

SPC-180 Series of TCSPC/FLIM Modules from Becker & Hickl



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SPC-180N Series

 becker-hickl.com/products/spc-180n-series

	SPC-180N	SPC-180NX	SPC-180NXX
Photon Channel			
Principle	Constant Fraction Discriminator (CFD)		
Discriminator Input Bandwidth	4 GHz		
Time Resolution (FWHM/RMS, electr.)	6.6 ps / 2.5 ps	< 3.5 ps / 1.6 ps	< 3 ps / 1.1 ps
Variance in Time of IRF max. (RMS)	< 0.4 ps over 100 s		
Optimum Input Voltage Range	-30 mV to -500 mV		
Min. Input Pulse Width	200 ps		
Threshold	0 to -250 mV		
Zero Cross Adjust	-100 mV to 100 mV		
Syncronisation Channel			
Principle	Constant Fraction Discriminator (CFD)		
Discriminator Input Bandwidth	4 GHz		
Optimum Input Voltage Range	-30 mV to -500 mV		

Min. Input Pulse Width	200 ps
Threshold	0 to -250 mV
Frequency Range	0 to 150 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 5 μ s	25 ns to 2.5 μ s	12.5 ns to 50 ns
Biased Amplifier Gain	1 to 15		
Biased Amplifier Offset (of TAC Range)	0 % to 50 %		
Time Range incl. Biased Amplifier	3.3 ns to 5 μ s	1.67 ns to 2.5 μ s	0.834 ns to 50 ns
Min. Time Channel Width	813 fs	407 fs	203 fs
ADC Principle	50 ns Flash ADC with Error Correction		
Diff. Nonlinearity	< 0.5 % RMS, typ. < 1 % peak-peak		

Data Acquisition

Histogram Mode

Method	on-board multi-dim. histogramming process
Dead Time	80 ns, independent of computer speed

Saturated Count Rate	12 MHz
Max. Counts / Time Channel	16 bits
Overflow Control	none, stop, repeat and correct
Collection Time	0.1 μ s to 100,000 s
Display Interval Time	10 ms to 100,000 s
Repeat Time	0.1 μ s to 100,000 s
Sequencing Recording	Programmable Hardware Sequencer, unlimited recording by Memory swapping, in curve mode and scan mode
Synchronisation with Scanning	Pixel, Line and Frame from Scanning Device
Routing	7 bit, TTL
Experiment Trigger	TTL
Data Acquisition	FIFO / Parameter-Tag Mode
Method	Time and wavelength tagging of individual photons and continuous writing to disk
Online Display	Decay functions, FCS, Cross-FCS, PCH MCS Traces
FCS Calculation	Multi-tau algorithm, online calculation and online fit
Number of Counts of Decay/ Waveform Recording	unlimited
Dead Time	80 ns

Saturated Count Rate, Peak	12 MHz
Sustained Count Rate (Bus Transfer Limit)	typ. 5 MHz
Max. Counts / Time Channel (Counting Depth)	unlimited
Output Data Format (ADC / Macrotime / Routing)	12 / 12 / 4
FIFO Buffer Capacity (Photons)	$2 * 10^6$
Macro Timer Resolution, Internal Clock	25 ns, 12 bit, overflows marked by MOTF entry in data stream
Input Macro Timer Resolution, Clock from Sync	10 ns to 100 ns, 12 bit, overflow marked by MOTF entry in data stream
Input Curve Control (external Routing)	4 bit, TTL
External Event Markers	4 bit, TTL
Input Count Enable Control	1 bit, TTL
Input Experiment Trigger	TTL
Data Acquisition	FIFO / Parameter-Tag Imaging Mode
Method	Buildingup images from time- and wavelength tagged data
Online Display	up to 8 Images in different time and wavelength windows

Synchronisation with Scanner	via Frame Clock, Line Clock and Pixel Clock Pulses			
Detector / Wavelength Channels	1 to 16			
Image resolution (64-bit SPCM Software)				
No. of Time Channels	64	256	1024	4096
No. of Pixels, 1 Detector Channel	4096 x 4096	2048 x 2048	1024 x 1024	512 x 512
No. of Pixels, 16 Detector Channels	1024 x 1024	512 x 512	256 x 256	128 x 128
Operation Environment				
PC System	Windows 8 / 10, > 8 GB RAM, 64 bit operating system recommended			
PC Interface	PCIe			
Power Consumption	approx. 12 W from +12 V			
Dimensions	230 mm x 130 mm x 18 mm			



