waveleng	th tanned data		
Online display		up to 8 ga	ated intensity im	ages or up to 8 lif	etime images		
Synchronisation with scanner Dead Time				Clock, and Pixel C tensity Channel:			
Detector / Wavelength Channels Image size in FIFO Imaging Mode (64 bit software)			1	1 to 16			
time channels / pixel	64	256	1024	4096	4096	4096	
No. of pixels, 1 detector channel No. of pixels, 16 detector channels (MW FLIM detector)	4096 x 4096 1024 x 1024	2048 x 2048 512 x 512	1024 x 1024 256 x 256	512 x 512 128 x 128	256 x 256 128 x 128	128 x 128 128 x 128	
peration Environment							
Computer System Bus Connectors	PC	Pentium, multi-co	re, >8GB RAM a	and 64 bit operati PCI	ng system reco	ommended	
Used PCI Slots				1			
Total power Consumption Dimensions		ap		n +5V, 0.7 W from 130 mm x 15 mm	i +12V		
elated Products							
SPC-160 TCSPC / FLIM modules SPC-150 and SPC-150N TCSPC modules		nfocal scanning I aAsP and GaAs I				and BDS ps diode la detector controller	asers
Simple-Tau compact TCSPC systems	PML-SPEC	and MW-FLIM m 20 Si and InGaAs	ulti-wavelength o		GVD-120 s	scan controller	odule
FLIM systems for laser scanning microscopes elated Literature	iu-100, id-22	o orand ingaAs	SPAD detector	modules	DD-32 USI	B-controlled delay m	ouule
W. Becker, Advanced time-correlated single photon countin W. Becker (ed.), Advanced time-correlated single photon co W. Becker, The bh TCSPC Handbook, 6th edition, 2015. 76	unting pplications. 8 pages, 1007 refe	Springer 2015. P rences. Available	lease contact bh	n for availability.	act bh for printe	ed copies.	
DCS-120 Confocal Scanning FLIM Systems, handbook. Ava Modular FLIM systems for Zeiss LSM 510 and LSM 710 last	mable of www.bec	Kei-HICKI.COM					

SPC-130

Time-Correlated Single Photon Counting Module

Saturated Count Rate 10 MHz Decay curves measured in seconds 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 Segential Recording Mode Spectrum Scan Mode with 8 Independent Time Windows **Continuous Flow Mode** FIFO / Time Tag Mode for FCS, FIDA, FILDA, BIFL 2 86 Canves 2 1 First 0.08 \$.000 Fluorescence decay of single molecules 3.0 -3.6 -3.2 -3.0 -2.8 -2.8 -2.8 -2.8 -2.8 -2.8 -Sector Marine € 128 Time [ns], Y- Point X Curves First 1 1e8 ate [Ph./s] Measurement in progress Device state: 1e7 SYNC OK 1e6 5.50E+5 2.0-1.8-1.6-1.4-1.2-Displaying data from file c\bhappl\spc\spc134.sdt 1e5 4.95E+5 1e4 TAC CFD SYN Time Fluorescence correlation 1e3 Collection 1.0 Range Limit Low ŧ Thres 100 2 70E+5 Step./CFD 2.00 \$ 50.00E-9 -100.00 -49.02 10 SYNC CFD TAC ADC



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



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

Synchronisation Channel

Principle Opt. 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

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

Data Acquisition (FIFO / Time-Tag Mode)

Method Dead Time 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

Operation Environment

Computer System Bus Connectors Used PCI Slots Power Consumption Dimensions

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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Boston Electronics Corporation

91 Boylston Street, Brookline. Massachusetts 02445 USA Tel: (800) 347 5445 or (617) 566 3821, Fax: (617) 731 0935 www.boselec.com tcspc@boselec.com



0 to 200 MHz 1-2-4 -100 mV to + 100 mV 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

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

Constant Fraction Discriminator (CFD)

- 50 mV to - 1 V

400 ps

- 20 mV to -500 mV

40 ns Flash ADC with Error Correction < 0.8% rms, typ. <2% peak-peak

on-board 2-dimensional histogramming process 100 ns, independent of computer speed 4096 1024 256 64 64 256 1024 4096 2¹⁶-1 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 TTI

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 PC Pentium PCI 1

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

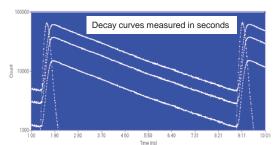
TCSPC Module

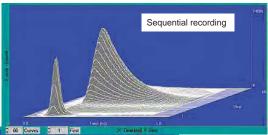
SPC-130 EM

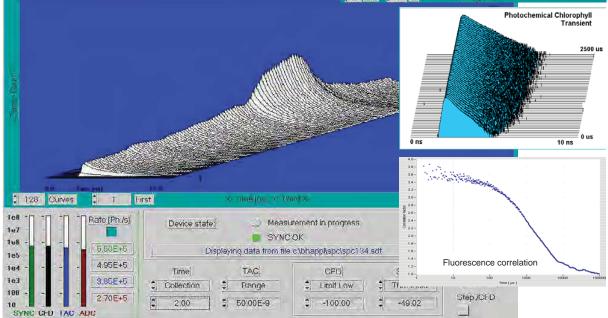
General-Purpose Time-Correlated Single Photon Counting Module

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









 Technology Leader in TCSPC

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



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

SPC-130 EM

Time Resolution (Jitter, FWHM / RMS, electrical) Optimum Input Voltage Range Min. Input Pulse Width Threshold Zero Cross Adjust nchronisation Channel (Stop Input) Principle Optimum Input Voltage Range Min. Input Pulse Width Threshold _	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)	820 fs per channel 2.5 ps rms
Min. Input Pulse Width Threshold Zero Cross Adjust nchronisation Channel (Stop Input) Principle Optimum Input Voltage Range Min. Input Pulse Width Threshold	400 ps - 20 mV to - 500 mV - 100 mV to + 100 mV	820 fs per 6.6 ps fwhm 2.5 ps rms
Threshold Zero Cross Adjust nchronisation Channel (Stop Input) Principle Optimum Input Voltage Range Min. Input Pulse Width Threshold	- 20 mV to - 500 mV - 100 mV to + 100 mV	per 25 ps rms
nchronisation Channel (Stop Input) Principle Optimum Input Voltage Range Min. Input Pulse Width Threshold		per 25 ne rme
Principle Optimum Input Voltage Range Min. Input Pulse Width Threshold	Constant Fraction Discriminator (CFD)	channel 2.0 p3 mis
Principle Optimum Input Voltage Range Min. Input Pulse Width Threshold	Constant Fraction Discriminator (CFD)	channer
Optimum Input Voltage Range Min. Input Pulse Width Threshold		+ \
Threshold	- 30 mV to - 1 V	
	400 ps	
	- 20 mV to -500 mV	
Frequency Range	0 to 200 MHz	I I
Frequency Divider Zero Cross Adjust	1-2-4 -100 mV to + 100 mV	/ 1
ne-to-Amplitude Converter / ADC		1
Principle	Ramp Generator / Biased Amplifier	
TAC Range	50 ns to 5 us	1
Biased Amplifier Gain	1 to 15	/ 1
Biased Amplifier Offset	0 to 100% of TAC Range	/
Time Range incl. Biased Amplifier	3.3 ns to 5 us	
min. Time / Channel ADC Principle	813 fs 40 ns Flash ADC with Error Correction	······
Diff. Nonlinearity	< 0.5% rms, typ. <1% peak-peak	
ta Acquisition (Histogram Mode)		
Method	on-board 2-dimensional histogramming pro	cess
Online display	Decay curves (waveforms)	
Dead Time	100 ns, independent of computer speed	t
Saturated count rate Sustained count rate	10 MHz 10 MHz	
Maximum useful count rate (50% loss)	5 MHz	
max. Number of Curves in Memory	65536 16384 4096 1024	256 64
Number of Time Channels / Curve	4 16 64 256	1024 4096
max. Counts / Channel	2 ¹⁶ -1	
Overflow Control	none / stop / repeat and correct	
Collection Time	0.1 us to 100,000 s	
Display Interval Time	0.1 us to 100,000 s	
Repeat Time Curve Control (Internal sequencing)	0.1 us to 100,000 s Programmable Hardware Sequencer	
Curve Control (Routing)	4 bit, TTL	
Count Enable Control	1 bit, TTL	
External event markers	4 bit, TTL	
Experiment Trigger	TTL	
ta Acquisition (FIFO / Time-Tag Mode) Method	Time and wavelength tagging of individual photons and con	tipuous writing to disk
Online display	Decay function, FCS, Cross-FCS, PCH, MCS	
FCS calculation	Multi-tau algorithm, online calculation and or	
Nunmer of counts of decay/waveform recording	unlimited	
Dead Time	100 ns	
Saturated count rate, peak	10 MHz	
Sustained count rate (bus transfer limited)	typ. 4 MHz	
Output Data Format (ADC / Macrotime / Routing) FIFO buffer Capacity (photons)	12 / 12 / 4 2 M	
Macro Timer Resolution, internal clock	50ns, 12 bit, overflows marked by MTOF entry in	data stream
Macro Timer Resolution, clock from SYNC input	10ns to 100ns, 12 bit, overflows marked by MTOF entr	
Curve Control (external Routing)	4 bit TTL	, ,
Count Enable Control	1 bit TTL	
Experiment trigger	TTL	
eration Environment	DC Doptium multi poro CDU recommenda	od
Computer System Bus Connectors	PC Pentium, multi-core CPU recommend PCI	80
Used PCI Slots	1	
Power Consumption	approx. 45 W at +5V, 2 W at +12V	
Dimensions	225 mm x 115 mm x 25 mm	
lated Products		
SPC-134 EM 4-channel TCSPC modules	PMC-100 cooled PMT modules	BDL-SMC picosecond diode lasers
SPC-150 TCSPC modules	HPM-100 GaAsP and GaAs hybrid detectors	BHL-600 picosecond diode lasers
SPC-154 4-channel TCSPC modules	PML-SPEC and MW-FLIM multi-wavelength detectors	BHLP-700 picosecond diode lasers
SPC-830 TCSPC modules	R3809U MCP PMTs, with HVM-100 power supply module	DDG-200 laser multiplexing controll
Simple-Tau 130 compact TCSPC systems	id-100 SPAD detector modules DCC-100 detector controller	GVD-100 scan controller
Simple-Tau 150 compact TCSPC systems Simple-Tau 134 compact 4-channel TCSPC systems	HRT-41, HRT-81, HRT-82 routing modules	Pin-photodiode modules for sync to SPCImage decay analysis
Simple-Tau 154 compact 4-channel TCSPC systems	HFAC and HFAH preamplifiers	Optispec decay analysis
Simple-Tau 830 TCSPC compact systems	A-PPI-D pulse inverters	
DPC-230 16-channel ps photon correlator module	Detector / shutter assemblies	