SPC-180N

TCSPC / FLIM Module

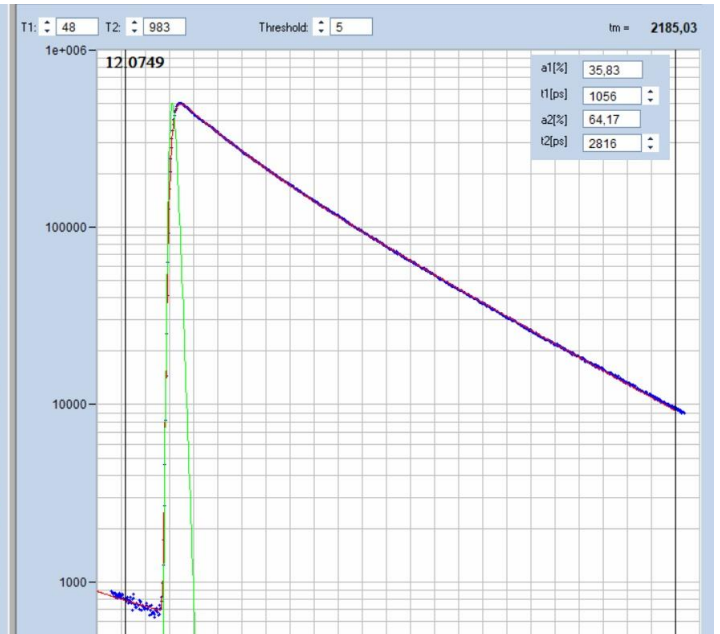
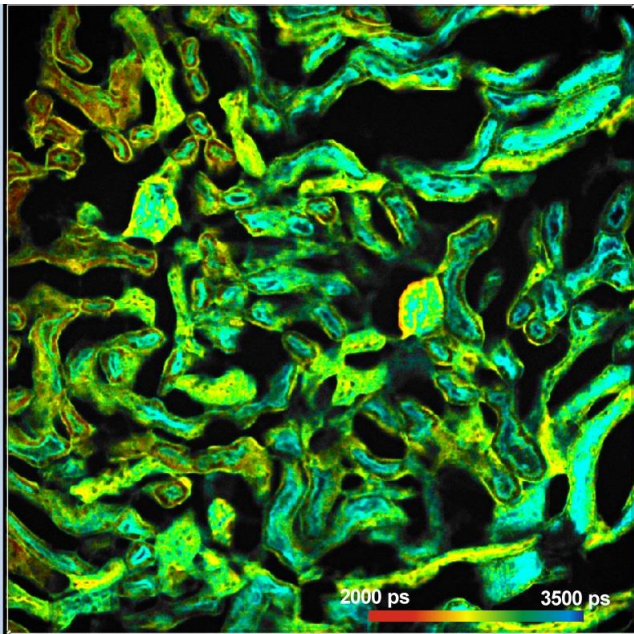
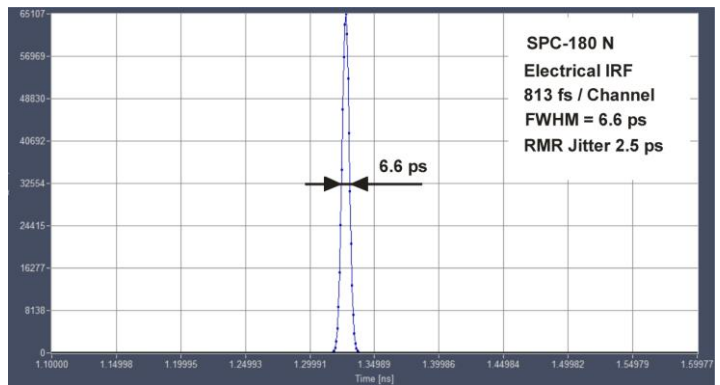
High-Resolution Time-Correlated Single Photon Counting Module

- High-throughput PCI-Express interface
- Ultra-fast, ultra-stable timing electronics
- Electrical IRF width 6.6 ps FWHM
- Internal timing jitter 2.5 ps RMS
- Time-channel width down to 813 fs
- Discriminator input bandwidth 4 GHz
- Photon distribution and time/parameter-tag modes
- Multi-detector / multi-wavelength capability
- Excitation-wavelength multiplexing
- Parallel operation of 2, 3 or 4 modules
- Laser repetition rates up to 150 MHz
- Dead time 80 ns
- Saturated count rate 12.5 MHz



- Fluorescence-decay experiments
- Anti-bunching experiments
- Single-wavelength FLIM, multi-wavelength FLIM
- Fast-acquisition FLIM
- Accumulated time-series FLIM
- Simultaneous FLIM / PLIM
- Mosaic FLIM

- Metabolic imaging
- Double-exponential FRET imaging
- FLIM of fast physiological processes
- Recording of Ca²⁺ transients
- fNIRS and NIRS experiments
- Single-molecule spectroscopy
- Fluorescence correlation



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worldwide.

More than 28 years experience in TCSPC. More than 2500 TCSPC systems



SPC-180N

TCSPC / FLIM Module

Photon Channel

Principle
 Discriminator Input Bandwidth
 IRF Width, FWHM
 RMS Timing Jitter
 Variance in Time of IRF Centroid
 Optimum Input Voltage Range
 Min. Input Pulse Width
 Threshold
 Zero Cross Adjust

Constant Fraction Discriminator (CFD)
 4 GHz
 < 6.6 ps, FWHM
 < 2.5 ps, RMS
 < 0.4 ps RMS over 100 seconds
 - 30 mV to - 500 mV
 200 ps
 0 to - 250 mV
 - 100 mV to + 100 mV

Synchronisation Channel

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

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

Time-to-Amplitude Converters / ADCs

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

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

Data Acquisition (Histogram Modes)

Method
 Dead Time
 Saturated Count Rate
 Useful Count Rate
 Max. Counts / Time Channel (Counting Depth)
 Overflow Control
 Collection Time
 Display Interval Time
 Repeat Time
 Sequential Recording
 Synchronisation with Scanning
 Routing
 Count Enable
 Experiment Trigger

on-board multi-dimensional hardware histogramming process
 80 ns, independent of computer speed
 12 MHz
 6 MHz
 $2^{16}-1$
 none / stop / repeat and correct
 0.1 us to 100,000 s
 10 ms to 100,000 s
 0.1 us to 100,000 s
 Unlimited recording by memory swapping
 pixel, line and frame clocks from scanning device
 7 bit TTL
 1 bit TTL
 TTL

Data Acquisition (FIFO / Parameter-Tag Mode)

Method
 Online Display
 FCS Calculation
 Number of Counts of Decay / Waveform Recording
 Dead Time
 Saturated Count Rate, Peak
 Sustained Count Rate (Bus-transfer Limited)
 Max. Counts / Time Channel (Counting Depth)
 Output Data Format (ADC / Macrotime / Routing)
 On-board FIFO Buffer Capacity (Photons)
 Macro Timer Resolution, Internal Clock
 Macro Timer Resolution, Clock from SYNC Input
 Routing
 External Event Markers
 Experiment Trigger

Parameter-tagging of individual photons and continuous writing to disk
 Decay function, FLIM, FCS, Cross-FCS, PCH, MCS traces
 Multi-tau algorithm, online calculation and online fit
 unlimited
 80 ns
 12 MHz
 5 MHz
 unlimited
 12 / 12 / 4 bit
 $2 \cdot 10^6$
 25 ns, 12 bit, overflows marked by MTOF entry in data stream
 10 ns to 100 ns, 12 bit, overflows marked by MTOF entry in data stream
 4 bit TTL
 4 bit, TTL
 TTL

Data Acquisition, FIFO Imaging

Method
 Online Display
 Synchronisation with Scanner
 Detector / Wavelength Channels
 Image Resolution, 64-bit SPCM Software
 No. of Time Channels
 No. of Pixels, 1 Detector Channel
 No. of Pixels, 16 Detector Channels

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

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

Operation Environment

Computer / Operating System
 Bus Connector
 Total Power Consumption
 Dimensions

PC Pentium, multi-core, >8GB RAM, Windows 10, Windows 11
 PCI-ex
 approx. 12 W from +12V
 230 mm x 130 mm x 18 mm

Related Products

SPC-180NX, SPC-180NXX TCSPC Modules, SPC-150N, SPC-150NX, SPC-150NXX TCSPC modules
 HPM-100 GaAsP and GaAs hybrid detectors, DCC-100PCle detector controller
 BDL-SMN ps diode lasers, BDS-SM, -SMY, -MM picosecond diode lasers, SPCImage NG data analysis software

Related Literature

W. Becker, The bh TCSPC Handbook, 9th edition (2021), 950 pages, available on <https://www.becker-hickl.com>. Please contact bh for printed copies.
 The bh TCSPC Technique, Principles and Applications. Overview brochure, 27 pages. Available on <https://www.becker-hickl.com>