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'



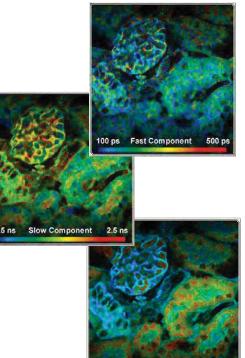
TCSPC Module

SPC-150

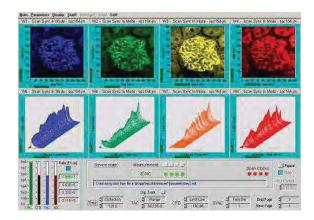
TCSPC Module for Imaging Applications

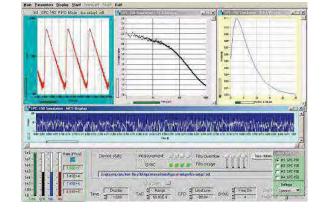
Picosecond resolution Ultra-high sensitivity Multi-detector / multi-wavelength capability High-speed on-board data acquisition Photon distribution and time-tag modes Image acquisition by synchronisation with ext. scanner Unlimited sequential recording of curves or images Imaging in histogram mode and 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



Ratio of Amplitudes







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

SPC-150

Photon Channel Constant Fraction Discriminator (CFD) Principle Time Resolution (FWHM / RMS, electr.) 8 ps / 5 ps Optimal Input Voltage Range - 50 mV to - 1 V Min. Input Pulse Width 400 ps Threshold - 20 mV to - 500 mV Zero Cross Adjust - 100 mV to + 100 mV Synchronisation Channels Principle Constant Fraction Discriminator (CFD) Optimal Input Voltage Range - 50 mV to - 1 V Min. Input Pulse Width 400 ps - 20 mV to -500 mV Threshold Frequency Range 0 to 200 MHz Frequency Divider 1-2-4 Zero Cross Adjust -100 mV to + 100 mV Time-to-Amplitude Converters / ADCs Principle Ramp Generator / Biased Amplifier TAC Range 50 ns to 2 us Biased Amplifier Gain 1 to 15 Biased Amplifier Offset 0 to 100% of TAC Range Time Range incl. Biased Amplifier 3.3 ns to 2 us min. Time / Channel 813 fs 50 ns Flash ADC with Error Correction ADC Principle Diff. Nonlinearity < 0.5% rms, typ. <1% peak-peak Data Acquisition (Histogram Mode) on-board multi-dimensional histogramming process Method Dead Time 100ns, independent of computer speed Saturated Count Rate, per TCSPC channel / total 10 MHz / 40 MHz Useful count rate, per TCSPC channel / total 5 MHz / 20 MHz Channels / Pixel 4096 256 64 16 1024 4 1 max. Scanning Area per TCSPC channel 16x16 64x64 128 x 128 256x256 2¹⁶-1 512x512 1024x1024 2048x2048 max. Counts / Time Channel Overflow Control none / stop / repeat and correct Collection Time 0.1 us to 10000 s **Display Interval Time** 10ms to 1000 s Repeat Time 0.1 us to 1000 s Sequential Recording Programmable Hardware Sequencer Unlimited recording by memory swapping, in curve mode and scan mode pixel, line and frame clocks from scanning device Synchronisation with Scanning Count Enable Control 1 bit TTL Experiment Trigger TTI Data Acquisition (FIFO / Time-Tag Mode) Method Time-tagging of individual photons, continuous writing to disk Online Display Decay function, FCS, Cross-FCS, PCH, MCS traces Dead Time 100 ns Output Data Format (ADC / Macrotime / Routing) 12 bit ADC / 12 bit macro time / 4 bit routing Output Data Format for Scan Clock Markers (pxl, line, frame) 12 bit macro time / pxl, line, frame FIFO Buffer Capacity (photons and clock markers) 2 M 25 ns, 12 bit Macro Timer Resolution, internal clock Macro Timer Resolution, clock from SYNC input Curve Control (external Routing) 10 ns to 100 ns, 12 bit 4 bit TTI Count Enable Control 1 bit TTL Data Acquisition, FIFO / Time-Tag Imaging Mode Method Buildup of Images from Time-Tag data Online Display Images of all wavelength channels Synchronisation with scanner via Frame Clock, Line Clock, and Pixel Clock pulses Detector / WavelengthChannels 1 to 16 Time Channels / Pixel 1024 64 4096 256 16 max. Scan Area (one detector / wavelength channel) 128 x 128 256x256 512x512 1024x1024 2048x2048 **Operation Environment** Computer System PC Pentium **Bus Connectors** PCI Used PCI Slots 1 approx. 12 W from +5V, 0.7 W from +12V Total power Consumption 240 mm x 130 mm x 15 mm Dimensions Product Literature US Representative: W. Becker, The bh TCSPC Handbook. Available on www.becker-hickl.com. Boston Electronics Corp tcspc@boselec.com www.boselec.com Tel: (800) 347 5445 or (617) 566 3821 Designed and manufactured by Fax: (617) 731 0935



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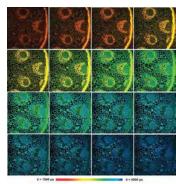
TCSPC Module

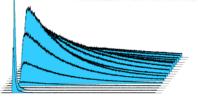
SPC-150N

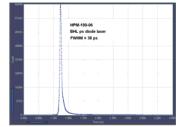
Time-Correlated Single Photon Counting Imaging and FCS Module for Laser Scanning Microscopes

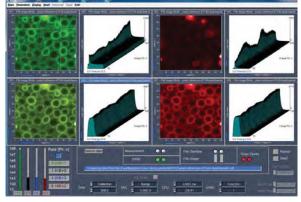
Improved version of SPC-150 TCSPC module Input discriminator bandwidth 4 GHz Reduced low-frequency timing wobble Multi-detector / multi-wavelength capability High-speed on-board data acquisition Photon distribution and parameter-tag modes Image acquisition by synchronisation with ext. scanner Imaging 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

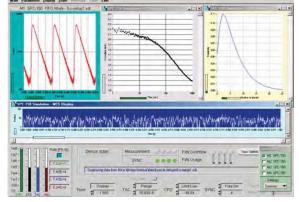
Standard fluorescence lifetime experiments Multi-wavelength lifetime experiments Recording of transient fluorescence lifetime effects Fluorescence lifetime imaging (FLIM) Multi-wavelength FLIM Fast-Acquisition FLIM, fast Sequential FLIM Fluorescence lifetime-transient scanning (FLITS) Combined fluorescence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