International Sales Representatives



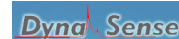
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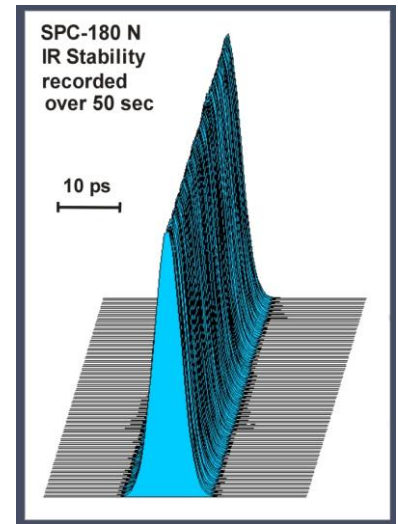
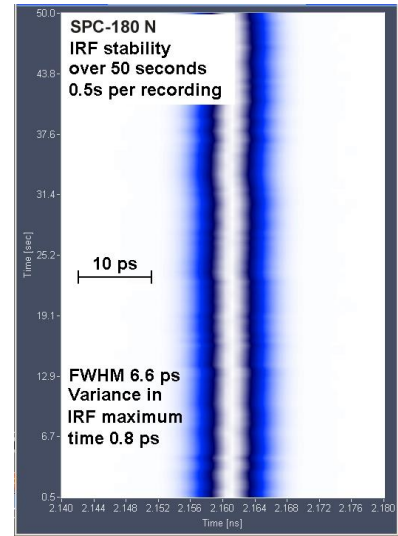
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SPC-180NX

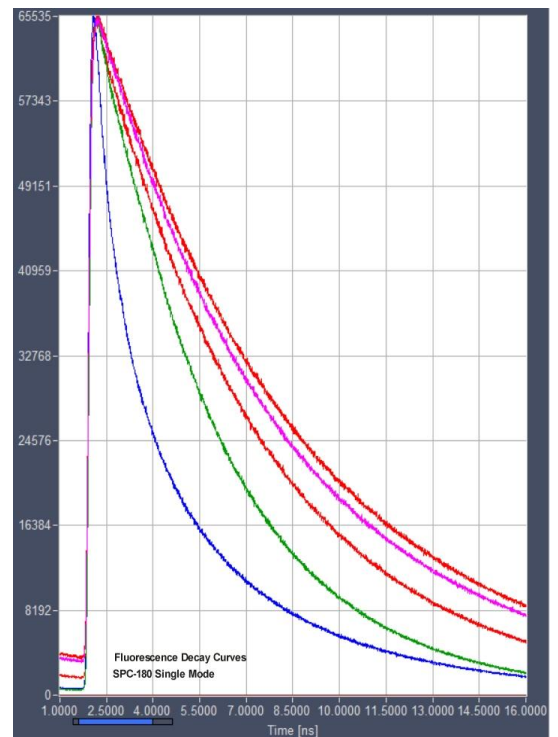
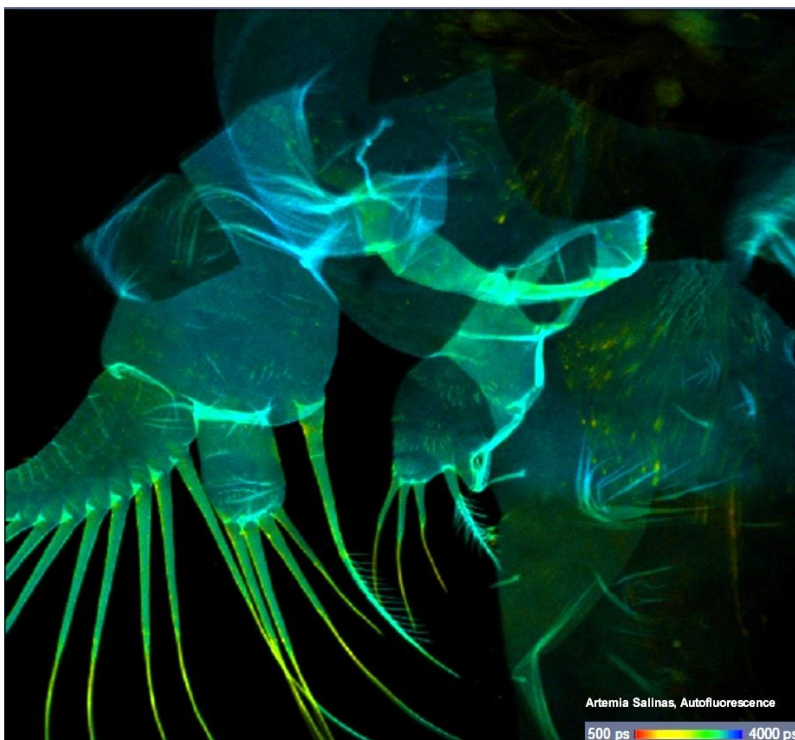
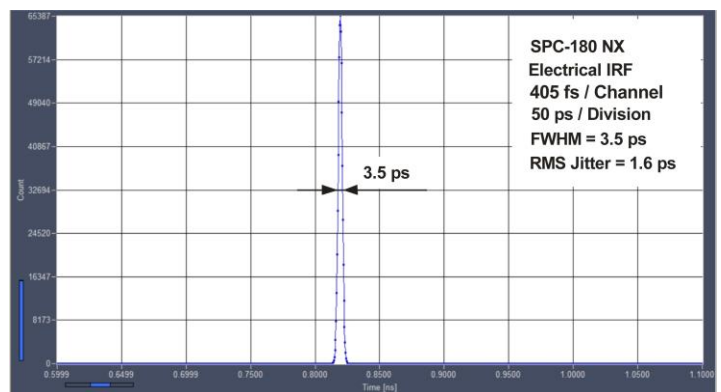
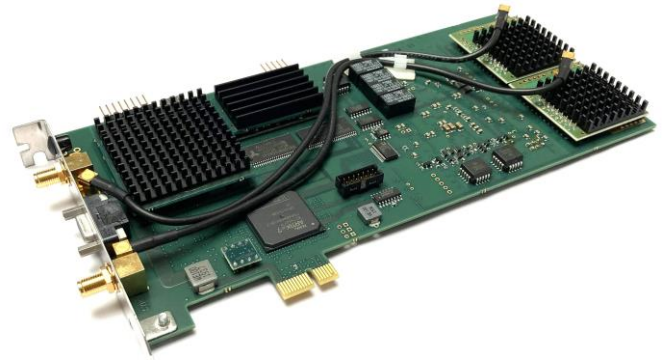
TCSPC / FLIM Module