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



SPC-150N

Principle	Constan	t Fraction Discrimi	nator (CFD)	500- 11	RF stability	
Discriminator Input Bandwidth		4 GHz			ver 50 seconds	
Time Resolution (FWHM / RMS, electr.) Variance in time of IRF maximum		6.6 ps / 2.5 ps <1 ps over 50 seco		42.0-	.5s per recordin	a
Optimum Input Voltage Range		- 30 mV to - 500 r		·	too per recordin	9
Min. Input Pulse Width		200 ps		37.6-		
Threshold Zero Cross Adjust		0 to - 250 mV - 100 mV to + 100	~~\/			
		- 100 1110 10 + 100	mv			
Synchronisation Channels Principle	Constan	t Fraction Discrimi	nator (CFD)	31.4-3		
Discriminator Input Bandwidth		4 GHz	(
Optimal Input Voltage Range		- 30 mV to - 500 r	nV	E 25.24	10 ps	
Min. Input Pulse Width Threshold		200 ps 0 to -250 mV		1	10 00	
Frequency Range		0 to 150 MHz		19.1		
Frequency Divider		1-2-4		12.1		
Zero Cross Adjust		-100 mV to + 100	mV			
Time-to-Amplitude Converters / ADCs Principle	Pomp	Generator / Biased	Amplifior		WHM 6.6 ps	
TAC Range	Ramp	50 ns to 5 us	Ampillei		ariance in RF maximum	
Biased Amplifier Gain		1 to 15			me 0.8 ps	
Biased Amplifier Offset Time Range incl. Biased Amplifier	0	to 100% of TAC R 3.3 ns to 5 us	ange		ine 0.0 ps	
min. Time / Channel		813 fs		1 100		
ADC Principle	50 ns Fl	ash ADC with Erro	r Correction	0.5	2144 2148 2152 2156	2 160 2.164 2 168 2 172 2 176
Diff. Nonlinearity, electrical	< 0.5	% rms, typ. <1% p	eak-peak		-Ti	me (nii)
Data Acquisition (Histogram Mode)						
Method Dead Time			ard multi-dimensio			
Saturated Count Rate			100ns, independe) MHz	speed	
Useful count rate				MHz		
Channels / Pixel	4096	1024 256		16	4	1
max. Scanning Area max. Counts / Time Channel	16x16	64x64 128 x 1	28 256x25	6 512x512 2 ¹⁶ -1	2 1024x1024	2048x2048
Overflow Control				epeat and corre	ct	
Collection Time				o 100,000 s		
Display Interval Time Repeat Time				o 100,000 s o 100,000 s		
Sequential Recording	Programmable Ha	ardware Sequence			swapping, in curve	mode and scan mode
Synchronisation with Scanning	0		line and frame cl	ocks from scann		
Count Enable Control				bit TTL		
Experiment Trigger				TTL		
Data Acquisition (FIFO / Parameter-Tag Mode) Method		Parameter-taggi	ng of individual n	hotons and cont	inuous writing to d	isk
Online display			function, FCS, CI			IGK
FCS calculation		Multi-t	au algorithm, onli		nd online fit	
Number of counts of decay / waveform recording Dead Time				limited 00 ns		
Saturated count rate, peak) MHz		
Sustained count rate (bus-transfer limited)				4 MHz		
Output Data Format (ADC / Macrotime / Routing)				/ 12 / 4 2 M		
FIFO buffer Capacity (photons) Macro Timer Resolution, internal clock		50ns, 12 bi	, overflows marke		rv in data stream	
Macro Timer Resolution, clock from SYNC input					entry in data stream	am
Curve Control (external Routing)				oit TTL		
External event markers Count Enable Control				it, TTL		
				bit TTL TTL		
Experiment trigger						
Experiment trigger			f images from tim	TTL e- and waveleng		
Experiment trigger ata Acquisition, FIFO / Parameter-Tag Imaging Mode Method Online display		up to 8 in	f images from tim nages in different	TTL e- and waveleng time and wavele	ength windows	
Experiment trigger Data Acquisition, FIFO / Parameter-Tag Imaging Mode Method Online display Synchronisation with scanner		up to 8 in	f images from tim nages in different me Clock, Line C	TTL e- and waveleng time and wavele lock, and Pixel (ength windows	
Experiment trigger Jata Acquisition, FIFO / Parameter-Tag Imaging Mode Method Online display		up to 8 in	f images from tim nages in different me Clock, Line C	TTL e- and waveleng time and wavele	ength windows	
Experiment trigger 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	64	up to 8 in via Fra 256	f images from tim nages in different me Clock, Line C 1 1024	TTL e- and waveleng time and wavele lock, and Pixel (to 16 4096	ength windows Clock pulses 4096	4096
Experiment trigger 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	4096 x 409	up to 8 in via Fra 256 6 2048 x 2048	f images from tim nages in different me Clock, Line C 1 1024 1024 x 1024	TTL e- and waveleng time and wavele lock, and Pixel (to 16 4096 512 x 512	ength windows Clock pulses 4096 256 x 256	128 x 128
Experiment trigger 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		up to 8 in via Fra 256 6 2048 x 2048	f images from tim nages in different me Clock, Line C 1 1024	TTL e- and waveleng time and wavele lock, and Pixel (to 16 4096	ength windows Clock pulses 4096 256 x 256	
Experiment trigger 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) Dperation Environment Computer System	4096 x 409 1024 x 102	up to 8 in via Fra 256 6 2048 x 2048 4 512 x 512	f images from tim nages in different me Clock, Line C 1 1024 1024 x 1024 256 x 256 ore, >8GB RAM a	TTL e- and waveleng time and wavelen tock, and Pixel (to 16 4096 512 x 512 128 x 128 nd 64 bit operat	ength windows Clock pulses 4096 256 x 256	128 x 128 128 x 128
Experiment trigger 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) Depration Environment Computer System Bus Connectors	4096 x 409 1024 x 102	up to 8 in via Fra 256 6 2048 x 2048 4 512 x 512	f images from tim nages in different me Clock, Line C 1 1024 1024 x 1024 256 x 256 ore, >8GB RAM a	TTL a- and waveleng time and wavele toock, and Pixel (to 16 4096 512 x 512 128 x 128 nd 64 bit operat PCI	4096 256 x 256 128 x 128	128 x 128 128 x 128
Experiment trigger 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) Dperation Environment Computer System	4096 x 409 1024 x 102	up to 8 in via Fra 256 6 2048 x 2048 4 512 x 512 C Pentium, multi-co	f images from tim nages in different me Clock, Line C 1 1024 1024 x 1024 256 x 256 ore, >8GB RAM a	TTL e- and waveleng time and wavele lock, and Pixel C to 16 4096 512 x 512 128 x 128 nd 64 bit operat PCI 1	ength windows 2lock pulses 256 x 256 128 x 128 ing system recomm	128 x 128 128 x 128
Experiment trigger bata 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) Operation Environment Computer System Bus Connectors Used PCI Slots	4096 x 409 1024 x 102	up to 8 in via Fra 256 6 2048 x 2048 4 512 x 512 C Pentium, multi-co	f images from tim nages in different me Clock, Line C 1024 1024 x 1024 256 x 256 pre, >8GB RAM a pprox. 12 W from	TTL e- and waveleng time and wavele lock, and Pixel C to 16 4096 512 x 512 128 x 128 nd 64 bit operat PCI 1	ength windows 2lock pulses 256 x 256 128 x 128 ing system recomm	128 x 128 128 x 128
Experiment trigger 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) Operation Environment Computer System Bus Connectors Used PCI Slots Total power Consumption	4096 x 409 1024 x 102	up to 8 in via Fra 256 6 2048 x 2048 4 512 x 512 C Pentium, multi-co	f images from tim nages in different me Clock, Line C 1024 1024 x 1024 256 x 256 pre, >8GB RAM a pprox. 12 W from	TTL e- and waveleng time and wavele lock, and Pixel (to 16 4096 512 × 512 128 × 128 nd 64 bit operat PCI 1 +5V, 0.7 W fron	ength windows 2lock pulses 256 x 256 128 x 128 ing system recomm	128 x 128 128 x 128
Experiment trigger 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) Deration Environment Computer System Bus Connectors Used PCI Slots Total power Consumption Dimensions Related Products SPC-150 TCSPC modules	4096 x 409 1024 x 102 Pt	up to 8 ir via Fra 256 6 2048 x 2048 4 512 x 512 C Pentium, multi-co a GaAsP and GaAs	f images from tim nages in different me Clock, Line C 1024 1024 x 1024 256 x 256 ore, >8GB RAM a oprox. 12 W from 240 mm x 1 hybrid detectors	TTL =- and waveleng time and wavele lock, and Pixel C to 16 4096 512 x 512 128 x 128 nd 64 bit operat PCI 1 +5V, 0.7 W from 30 mm x 15 mm	Angth windows 2lock pulses 4096 256 x 256 128 x 128 ing system recomm n +12V DCC-100 dete	128 x 128 128 x 128 nended actor controller
Experiment trigger 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 channels (MW FLIM detector) Deration Environment Computer System Bus Connectors Used PCI Slots Total power Consumption Dimensions Related Products SPC-150 TCSPC modules SPC-154 4-channel TCSPC modules	4096 x 409 1024 x 102 Pr HPM-100 PML-SPE	up to 8 in via Fra 256 6 2048 x 2048 4 512 x 512 C Pentium, multi-co al GaAsP and GaAs C and MW-FLIM m	f images from tim nages in different me Clock, Line C 1024 1024 x 1024 256 x 256 ore, >8GB RAM a oprox. 12 W from 240 mm x 1 hybrid detectors ulti-wavelength d	TTL =- and waveleng time and wavele lock, and Pixel C to 16 4096 512 x 512 128 x 128 nd 64 bit operat PCI 1 +5V, 0.7 W from 30 mm x 15 mm	ngth windows clock pulses 4096 256 x 256 128 x 128 ing system recomm n +12V	128 x 128 128 x 128 nended actor controller
Experiment trigger 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 channels (MW FLIM detector) Detector channels (MW FLIM detector) Detector channels (MW FLIM detector) Detector channels Computer System Bus Connectors Used PCI Slots Total power Consumption Dimensions Celated Products SPC-150 TCSPC modules SPC-154 4-channel TCSPC modules Simple-Tau compact TCSPC systems	4096 x 409 1024 x 102 Pr HPM-100 PML-SPE PMC-100	up to 8 in via Fra 256 6 2048 x 2048 4 512 x 512 C Pentium, multi-co a GaAsP and GaAs C and MW-FLIM m cooled PMT modu	f images from tim nages in different me Clock, Line C 1024 1024 x 1024 256 x 256 ore, >8GB RAM a oprox. 12 W from 240 mm x 1 hybrid detectors ulti-wavelength d les	TTL =- and waveleng time and wavele lock, and Pixel C to 16 4096 512 x 512 128 x 128 nd 64 bit operat PCI 1 +5V, 0.7 W from 30 mm x 15 mm	Angth windows 2lock pulses 4096 256 x 256 128 x 128 ing system recomm n +12V DCC-100 dete	128 x 128 128 x 128 nended actor controller
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Experiment trigger 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) Deration Environment Computer System Bus Connectors Used PCI Slots Total power Consumption Dimensions Related Products SPC-150 TCSPC modules SPC-150 TCSPC modules Simple-Tau compact TCSPC systems FLIM systems for laser scanning microscopes	4096 x 409 1024 x 102 Pr HPM-100 PML-SPE PMC-100	up to 8 in via Fra 256 6 2048 x 2048 4 512 x 512 C Pentium, multi-co a GaAsP and GaAs C and MW-FLIM m cooled PMT modu	f images from tim nages in different me Clock, Line C 1024 1024 x 1024 256 x 256 ore, >8GB RAM a oprox. 12 W from 240 mm x 1 hybrid detectors ulti-wavelength d les es	TTL =- and waveleng time and waveleng lock, and Pixel C to 16 4096 512 x 512 128 x 128 nd 64 bit operat PCI 1 +5V, 0.7 W from 30 mm x 15 mm etectors	Angth windows 2lock pulses 4096 256 x 256 128 x 128 ing system recomm n +12V DCC-100 dete	128 x 128 128 x 128 nended actor controller
Experiment trigger 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 channels (MW FLIM detector) Deration Environment Computer System Bus Connectors Used PCI Slots Total power Consumption Dimensions Related Products SPC-150 TCSPC modules Simple-Tau compact TCSPC systems FLIM systems for laser scanning microscopes DCS-120 confocal scanning FLIM system Related Literature W. Becker, Advanced time-correlated single photon count	4096 x 409 1024 x 102 Pri HPM-100 PML-SPE PMC-100 id-100 SP.	up to 8 ir via Fra 256 6 2048 x 2048 4 512 x 512 C Pentium, multi-cu al GaAsP and GaAs C and MW-FLIM m Cooled PMT modu AD detector modul	f images from tim nages in different me Clock, Line C 1024 1024 x 1024 256 x 256 ore, >8GB RAM a oprox. 12 W from 240 mm x 1 hybrid detectors ulti-wavelength d les es BDL-SMN p e contact bh for a	TTL e- and waveleng time and waveleng time and waveleng lock, and Pixel C to 16 4096 512 x 512 128 x 128 nd 64 bit operat PCI 1 +5V, 0.7 W from 30 mm x 15 mm etectors os diode lasers vailability.	Angth windows 200ck pulses 4096 256 x 256 128 x 128 ing system recomm n +12V DCC-100 dete GVD-120 scar	128 x 128 128 x 128 nended actor controller
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Experiment trigger 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 channels (MW FLIM detector) Deration Environment Computer System Bus Connectors Used PCI Slots Total power Consumption Dimensions Related Products Simple-Tau compact TCSPC modules Simple-Tau compact TCSPC modules Simple-Tau compact TCSPC systems FLIM systems for laser scanning microscopes DCS-120 confocal scanning FLIM system Related Literature W. Becker, Advanced time-correlated single photon count Count Counter M. Becker, Advanced time-correlated single photon count Counter C	4096 x 409 1024 x 102 Pr HPM-100 PML-SPE PMC-100 id-100 SP. ing techniques. Sp ges, 823 reference gle photon counti	up to 8 ir via Fra 256 6 2048 x 2048 4 512 x 512 C Pentium, multi-co al GaAsP and GaAs C and MW-FLIM m cooled PMT modu AD detector modul ringer 2005. Pleas s. Available on wm ng. User handboof	f images from tim nages in different me Clock, Line C 1024 1024 x 1024 256 x 256 ore, >8GB RAM a oprox. 12 W from 240 mm x 1 hybrid detectors ulti-wavelength d les es BDL-SMN e contact bh for a w.becker-hickl.cc	TTL e- and waveleng time and wavele lock, and Pixel (to 16 4096 512 x512 128 x 128 nd 64 bit operat PCI 1 +5V, 0.7 W from 30 mm x 15 mm etectors os diode lasers vailability. m. Contact bh fi	Augh windows Auge 256 x 256 128 x 128 ang system recomm n +12V DCC-100 dete GVD-120 scar pr printed copies.	128 x 128 128 x 128 nended actor controller
Experiment trigger 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 channel (MW FLIM detector) Deration Environment Computer System Bus Connectors Used PCI Slots Total power Consumption Dimensions Pelated Products SPC-150 TCSPC modules SPC-154 4-channel TCSPC systems FLIM system for laser scanning microscopes DCS-120 confocal scanning FLIM system Paleker, The bh TCSPC Handbook, 5th edition. 690 pa	4096 x 409 1024 x 102 Pr HPM-100 PML-SPEr PMC-100 id-100 SP ing techniques. Sp ges, 823 reference ngle photon counti vailable on ww.be ser scanning micro	up to 8 ir via Fra 256 6 2048 x 2048 4 512 x 512 C Pentium, multi-cr 2 GaAsP and GaAs C and MW-FLIM m cooled PMT modu AD detector modul ringer 2005. Pleas s. Available on w ng. User handbook icker-hickl.com sscopes, handbook	f images from tim nages in different me Clock, Line C 1024 1024 x 1024 256 x 256 ore, >8GB RAM a oprox. 12 W from 240 mm x 1 hybrid detectors ulti-wavelength d les es BDL-SMN j e contact bh for a w.becker-hickl.cc c. Available on w	TTL e- and waveleng time and waveleng time and waveleng to the and waveleng to the and waveleng to the and waveleng 512 x 512 128 x 128 128 x 128 148 x 128 164 bit operat PCI 1 +5V, 0.7 W from 30 mm x 15 mm etectors bis diode lasers vailability. m. Contact bh fi w.becker-hickl.	Aught windows Aught windows 256 x 256 128 x 128 ang system recomm a +12V DCC-100 dete GVD-120 scar pr printed copies. com	128 x 128 128 x 128 hended ector controller h controller