High-Resolution Time-Correlated Single Photon Counting Module

High-throughput PCI-Express interface
Ultra-fast ultra-stable timing electronics
Electrical IRF width 3.5 ps FWHM
Internal timing jitter 1.6 ps RMS
Time-channel width down to 405 fs
Discriminator input bandwidth 4 GHz
Photon distribution and parameter-tag modes
Multi-detector / multi-wavelength capability
Excitation-wavelength multiplexing
Parallel operation of 2, 3 or 4 modules
Laser repetition rates up to 150 MHz
Dead time 80 ns
Saturated count rate 12.5 MHz

Fluorescence-decay experiments
Anti-bunching experiments
Single-wavelength FLIM, multi-wavelength FLIM
Fast-acquisition FLIM
Accumulated time-series FLIM
Simultaneous FLIM / PLIM
Mosaic FLIM

Metabolic imaging
Double-exponential FRET imaging
FLIM of fast physiological processes
Recording of Ca^{2+} transients
fNIRS and NIRS experiments
Single-molecule spectroscopy
Fluorescence correlation



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SPC-180NX

TCSPC / FLIM Module

Photon Channel

Principle
 Discriminator Input Bandwidth
 IRF Width, FWHM
 RMS Timing Jitter
 Variance in Time of IRF Centroid
 Optimum Input Voltage Range
 Min. Input Pulse Width
 Threshold
 Zero Cross Adjust

Constant Fraction Discriminator (CFD)
 4 GHz
 < 3.5 ps, FWHM
 < 1.6 ps, RMS
 < 0.4 ps RMS over 100 seconds
 - 30 mV to - 500 mV
 200 ps
 0 to - 250 mV
 - 100 mV to + 100 mV

Synchronisation Channel

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

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

Time-to-Amplitude Converters / ADCs

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

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

Data Acquisition (Histogram Modes)

Method
 Dead Time
 Saturated Count Rate
 Useful Count Rate
 Max. Counts / Time Channel (Counting Depth)
 Overflow Control
 Collection Time
 Display Interval Time
 Repeat Time
 Sequential Recording
 Synchronisation with Scanning
 Routing
 Count Enable
 Experiment Trigger

on-board multi-dimensional hardware histogramming process
 80 ns, independent of computer speed
 12 MHz
 6 MHz
 $2^{16}-1$
 none / stop / repeat and correct
 0.1 us to 100,000 s
 10 ms to 100,000 s
 0.1 us to 100,000 s
 Unlimited recording by memory swapping
 pixel, line and frame clocks from scanning device
 7 bit TTL
 1 bit TTL
 TTL