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

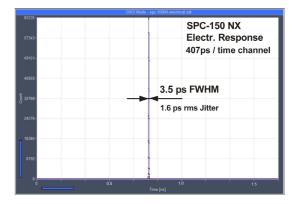
SPC-150NX

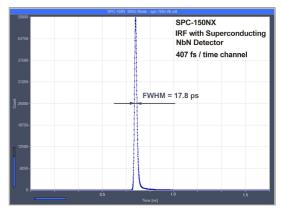
TCSPC / FLIM Module

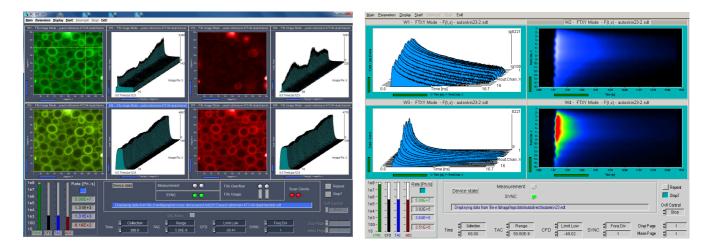
Time-Correlated Single Photon Counting Module for Ultra-Fast Detectors

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 Ca²⁺ transients fNIRS and NIRS experiments Single-molecule spectroscopy FCS, FCCS, PCH









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



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

SPC-150NX

TCSPC / FLIM Module

Photon Channel Constant Fraction Discriminator (CFD) Principle Discriminator Input Bandwidth 4 GHz 3.3 ps / 1.6 ps <1 ps over 50 seconds - 30 mV to - 500 mV Time Resolution (FWHM / RMS, electr.) Variance in time of IRF maximum Optimum Input Voltage Range Min. Input Pulse Width 200 ps 0 to - 250 mV - 100 mV to + 100 mV Threshold Zero Cross Adjust Synchronisation Channels Constant Fraction Discriminator (CFD) Principle Discriminator Input Bandwidth Optimal Input Voltage Range 4 GHz - 30 mV to - 500 mV Min. Input Pulse Width Threshold 200 ps 0 to -250 mV Frequency Range SYNC Frequency Divide 0 to 150 MHz 1 - 2 - 4 -100 mV to + 100 mV Zero Cross Adjust Time-to-Amplitude Converters / ADCs Ramp Generator / Biased Amplifier Principle TAC Range 25 ns to 2.5 us Biased Amplifier Gain Biased Amplifier Offset 1 to 15 0 to 50% of TAC Range Time Range incl. Biased Amplifier min. Time / Channel ADC Principle 1.67 ns to 2.5 us 407 fs 50 ns Flash ADC with Error Correction Diff. Nonlinearity, electrical < 0.5% rms, typ. <1% peak-peak Data Acquisition (Histogram Modes) Method on-board multi-dimensional hardware histogramming process 100 ns, independent of computer speed Dead Time 10 MHz 5 MHz 2¹⁶-1 none / stop / repeat and correct Saturated Count Rate Useful count rate max. Counts / Time Channel (counting depth) Overflow Control 0.1 us to 100,000 s 0.1 us to 100,000 s Collection Time Display Interval Time 0.1 us to 100.000 s Repeat Time Sequential Recording Synchronisation with Scanning Programmable Hardware Sequencer, unlimited recording by memory swapping, in curve mode and scan mode pixel, line and frame clocks from scanning device Routing 7 bit TTL Experiment Trigger TTL Data Acquisition (FIFO / Parameter-Tag Mode) Parameter-tagging of individual photons and continuous writing to disk Method Online display Decay function, FCS, Cross-FCS, PCH, MCS traces Multi-tau algorithm, online calculation and online fit FCS calculation unlimited 100 ns Number of counts of decay / waveform recording Dead Time Saturated count rate, peak 10 MHz Sustained count rate (bus-transfer limited) typ. 4 MHz max. counts / time cChannel (counting depth) Output Data Format (ADC / Macrotime / Routing) unlimited 12 / 12 / 4 bit 2.10⁶ FIFO buffer Capacity (photons) Macro Timer Resolution, internal clock 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 Macro Timer Resolution, clock from SYNC input 4 bit TTL Routing External event markers 4 bit. TTL TTL Experiment trigger Data Acquisition, FIFO / Parameter-Tag Imaging Mode Buildup of images from time- and wavelength tagged data up to 8 images in different time and wavelength windows Method Online display Synchronisation with scanner Detector / Wavelength Channels via Frame Clock, Line Clock, and Pixel Clock pulses 1 to 16 Image resolution, 64-bit SPCM software No of time channels 64 256 1024 4096 No. of pixels, 1 detector channel No. of pixels, 16 detector channels 4096 x 4096 1024 x 1024 512 x 512 128 x 128 2048 x 2048 1024 x 1024 512 x 512 256 x 256 **Operation Environment** Computer System PC Pentium, multi-core, >8GB RAM and 64 bit operating system recommended Bus Connectors PCI Used PCI Slots approx. 12 W from +5V, 0.7 W from +12V Total power Consumption Dimensions 240 mm x 130 mm x 15 mm Related Products HPM-100 GaAsP and GaAs hybrid detectors SPC-150N TCSPC modules DCC-100 detector controlle Simple-Tau 150 compact TCSPC systems Simple-Tau 154 compact 4-channel TCSPC systems PML-SPEC and MW-FLIM multi-wavelength detectors BDL-SMN ps diode lasers PMC-100 cooled PMT modules BDS-SM, -SMY, -MM picosecond diode lasers DCS-120 confocal scanning FLIM system id-100 SPAD detector modules

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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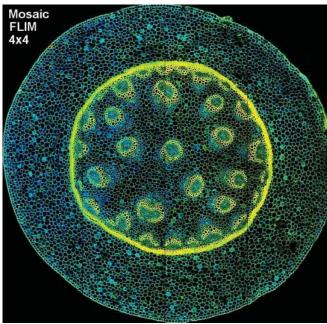
TCSPC Module

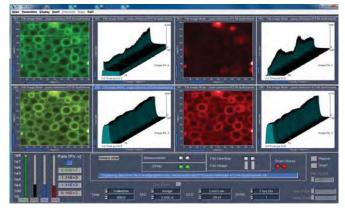
SPC-160

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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SPC-160

Photon Channel Principle Discriminator Input Bandwidth Time Resolution (FWHM / RMS, electr.) Variance in time of IRF maximum								
Discriminator Input Bandwidth Time Resolution (FWHM / RMS, electr.) Variance in time of IRF maximum	Consta	nt Erootic	n Diagriminator			50.0		
Time Resolution (FWHM / RMS, electr.) Variance in time of IRF maximum	Consta		n Discriminator 4 GHz	(CFD)				IRF stability
			os / 2.5 ps					over 50 s
			er 50 seconds			43.8+		0.5s per
Optimum Input Voltage Range			/ to - 500 mV					recording
Min. Input Pulse Width Threshold			200 ps - 250 mV			37.6		
Zero Cross Adjust			/ to + 100 mV					
ynchronisation Channels								
Principle	Consta	nt Fractio	n Discriminator	(CFD)		31.4-		
Discriminator Input Bandwidth			4 GHz					
Optimal Input Voltage Range			/ to - 500 mV			The second		10 ps
Min. Input Pulse Width Threshold			200 ps -250 mV			25.2		
Frequency Range			150 MHz			No.		
Frequency Divider			1-2-4			19.1-		
Zero Cross Adjust		-100 m\	/ to + 100 mV					FWHM 6.6 ps
ime-to-Amplitude Converters / ADCs						and the second se		Variance in
Principle	Ramp		or / Biased Amp	ifier		12.9-		IRF maximum
TAC Range Biased Amplifier Gain			ns to 5 us I to 15					time 0.8 ps
Biased Amplifier Offset			of TAC Range			6.7-		
Time Range incl. Biased Amplifier			ns to 5 us			22/10		
min. Time / Channel	50		813 fs					
ADC Principle Diff. Nonlinearity, electrical			C with Error Corre yp. <1% peak-pe			2140 2144 2	40 2152 2166 2160	2 164 2 166 2 172 2 176
	< 0.:	270 I IIIS, T	yp. <1 /₀ peak-pe	an			Timut (ins	1
ata Acquisition (Histogram Mode) Method			on-board mi	Iti-dimensional I	nietoarommina	DIOCOSC		
Dead Time				independent of				
Saturated Count Rate				12.5 Mł				
Useful count rate				6.25 MH	Ηz			
Channels / Pixel	4096	1024	256	64	16 510×510	4	1	49
max. Scanning Area max. Counts / Time Channel	16x16	64x64	128 x 128	256x256 2 ¹⁶ -1	512x512	1024x1024	2048x20	40
Overflow Control			no	ne / stop / repea	at and correct			
Collection Time				0.1 us to 100	0,000 s			
Display Interval Time				0.1 us to 100				
Repeat Time Sequential Recording	Programmable H	lardwara	Sequencer unlir	0.1 us to 100		apping in curv	a mode and sca	mode
Synchronisation with Scanning	i iogrammable i	aluwale		nd frame clocks			e mode and sca	THIODE
Count Enable Control			F	1 bit TT		5		
Experiment Trigger				TTL				
ata Acquisition (FIFO / Parameter-Tag Mode)								
Method		Parar	neter-tagging of i				lisk	
Online display FCS calculation				on, FCS, Cross- orithm, online ca				
Number of counts of decay / waveform recording			wun-tau alg	unlimite		onine ni		
Dead Time				100 ns				
Saturated count rate, peak				10 MH				
Sustained count rate (bus-transfer limited)				typ. 4 M				
Output Data Format (ADC / Macrotime / Routing) FIFO buffer Capacity (photons)				12 / 12 / 2 M	4			
Macro Timer Resolution, internal clock		5	0ns, 12 bit, over		MTOF entry	in data stream		
Macro Timer Resolution, clock from SYNC input			to 100ns, 12 bit,				am	
Curve Control (external Routing)				4 bit T1		-		
External event markers				4 bit, T				
Count Enable Control				1 bit TT TTL	L			
Experiment trigger				116				
ata Acquisition, FIFO / Parameter-Tag Imaging Mode Method	1		Buildup of imag	es from time- on	d wavelength	tagged data		
Online display			up to 8 images					
				ock, Line Clock,	and Pixel Clo			
Synchronisation with scanner				1 to 16	6			
Synchronisation with scanner Detector / Wavelength Channels	64		256	1024	4096	4096	4096	
Synchronisation with scanner Detector / Wavelength Channels Image size in FIFO Imaging Mode (64 bit software)		~ ~				4096 256 x 256	4096 128 x 128	
Synchronisation with scanner Detector / Wavelength Channels Image size in FIFO Imaging Mode (64 bit software) time channels / jixel	64 4096 x 40	96 204				128 x 128	128 x 128	
Synchronisation with scanner Detector / Wavelength Channels Image size in FIFO Imaging Mode (64 bit software)	4096 x 40 1024 x 10			6 x 256 12	8 x 128	120 X 120		
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) peration Environment	4096 x 40 1024 x 10	24 5´	2 x 512 25					
Synchronisation with scanner Detector / Wavelength Channels Image size in FIFO Imaging Mode (64 bit software) time channels / jixel 1 detector channel 16 detector channels (MW FLIM detector) peration Environment Computer System	4096 x 40 1024 x 10	24 5´		GB RAM and 6			mended	
Synchronisation with scanner Detector / Wavelength Channels Image size in FIFO Imaging Mode (64 bit software) time channels / pixel 1 detector channels (MW FLIM detector) peration Environment Computer System Bus Connectors	4096 x 40 1024 x 10	24 5´	2 x 512 25	GB RAM and 6 PCI			mended	
Synchronisation with scanner Detector / Wavelength Channels Image size in FIFO Imaging Mode (64 bit software) time channels / pixel 16 detector channel 16 detector channels (MW FLIM detector) peration Environment Computer System Bus Connectors Used PCI Slots	4096 x 40 1024 x 10	24 5´	2 x 512 25 m, multi-core, >8	GB RAM and 6 PCI 1	4 bit operating	system recomi	mended	
Synchronisation with scanner Detector / Wavelength Channels Image size in FIFO Imaging Mode (64 bit software) time channels / pixel 1 detector channels 16 detector channels (MW FLIM detector) peration Environment Computer System Bus Connectors	4096 x 40 1024 x 10	24 5´	2 x 512 25 m, multi-core, >8 approx.	GB RAM and 6 PCI	4 bit operating , 0.7 W from +	system recomi	nended	
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) peration Environment Computer System Bus Connectors Used PCI Slots Total power Consumption Dimensions	4096 x 40 1024 x 10	24 5´	2 x 512 25 m, multi-core, >8 approx.	GB RAM and 6 PCI 1 12 W from +5V	4 bit operating , 0.7 W from +	system recomi	nended	
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) peration Environment Computer System Bus Connectors Used PCI Slots Total power Consumption Dimensions	4096 x 40 1024 x 10 F HPM-100	24 5 [°] PC Pentiu) GaAsP ;	2 x 512 25 m, multi-core, >8 approx.	GB RAM and 6 PCI 1 12 W from +5V 312 mm x 130 m detectors	4 bit operating , 0.7 W from + m x 15 mm	system recom	nended ector controller	
Synchronisation with scanner Detector / Wavelength Channels Image size in FIFO Imaging Mode (64 bit software) time channels / pixel 1 detector channels (MW FLIM detector) peration Environment Computer System Bus Connectors Used PCI Slots Total power Consumption Dimensions elated Products SPC-150 and SPC-150N TCSPC modules SPC-150 and SPC-150N TCSPC modules	4096 x 40 1024 x 10 F HPM-100 PML-SPE	24 5 [°] PC Pentiu) GaAsP : EC and M	2 x 512 25 m, multi-core, >8 approx. and GaAs hybrid W-FLIM multi-wa	GB RAM and 6 PCI 1 12 W from +5V 312 mm x 130 m detectors	4 bit operating , 0.7 W from + m x 15 mm	9 system recomi 12V DCC-100 det GVD-120 sca	ector controller n controller	
Synchronisation with scanner Detector / Wavelength Channels Image size in FIFO Imaging Mode (64 bit software) time channels / pixel 16 detector channels (MW FLIM detector) peration Environment Computer System Bus Connectors Used PCI Slots Total power Consumption Dimensions elated Products SPC-150 and SPC-150N TCSPC modules SPC-154 4-channel TCSPC modules Simple-Tau compact TCSPC systems	4096 x 40 1024 x 10 F HPM-100 PML-SPE PMC-100	24 5 ⁴ PC Pentiu) GaAsP ; EC and M) cooled F	2 x 512 25 m, multi-core, >8 approx. and GaAs hybrid W-FLIM multi-wa PMT modules	GB RAM and 6 PCI 1 12 W from +5V 312 mm x 130 m detectors	4 bit operating , 0.7 W from + m x 15 mm	9 system recomi 12V DCC-100 det GVD-120 sca	ector controller	nodule
Synchronisation with scanner Detector / Wavelength Channels Image size in FIFO Imaging Mode (64 bit software) time channels / pixel 16 detector channels (MW FLIM detector) peration Environment Computer System Bus Connectors Used PCI Slots Total power Consumption Dimensions elated Products SPC-150 and SPC-150N TCSPC modules SPC-154 4-channel TCSPC modules Simple-Tau compact TCSPC modules FLIM systems for laser scanning microscopes	4096 x 40 1024 x 10 F HPM-100 PML-SPE PMC-100 id-100 ST	24 5 PC Pentiu) GaAsP : EC and M) cooled F PAD dete	2 x 512 25 m, multi-core, >8 approx. and GaAs hybrid W-FLIM multi-wa 2MT modules cor modules	GB RAM and 6 PCI 1 2 W from +5V 312 mm x 130 m detectors avelength detect	4 bit operating , 0.7 W from + m x 15 mm	9 system recomi 12V DCC-100 det GVD-120 sca	ector controller n controller	nodule
Synchronisation with scanner Detector / Wavelength Channels Image size in FIFO Imaging Mode (64 bit software) time channels / pixel 16 detector channels (MW FLIM detector) peration Environment Computer System Bus Connectors Used PCI Slots Total power Consumption Dimensions elated Products SPC-150 and SPC-150N TCSPC modules SPC-154 4-channel TCSPC modules Simple-Tau compact TCSPC modules FLIM systems for laser scanning microscopes DCS-120 confocal scanning FLIM system	4096 x 40 1024 x 10 F HPM-100 PML-SPE PMC-100 id-100 ST	24 5 PC Pentiu) GaAsP : EC and M) cooled F PAD dete	2 x 512 25 m, multi-core, >8 approx. and GaAs hybrid W-FLIM multi-wa PMT modules	GB RAM and 6 PCI 1 2 W from +5V 312 mm x 130 m detectors avelength detect	4 bit operating , 0.7 W from + m x 15 mm	9 system recomi 12V DCC-100 det GVD-120 sca	ector controller n controller	nodule
Synchronisation with scanner Detector / Wavelength Channels Image size in FIFO Imaging Mode (64 bit software) time channels / pixel 1 detector channels (MW FLIM detector) peration Environment Computer System Bus Connectors Used PCI Slots Total power Consumption Dimensions elated 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 elated Literature	4096 x 40 1024 x 10 F HPM-100 PML-SPE PMC-100 id-100 SF BDL-SMI	24 5 PC Pentiu C Pentiu	2 x 512 25 m, multi-core, >8 approx. and GaAs hybrid W-FLIM multi-wa MT modules ctor modules S ps diode laser	IGB RAM and 6 PCI 12 W from +5V 312 mm x 130 m detectors avelength detect	4 bit operating , 0.7 W from + m x 15 mm tors	9 system recomi 12V DCC-100 det GVD-120 sca	ector controller n controller	nodule
Synchronisation with scanner Detector / Wavelength Channels Image size in FIFO Imaging Mode (64 bit software) time channels / pixel 16 detector channels (MW FLIM detector) operation Environment Computer System Bus Connectors Used PCI Slots Total power Consumption Dimensions telated Products SPC-150 and SPC-150N TCSPC modules SPC-154 4-channel TCSPC modules SPC-124 channel TCSPC modules SPC-120 confocal scanning microscopes DCS-120 confocal scanning FLIM system telated Literature W. Becker, Advanced time-correlated single photon co	4096 x 40 1024 x 10 F HPM-100 PML-3PE PMC-100 id-100 SF BDL-SMt punting techniques. Sj	24 5 PC Pentiu PG C Pentiu C C and M C cooled F PAD dete N and BD pringer 2	2 x 512 25 m, multi-core, >8 approx. and GaAs hybrid W-FLIM multi-wa PMT modules ctor modules S ps diode lasen 005. Please cont	IGB RAM and 6 PCI 1 12 W from +5V 112 mm x 130 m detectors avelength detect s act bh for availa	4 bit operating , 0.7 W from + m x 15 mm tors bility.	DCC-100 det GVD-120 sca DB-32 USB-c	ector controller n controller	nodule
Synchronisation with scanner Detector / Wavelength Channels Image size in FIFO Imaging Mode (64 bit software) time channels / pixel 1 detector channels (MW FLIM detector) peration Environment Computer System Bus Connectors Used PCI Slots Total power Consumption Dimensions elated 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 elated Literature	4096 x 40 1024 x 10 F HPM-100 PML-SPE PMC-100 id-100 ST BDL-SMf punting techniques. Sj pages, 823 reference	24 5 PC Pentiu C Pentiu C GaAsP : C and M C cooled F PAD dete V and BD pringer 2 es. Availa	2 x 512 25 m, multi-core, >5 approx. and GaAs hybrid W-FLIM multi-wa MT modules S ps diode laser 205. Please cont able on www.bec	IGB RAM and 6 PCI 1 12 W from +5V 312 mm x 130 m detectors avelength detect s act bh for availa ker-hickl.com. C	4 bit operating , 0.7 W from + m x 15 mm ors bility. contact bh for	12V DCC-100 det GVD-120 sca DB-32 USB-co	ector controller n controller	nodule
Synchronisation with scanner Detector / Wavelength Channels Image size in FIFO Imaging Mode (64 bit software) time channels / pixel 16 detector channels (MW FLIM detector) peration Environment Computer System Bus Connectors Used PCI Slots Total power Consumption Dimensions elated Products SPC-150 and SPC-150N TCSPC modules SPC-154 4-channel TCSPC modules SPC-154 4-channel TCSPC modules SPC-124 compact TCSPC systems FLIM systems for laser scanning microscopes DCS-120 confocal scanning FLIM system elated Literature W. Becker, Advanced time-correlated single photon co W. Becker, The bh TCSPC Handbook, 5th edition. 690 PML-16-C 16 channel detector head for time-correlated DCS-120 Confocal Scanning FLIM Systems, handbook	4096 x 40 1024 x 10 F HPM-100 PML-3PE PMC-100 id-100 Sf BDL-SMf bunting techniques. Sj pages, 823 referenc d single photon count c. Available on www.t	24 5 24 5 26 Pentiu 9 GaAsP 25 and M 9 cooled F 2AD dete N and BD pringer 2 es. Availa ing. Use ing. Use	2 x 512 25 m, multi-core, >8 approx. and GaAs hybrid W-FLIM multi-wa PMT modules ctor modules S ps diode lasen 005. Please cont able on www.bec handbook. Avai kl.com	IGB RAM and 6 PCI 1 12 W from +5V 112 mm x 130 m detectors avelength detect s act bh for availa ker-hickl.com. C lable on www.be	4 bit operating , 0.7 W from + m x 15 mm tors billity. contact bh for acker-hickl.con	DCC-100 det GVD-120 sca DB-32 USB-c printed copies.	ector controller n controller	nodule
Synchronisation with scanner Detector / Wavelength Channels Image size in FIFO Imaging Mode (64 bit software) time channels / pixel 1 detector channels (MW FLIM detector) peration Environment Computer System Bus Connectors Used PCI Slots Total power Consumption Dimensions elated Products SPC-150 and SPC-150N TCSPC modules SPC-154 4-channel TCSPC modules SPC-154 4-channel TCSPC modules SPC-154 4-channel TCSPC modules SPC-150 confocal scanning FLIM system elated Literature W. Becker, Advanced time-correlated single photon co W. Becker, The bh TCSPC Handbook, 5th edition. 690 PML-16-C 16 channel detector head for time-correlated DCS-120 Confocal Scanning FLIM Systems, handbook Modular FLIM systems for Zeiss LSM 510 and LSM 711	4096 x 40 1024 x 10 F HPM-100 PML-SPE PMC-100 id-100 ST BDL-SMf pages, 823 referenc d single photon count c. Available on www.b 0 laser scanning mic	24 5 PC Pentiu) GaAsP : EC and M) cooled F PAD dete N and BD pringer 2 es. Avail: ing. User vecker-hio roscopes	2 x 512 25 m, multi-core, >8 approx. and GaAs hybrid W-FLIM multi-wa PMT modules ctor modules S ps diode lasen 005. Please cont able on www.bec handbook. Avai kl.com	IGB RAM and 6 PCI 1 12 W from +5V 112 mm x 130 m detectors avelength detect s act bh for availa ker-hickl.com. C lable on www.be	4 bit operating , 0.7 W from + m x 15 mm tors billity. contact bh for acker-hickl.con	DCC-100 det GVD-120 sca DB-32 USB-c printed copies.	ector controller n controller	nodule
Synchronisation with scanner Detector / Wavelength Channels Image size in FIFO Imaging Mode (64 bit software) time channels / pixel 16 detector channels (MW FLIM detector) peration Environment Computer System Bus Connectors Used PCI Slots Total power Consumption Dimensions elated Products SPC-150 and SPC-150N TCSPC modules SPC-154 4-channel TCSPC modules SPC-154 4-channel TCSPC modules SPC-124 compact TCSPC systems FLIM systems for laser scanning microscopes DCS-120 confocal scanning FLIM system elated Literature W. Becker, Advanced time-correlated single photon co W. Becker, The bh TCSPC Handbook, 5th edition. 690 PML-16-C 16 channel detector head for time-correlated DCS-120 Confocal Scanning FLIM Systems, handbook	4096 x 40 1024 x 10 F HPM-100 PML-SPE PMC-100 id-100 SM BDL-SM butting techniques. SI pages, 823 reference d single photon counf c. Available on www.tb 0 laser scanning mici 0 laser scanning mici 0 laser scanning mici	24 5 PC Pentiu) GaAsP : EC and M) cooled F PAD dete N and BD pringer 2 es. Avail: ing. User vecker-hio roscopes	2 x 512 25 m, multi-core, >8 approx. and GaAs hybrid W-FLIM multi-wa PMT modules ctor modules S ps diode lasen 005. Please cont able on www.bec handbook. Avai kl.com	IGB RAM and 6 PCI 1 12 W from +5V 112 mm x 130 m detectors avelength detect s act bh for availa ker-hickl.com. C lable on www.be	4 bit operating , 0.7 W from + m x 15 mm tors billity. contact bh for acker-hickl.con	DCC-100 det GVD-120 sca DB-32 USB-c printed copies.	ector controller n controller	nodule