Data Acquisition (FIFO / Parameter-Tag Mode)

Method
 Online Display
 FCS Calculation
 Number of Counts of Decay / Waveform Recording
 Dead Time
 Saturated Count Rate, Peak
 Sustained Count Rate (Bus-transfer Limited)
 Max. Counts / Time Channel (Counting Depth)
 Output Data Format (ADC / Macrotime / Routing)
 On-board FIFO Buffer Capacity (Photons)
 Macro Timer Resolution, Internal Clock
 Macro Timer Resolution, Clock from SYNC Input
 Routing
 External Event Markers
 Experiment Trigger

Parameter-tagging of individual photons and continuous writing to disk
 Decay function, FCS, Cross-FCS, PCH, MCS traces
 Multi-tau algorithm, online calculation and online fit
 unlimited
 80 ns
 12 MHz
 5 MHz
 unlimited
 $2 \cdot 10^6$
 25 ns, 12 bit, overflows marked by MTOF entry in data stream
 10 ns to 100 ns, 12 bit, overflows marked by MTOF entry in data stream
 4 bit TTL
 4 bit, TTL
 TTL

Data Acquisition, FIFO Imaging

Method
 Online Display
 Synchronisation with Scanner
 Detector / Wavelength Channels
 Image Resolution, 64-bit SPCM Software
 No of Time Channels
 No. of Pixels, 1 Detector Channel
 No. of Pixels, 16 Detector Channels

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

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

Operation Environment

Computer / Operating System
 Bus Connector
 Used PCI-ex Slots
 Total Power Consumption
 Dimensions

PC Pentium, multi-core, >8GB RAM, Windows 10
 PCI-ex
 1
 approx. 12 W from +12V
 230 mm x 130 mm x 18 mm

Related Products

SPC-150N, SPC-150NX, SPC-150NXX TCSPC modules, HPM-100 GaAsP and GaAs hybrid detectors, DCC-100PCIe detector controller
 BDL-SMN ps diode lasers, BDS-SM, -SMY, -MM picosecond diode lasers, SPCImage NG data analysis software