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

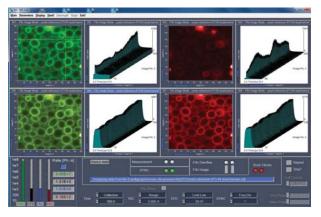
SPC-160 PCIE TCSPC/ FLIM Module

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 Ca²⁺ transients

fNIRS and NIRS experiments Single-molecule spectroscopy FCS, FCCS, Photon Counting Histograms Anti-bunching experiments





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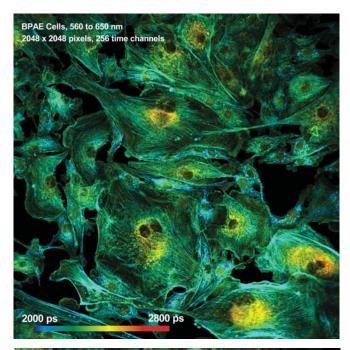
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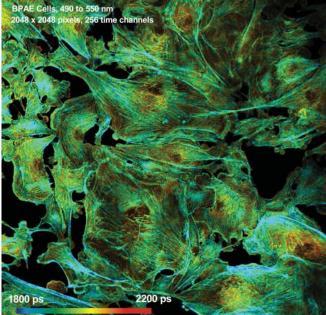
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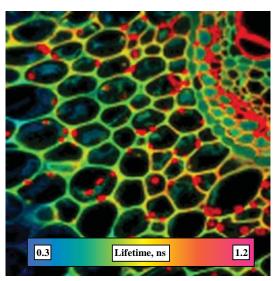
SPC-160 PCIE TCSPC / FLIM Module

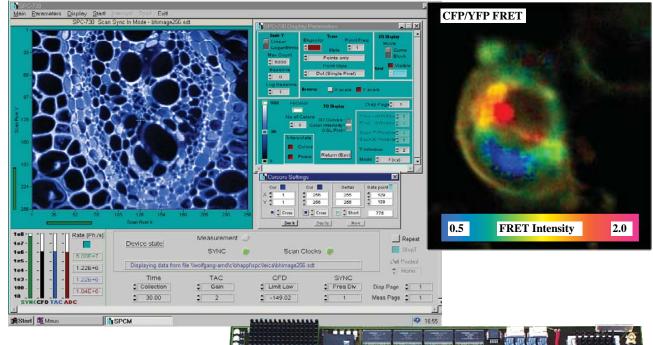
Principle Discriminator Input Bandwidth Time Resolution (FWHM / RMS, electr.) Variance in time of IRF maximum Optimum Input Voltage Range Min. Input Voltage Range Min. Input Pulse Width Threshold Zero Cross Adjust	<1 -	Fraction Discrimin 4 GHz 6.6 ps / 2.5 ps ps over 50 seco 30 mV to - 500 n 200 ps 0 to - 250 mV 100 mV to + 100	nds nV		50.0- 43.8- 37.6-		IRF stability over 50 s 0.5s per recording
ynchronisation Channels		100 1117 10 + 100	iii v				
Principle Discriminator Input Bandwidth	Constant	Fraction Discrimir 4 GHz	nator (CFD)		31.4-		
Optimal Input Voltage Range Min. Input Pulse Width	-	30 mV to - 500 n 200 ps	۱V		100		10 ps
Threshold		0 to -250 mV			25.2-		HO PS
Frequency Range Frequency Divider		0 to 150 MHz 1-2-4					
Zero Cross Adjust	-1	00 mV to + 100 r	nV		19.1 -		FWHM 6.6 ps
me-to-Amplitude Converters / ADCs Principle	Ramp G	enerator / Biased	Amplifier		12.9-		Variance in IRF maximur
TAC Range Biased Amplifier Gain		50 ns to 5 us 1 to 15					time 0.8 ps
Biased Amplifier Offset Time Range incl. Biased Amplifier	0 t	o 50% of TAC Ra 3.3 ns to 5 us	inge		6.7-		
min. Time / Channel		813 fs					
ADC Principle Diff. Nonlinearity, electrical		sh ADC with Error rms, typ. <1% pe			0.5-	, aire aire aire aire :	nie nie nie nie
ata Acquisition (Histogram Mode)						4 2.148 2.152 2.196 2.160 ; Time [ns]	2.164 2.168 2.172 2.176
Method Dead Time				ional histogrammi ent of computer sp			
Saturated Count Rate Useful count rate			12	2.5 MHz 25 MHz			
Channels / Pixel		024 256	64	16	4	1	
max. Scanning Area max. Counts / Time Channel	16x16 64	4x64 128 x 1		56 512x512 2 ¹⁶ -1	1024x10)24 2048x204	8
Overflow Control Collection Time				repeat and correct to 100,000 s	ct		
Display Interval Time			0.1 us	to 100,000 s			
Repeat Time Sequential Recording	Programmable Har	dware Sequencer		to 100,000 s rding by memory :	swapping, in cu	urve mode and scan	mode
Synchronisation with Scanning	- 3	pixel,	line and frame c	locks from scann	ing device		
Count Enable Control Experiment Trigger			1	bit TTL TTL			
ata Acquisition (FIFO / Parameter-Tag Mode) Method		Doromotor toggi	og of individual r	abatana and aanti	nuovo viriting t	a diak	
Online display		Decay	unction, FCS, C	photons and conti cross-FCS, PCH,	MCS traces	U UISK	
FCS calculation Number of counts of decay / waveform recording		Multi-ta		line calculation ar nlimited	id online fit		
Dead Time				80 ns			
Saturated count rate, peak Sustained count rate (bus-transfer limited)			typ	2.5 MHz o. 4 MHz			
Output Data Format (ADC / Macrotime / Routing) FIFO buffer Capacity (photons)			12	2/12/4 2M			
Macro Timer Resolution, internal clock Macro Timer Resolution, clock from SYNC input				ed by MTOF entr marked by MTOF			
Curve Control (external Routing)			4	bit TTL	entry in data s	sileani	
External event markers Count Enable Control				bit, TTL bit TTL			
Experiment trigger				TTL			
ata Acquisition, FIFO / Parameter-Tag Imaging Mode Method		Buildup of	images from tim	ne- and waveleng	th tanned data		
Online display		up to 8 ga	ated intensity im	ages or up to 8 lif	etime images		
Synchronisation with scanner Dead Time				Clock, and Pixel C tensity Channel:			
Detector / Wavelength Channels Image size in FIFO Imaging Mode (64 bit software)			1	1 to 16			
time channels / pixel	64	256	1024	4096	4096	4096	
No. of pixels, 1 detector channel No. of pixels, 16 detector channels (MW FLIM detector)	4096 x 4096 1024 x 1024	2048 x 2048 512 x 512	1024 x 1024 256 x 256	512 x 512 128 x 128	256 x 256 128 x 128	128 x 128 128 x 128	
peration Environment							
Computer System Bus Connectors	PC	Pentium, multi-co	re, >8GB RAM a	and 64 bit operati PCI	ng system reco	ommended	
Used PCI Slots				1			
Total power Consumption Dimensions		ap		n +5V, 0.7 W from 130 mm x 15 mm	i +12V		
elated Products							
SPC-160 TCSPC / FLIM modules SPC-150 and SPC-150N TCSPC modules		nfocal scanning I aAsP and GaAs I				and BDS ps diode la detector controller	asers
Simple-Tau compact TCSPC systems	PML-SPEC	and MW-FLIM m 20 Si and InGaAs	ulti-wavelength o		GVD-120 s	scan controller	odule
FLIM systems for laser scanning microscopes elated Literature	iu-100, id-22	o orand ingaAs	SPAD detector	modules	DD-32 USI	B-controlled delay m	ouule
W. Becker, Advanced time-correlated single photon countin W. Becker (ed.), Advanced time-correlated single photon co W. Becker, The bh TCSPC Handbook, 6th edition, 2015. 76	unting pplications. 8 pages, 1007 refe	Springer 2015. P rences. Available	lease contact bh	n for availability.	act bh for printe	ed copies.	
DCS-120 Confocal Scanning FLIM Systems, handbook. Ava Modular FLIM systems for Zeiss LSM 510 and LSM 710 last	mable of www.bec	Kei-HICKI.COM					