Related Literature

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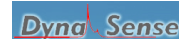
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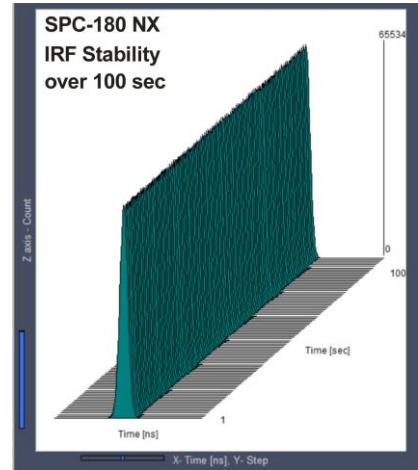
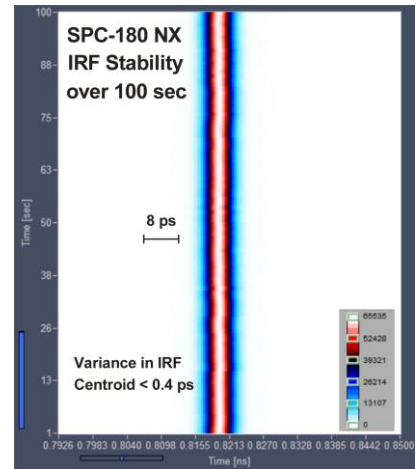
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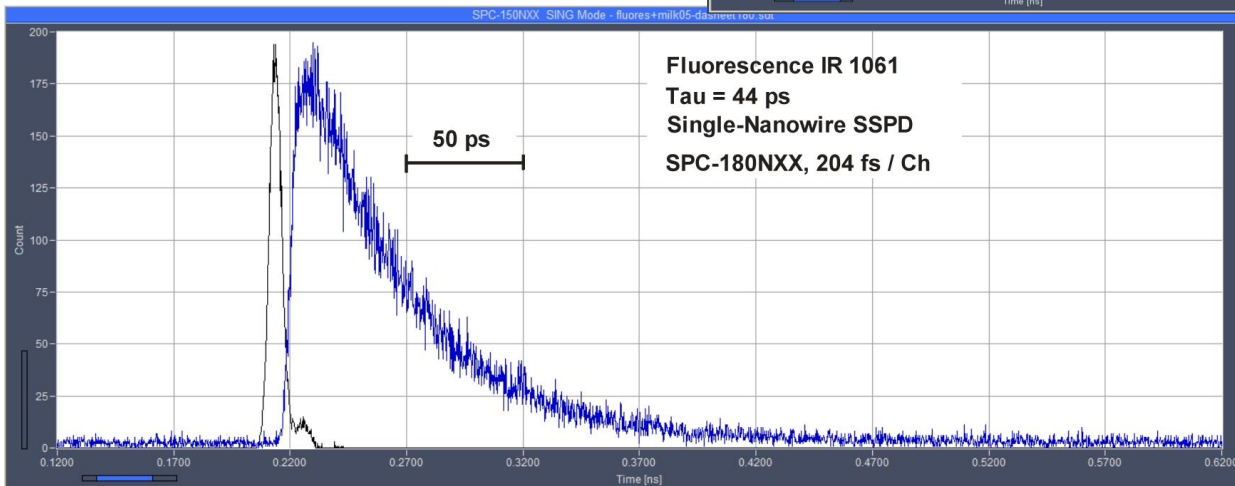
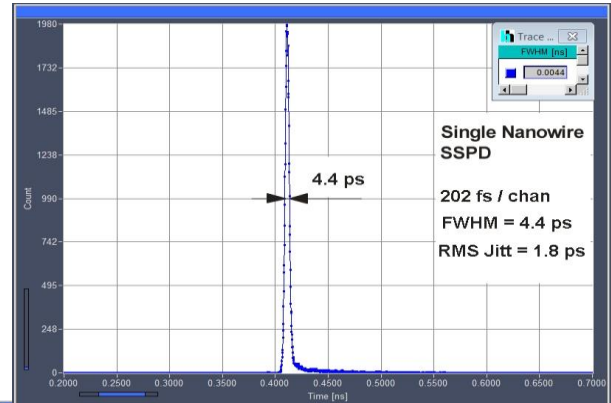
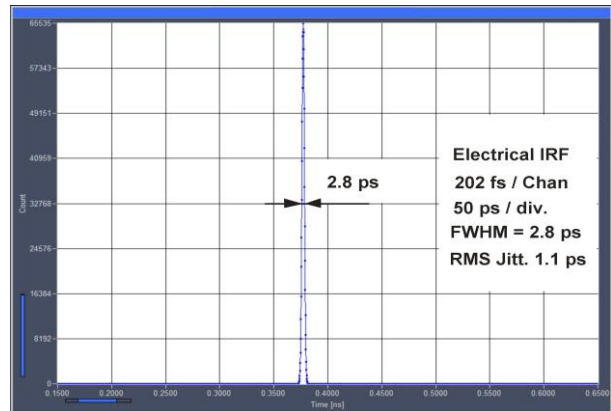
SPC-180NXX

Ultrafast TCSPC Module

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

- High-throughput PCI-Express interface
- Ultra-fast, ultra-stable timing electronics
- Electrical IRF width < 3 ps FWHM
- Internal RMS timing jitter 1.1 ps
- Minimum time channel width 203 fs
- Ultra-high IRF stability
- Input discriminator bandwidth 4 GHz
- Photon distribution and parameter-tag modes
- Multi-detector / multi-wavelength capability
- Dual time-base operation
- Parallel operation of modules
- Laser repetition rates up to 150 MHz
- Saturated count rate 10 MHz

- Ideal for superconducting NbN detectors (SSPDs)
- Ultra-fast fluorescence lifetime experiments
- Ultra-fast light scattering experiments
- Anti-bunching experiments
- Multi-wavelength lifetime experiments
- Recording of transient fluorescence lifetime effects
- Single-wavelength FLIM, multi-wavelength FLIM
- High-resolution FLIM, time-series FLIM
- Mosaic FLIM, lateral, longitudinal, temporal mosaics
- Simultaneous PLIM and FLIM
- FLITS
- Double-exponential FRET imaging
- Recording of Ca²⁺ transients
- fNIRS and NIRS experiments
- Single-molecule spectroscopy
- FCS, FCCS, PCH



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More than 28 years experience in TCSPC. More than 2500 TCSPC systems worldwide.



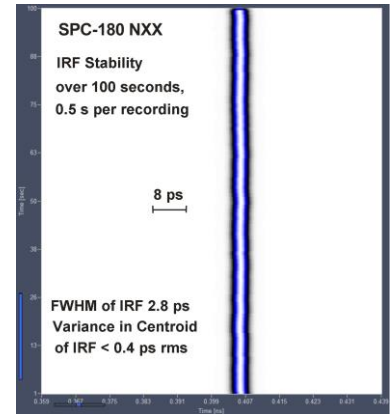
SPC-180NXX

Ultrafast TCSPC Module

Photon Channel

- Principle
- Discriminator Input Bandwidth
- IRF Width, FWHM
- RMS Timing Jitter
- Variance in Time of IRF Centroid
- Optimum Input Voltage Range
- Min. Input Pulse Width
- Threshold
- Zero Cross Adjust

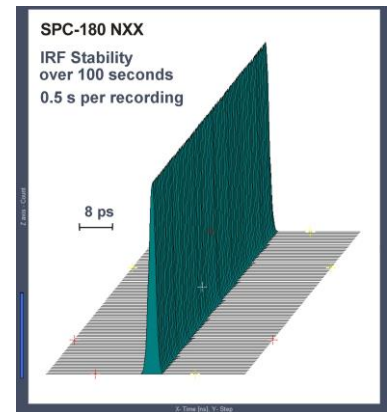
- Constant Fraction Discriminator (CFD)
- 4 GHz
- <3 ps, FWHM
- 1.1 ps, RMS
- <0.4 ps RMS over 100 seconds
- 30 mV to - 500 mV
- 200 ps
- 0 to - 250 mV
- 100 mV to + 100 mV



Synchronisation Channel

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

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



Time-to-Amplitude Converters / ADCs

- Principle
- TAC Range
- Biased Amplifier Gain
- Biased Amplifier Offset
- Time Range incl. Biased Amplifier
- Min. Time / Channel
- ADC Principle
- Diff. Nonlinearity, Electrical

- Ramp Generator / Biased Amplifier
- 12.5 ns, 25 ns, 50 ns
- 1 to 15
- 0 to 50 % of TAC Range
- 0.834 ns to 50 ns
- 203 fs
- 50 ns Flash ADC with Error Correction
- < 0.5 % RMS, typ. <1 % peak-peak

Data Acquisition (Histogram Modes)

- Method
- Dead Time
- Saturated Count Rate
- Max. Counts / Time Channel (Counting Depth)
- Overflow Control
- Collection Time
- Display Interval Time
- Repeat Time
- Sequential Recording
- Synchronisation with Scanning
- Routing
- Count Enable
- Experiment Trigger

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

Data Acquisition (FIFO / Parameter-Tag Mode)

- Method
- Online Display
- FCS Calculation
- Number of Counts of Decay / Waveform Recording
- Dead Time
- Saturated Count Rate, Peak
- Sustained Count Rate (Bus-transfer Limited)
- Max. Counts / Time Channel (Counting Depth)
- Output Data Format (ADC / Macrotime / Routing)
- FIFO Buffer Capacity (Photons)
- Macro Timer Resolution, Internal Clock
- Macro Timer Resolution, Clock from SYNC Input
- Routing
- Count Enable
- External Event Markers
- Experiment Trigger

- Parameter-tagging of individual photons and continuous writing to disk
- Decay function, FCS, Cross-FCS, PCH, MCS traces
- Multi-tau algorithm, online calculation and online fit
- unlimited
- 80 ns
- 10 MHz
- typ. 4 MHz
- unlimited
- 12 / 12 / 4 bit
- 2¹⁰
- 50 ns, 12 bit, overflows marked by MTOF entry in data stream
- 10 ns to 100 ns, 12 bit, overflows marked by MTOF entry in data stream
- 4 bit TTL
- 1 bit TTL
- 4 bit, TTL
- TTL

FLIM Data Acquisition, FIFO Imaging Mode

- Method
- Online Display
- Synchronisation with Scanner
- Detector / Wavelength Channels
- Image Resolution, 64-bit SPCM Software
- No. of Time Channels
- No. of Pixels, 1 Detector Channel
- No. of Pixels, 16 Detector Channels

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

Operation Environment

- Computer System
- Bus Connectors
- Used PCI Slots
- Total Power Consumption
- Dimensions

- PC Pentium, multi-core, >8GB RAM, Windows 10, Windows 11
- PCI-ex
- 1
- approx. 12 W from +12V
- 240 mm x 130 mm x 15 mm

Related Products

- SPC-180N, SPC-180NX TCSPC modules
- SPC-150N, SPC-150NX, SPC-150NXX TCSPC Modules
- DCS-120 FLIM Systems

- HPM-100 detectors
- PML-SPEC and MW-FLIM multi-wavelength detectors
- PMC-150 cooled PMT modules

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

Related Literature

4.4 ps IRF width of TCSPC with an NbN Superconducting Nanowire Single Photon Detector. Application note, please see www.becker-hickl.com
 W. Becker, The bh TCSPC Handbook, 9th edition (2021). Available on www.becker-hickl.com. Contact bh for printed copies.

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