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



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	Ormation Franting Disoriesiantes
Principle	Constant Fraction Discriminator
Time Resolution (FWHM / RMS, electr.)	7 ps / 4 ps
Opt. Input Voltage Range	- 50 mV to - 1 V
Min. Input Pulse Width	400 ps - 20 mV to - 500 mV
Lower Threshold	- 100 mV to + 100 mV
Zero Cross Adjust	
Synchronisation Channel	
Principle	Constant Fraction Discriminator
Opt. Input Voltage Range	- 50 mV to - 1 V
Min. Input Pulse Width	400 ps
Threshold	- 20 mV to -500 mV
Frequency Range	0 to 200 MHz
Frequency Divider	1-2-4-8-16
Zero Cross Adjust	-100 mV to + 100 mV
Time to Amplitude Convertor (ADC	
Time-to-Amplitude Converter / ADC	Dome Concreter / Biscord Amplifier
	Ramp Generator / Biased Amplifier 50 ns to 2 us
TAC Range Biased Amplifier Gain	1 to 15
Biased Amplifier Offset	0 to 100% of TAC Range
Time Range incl. Biased Amplifier	3.3 ns to 2 us
min. Time / Channel	813 fs
TAC Window Discriminator	Any Window inside TAC Range
ADC Principle	50 ns 12 bit Flash ADC with Error Correction
Diff. Nonlinearity (dith width 1/8, 90% of TAC rang	
Diff. Norminearity (diff width 1/0, 50% of 1AO rang	
Data Acquisition, Histogram Modes	
	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
Number of Time Channels / Pixel Ilmage Resolution (pixels), 1 Detector Channel	1 4 16 64 256 1024 4096 4096 x 4096 2048 x 2048 1024 x 1024 512 x 512 256 x 256 128 x 128 64 x 64
Number of Time Channels / Pixel Ilmage Resolution (pixels), 1 Detector Channel Ilmage Resolution (pixels), 4 Detector Channels	1 4 16 64 256 1024 4096 4096 x 4096 2048 x 2048 1024 x 1024 512 x 512 256 x 256 128 x 128 64 x 64 2048 x 2048 1024 x 1024 512 x 512 256 x 256 128 x 128 64 x 64 32 x 32
Number of Time Channels / Pixel Ilmage Resolution (pixels), 1 Detector Channel Ilmage Resolution (pixels), 4 Detector Channels Ilmage Resolution (pixels), 16 Detector Channels	1 4 16 64 256 1024 4096 4096 x 4096 2048 x 2048 1024 x 1024 512 x 512 256 x 256 128 x 128 64 x 64 2048 x 2048 1024 x 1024 512 x 512 256 x 256 128 x 128 64 x 64 32 x 32 1024 x 1024 512 x 512 256 x 256 128 x 128 64 x 64 32 x 32 16 x 16
Number of Time Channels / Pixel Ilmage Resolution (pixels), 1 Detector Channel Ilmage Resolution (pixels), 4 Detector Channels Ilmage Resolution (pixels), 16 Detector Channels Counts / Time Channel	$\begin{array}{cccccccccccccccccccccccccccccccccccc$
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Number of Time Channels / Pixel Ilmage Resolution (pixels), 1 Detector Channel Ilmage Resolution (pixels), 4 Detector Channels Ilmage Resolution (pixels), 16 Detector Channels Counts / Time Channel Counts / Time Channel ('Single' mode, repeat and Overflow Control	$\begin{array}{cccccccccccccccccccccccccccccccccccc$
Number of Time Channels / Pixel IImage Resolution (pixels), 1 Detector Channel IImage Resolution (pixels), 4 Detector Channels IImage Resolution (pixels), 16 Detector Channels Counts / Time Channel Counts / Time Channel ('Single' mode, repeat and Overflow Control Collection Time (per curve or per pixel)	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$
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approx. 20 W at +5V, 0.7 W at +12V 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 downlaod 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.



Dimensions

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Boston Electronics Corporation 91 Boylston Street, Brookline. Massachusetts 02445 USA Tel: (800) 347 5445 or (617) 566 3821, Fax: (617) 731 0935 www.boselec.com tcspc@boselec.com

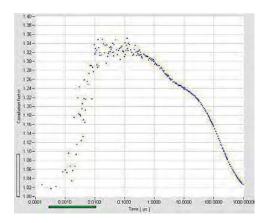


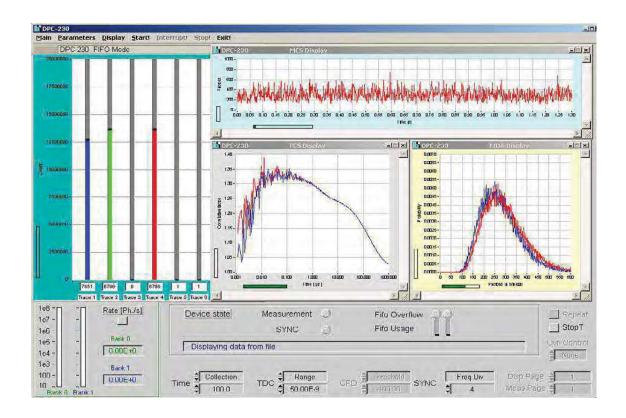
DPC-230 16 Channel Photon Correlator

Photon correlation down to the ps range

16 LVTTL inputs for SPADs or 4 CFD inputs for PMTs Recording of absolute photon times Autocorrelation within 16 LVTTL or 4 CFD channels Cross-correlation between any pairs of LVTTL or CFD channels 3-channel TCSPC mode with 165 ps time channel width Multiscaler operation of 15 LVTTL 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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UK Representative: Photonic Solutions PLC sales@psplc.com www.psplc.com



DPC-230 16 Channel Photon Correlator

LVTTL Inputs

No. of channels Input Voltage Threshold Min. Input Pulse Width Min. Pulse Distance Connectors

CFD Inputs

No of channels Threshold Zero Cross Adjust Connectors

Experiment Trigger Input Input Voltage

Threshold

Data Acquisition, Correlation Mode

Method Correlation of photons Autocorrelation Cross-correlation Time increment Dead Time No of parallel channels On-board FIFO Buffer size Readout Sustained readout rate (typ., depends on computer)

Data Acquisition, TCSPC Mode

Method Correlation of photons Start (photon) channels Dead Time Stop channel Stop input rate Stop frequency divider Time channel width On-board FIFO Buffer size Readout Sustained readout rate (typ., depends on computer)

Data Acquisition, Multiscaler Mode

Method Correlation of photons Start (reference) channel Stop (photon) channels Dead Time Time channel width On-board FIFO Buffer size Readout Sustained readout rate (typ., depends on computer)

Operation Environment

Computer System Recommended configuration Bus Connector Power Consumption Dimensions

Related Products

16 LVTTL 1.4 V 2 ns 5.5 ns MCX, on board

4 - 20 mV to - 500 mV - 100 mV to + 100 mV SMA, front panel

LVTTL 1.4 V

Time-tag recording, absolute photon times Multi tau or linear tau algorithm, online or offline all channels any pairs of channels 164.61 ps < 10 ns 16 LVTTL or 4 CFD channels 4 10⁶ photons continuous readout during measurement 7 10⁶ photons

> Time-tag recording, reversed start-stop Start-stop histogram, online or offline 3 CFD inputs < 10 ns1 CFD input max 150 MHz 1 - 2 - 4164.61 ps $4 10^6 \text{ photons}$ continuous readout during measurement $7 10^6 \text{ photons}$

Time-tag recording, direct start-multistop Start-stop histogram, online or offline 1 CFD input or 1 LVTTL input 3 CFD inputs or 15 LVTTL inputs < 10 ns 164.61 ps $4 10^6$ photons continuous readout during measurement $7 10^6$ photons

> Pentium PC >1024 Mb RAM, >100 Gb HD PCI approx. 12 W from +5V 312 mm x 124 mm x 20 mm

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 downlaod or call for individual data sheets and manuals.



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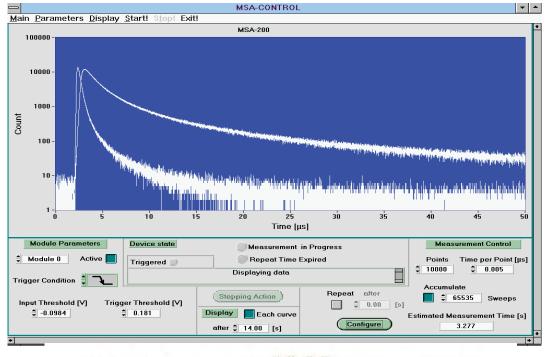




5ns Photon Counter / Multiscaler

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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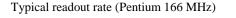


MSA-300

Specification

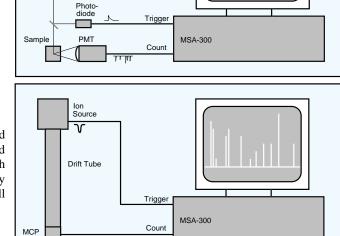
Time per Channel Count Rate No of Points / Curve **Overall Recording Length** Accumulation (up to 256 events/point) Accumulation (> 256 events/point) **Count Input Impedance** Count Input Amplitude Count Input Threshold Min.Count Input Pulse Width Trigger Input Impedance Count and Trigger Input Connectors Trigger Input Amplitude Trigger Input Threshold Min. Trigger Pulse Width Data Readout

min. 5 ns up to 100 MHz up to 512 k up to 2.62 ms Hardware, no dead time between recording cycles Software 50 Ω $\pm 20 \text{ mV}$ to $\pm 1 \text{ V}$ 0 to \pm 200 mV, \pm 8 bit resolution 800 ps 50 Ω MCX $\pm 20 \text{ mV}$ to $\pm 1 \text{ V}$ 0 to ± 1 V, ± 8 bit resolution 800 ps subsequent data points are read by subsequent input instructions 1us/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 repetion 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.

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



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800 MHz Gated Photon Counter / Multiscaler

2 Counter Channels

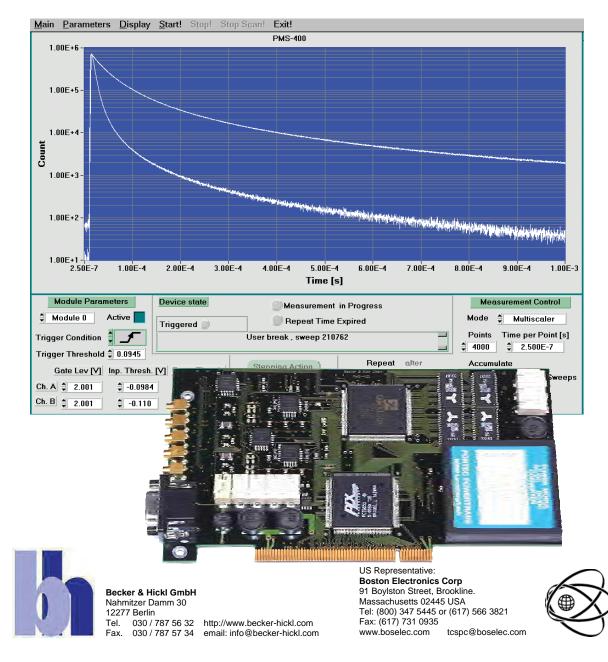
800 MHz Count Rate, 32 bit Resolution Direct Interfacing to most Detectors Multiscaler Mode: Up to 64k Time Channels, min. 250ns / Channel Gated Photon Counting: 1.5 ns min. Gate Pulse Width Event Recording Mode: Up to 32 k Events 32 bit Accumulation Counter for ultra-fast Accumulation

new

new

On-Board Discriminators, Timing and Control Logics PCI Board with fast DMA (Bus Master),

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



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 ist stored.

Gated Detection

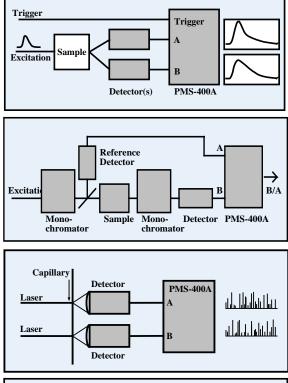
The gate is opened during the laser pulse only. Events outside the laser pulses are suppressed. Exceptionally low background count rate.

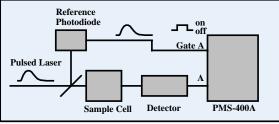
Gating off Scattering Pulses

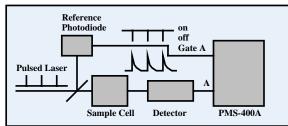
The gate is closed during the laser pulses. Scattered photons during the laser pulses are suppressed, the luminescence photons outside the laser pulses are recorded.

Specification (Typical Values)

Counter Channels Count Rate (Input Amplitude 50mV, peak-peak) min. Count Pulse Width min. Gate Width (Input Amplitude 200mV, peak-peak) min Trigger Pulse Width Discriminator Threshold (Count Inputs) Discriminator Threshold (Gate Inputs) Discriminator Threshold (Trigger Input) Input Connectors Counter Width Accumululation Counter Dead time between sweeps No. of Time Bins Time / Bin Hardware Environment Software Environment Dimensions







800 MHz 800 ps 1 ns 1 ns -1 V to +1 V in steps of 4 mV -2 V to +2 V in steps of 16 mV -2 V to +2 V in steps of 16 mV MCX, 50 32 bit 32 bit < 100ns 64 k for each counter channel 250 ns to 100 000 s Pentium PC Windows 95, 98, 2000 or NT 180 mm x 108 mm x 15 mm

2



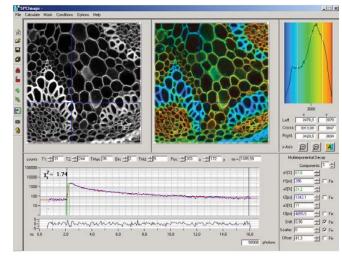
Simple-Tau 164 Table-Top TCSPC Systems

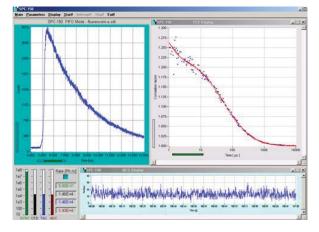
Four-channel single photon counting systems in lap-top format

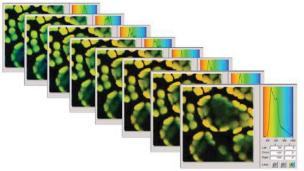
Four fully parallel SPC-160 TCSPC Channels

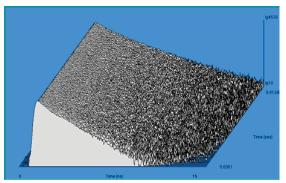
Laptop computer with extension box Coupled via fast bus extension interface Four parallel SPC-160 TCSPC modules **Picosecond resolution** Time channel width down to 813 fs **Electronic IRF 8 ps FWHM Unprecedented count rate** Unprecedented timing stability Photon distribution and time-tag modes Standard 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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Simple-Tau 164 Table-Top TCSPC Systems

Photon Channels Principle Time Resolution (FWHM / RMS, electr.) Opt. Input Voltage Range Min. Input Pulse Width Lower Threshold Upper Threshold Zero Cross Adjust		Consta	nt Fraction Discrimi 8 ps / 5 ps - 50 mV to - 1 \ 400 ps - 20 mV to - 500 r - - 100 mV to + 100	/ nV			
Synchronisation Channels							
Principle Opt. Input Voltage Range Min. Input Pulse Width Threshold Frequency Range Frequency Divider Zero Cross Adjust		Consta	nt Fraction Discrimi - 50 mV to - 1 V 400 ps - 20 mV to -500 m 0 to 200 MHz 1-2-4 -100 mV to + 100	/ nV			
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		(50 ns F	o Generator / Biased 50 ns to 2 us 1 to 15 0 to 100% of TAC R 3.3 ns to 2 us 813 fs lash ADC with Erro 5% rms, typ. <1% pr	ange r Correction			
Data Acquisition (Histogram Modes)							
Method Dead Time Saturated Count Rate, per TCSPC channel / total Useful count rate, per TCSPC channel / total	on-board multi-dimensional histogramming process 100ns, independent of computer speed 10 MHz / 40 MHz 5 MHz / 20 MHz					1024	4096
Number of Time Channels / Pixel Image Resolution (pixels), 1 Detector Channel max. Counts / Time Channel	1 2048 x 2048	4 1024 x 1024	16 512 x 512 2 ¹⁶ -1	64 256 x 256	256 128 x 128	64 x 64	4096 32 x 32
Overflow Control Collection Time Display Interval Time		non	e / stop / repeat and 0.1 us to 10000 100ms to 1000	s s			
Repeat Time Sequential Recording	Unlimit		0.1 us to 1000 s mmable Hardware nemory swapping, ir	Sequencer	d scan mode		
Synchronisation with scanning Count Enable Control Experiment Trigger			rame clocks from so 1 bit TTL TTL				
Data Acquisition (FIFO / Time-Tag Mode)							
Method Online Display Dead Time Output Data Format (ADC / Macrotime / Routing)			vidual photons and CS, Cross-FCS, PC 125 ns 12 / 12 / 3				
FIFO buffer Capacity (photons) Macro Timer Resolution, internal clock Macro Timer Resolution, clock from SYNC input Curve Control (external Routing)	12 / 12 / 3 8 M 50ns, 12 bit 10ns to 100ns, 12 bit 3 bit TTL						
Count Enable Control Waveform recording No of counts per time channel Image Acquisition in time-tag mode	recording		1 bit TTL e-tag data, up to 16 unlimited rame pulses, online				
FCS calculation	recording		rithm, online calcula				

Related Products and Accessories

SPC-130 through SPC-830 TCSPC boards, Simple-Tau 130, 140, 150, 152 systems, FLIM systems, MCPs, PMT modules, SPAD modules, multi-spectral detector assemlies, routing devices for multichannel TCSPC, preamplifiers, PIN and avalanche photodiode modules, ps diode lasers.

Please download the bh TCSPC Handbook from www.becker-hickl.com



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by Wolfgang Becker

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TCSPC for Microscopy

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

