



# SPC-180N

# TCSPC / FLIM Module

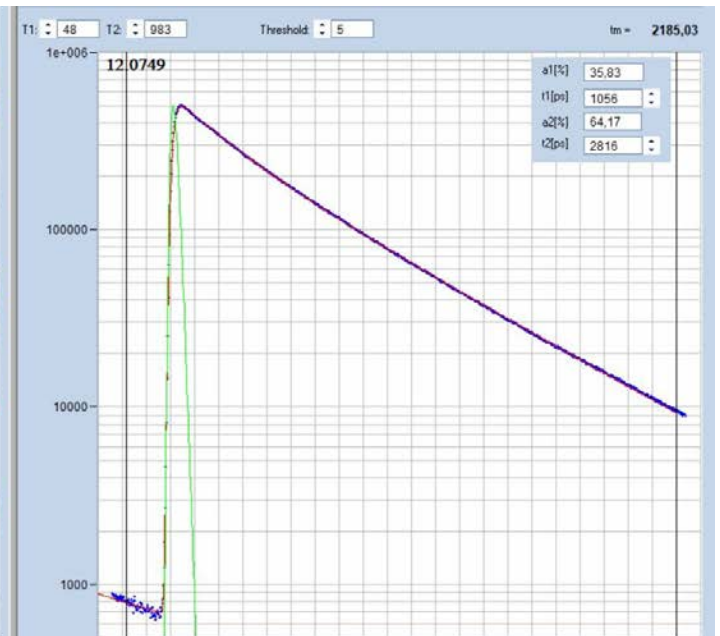
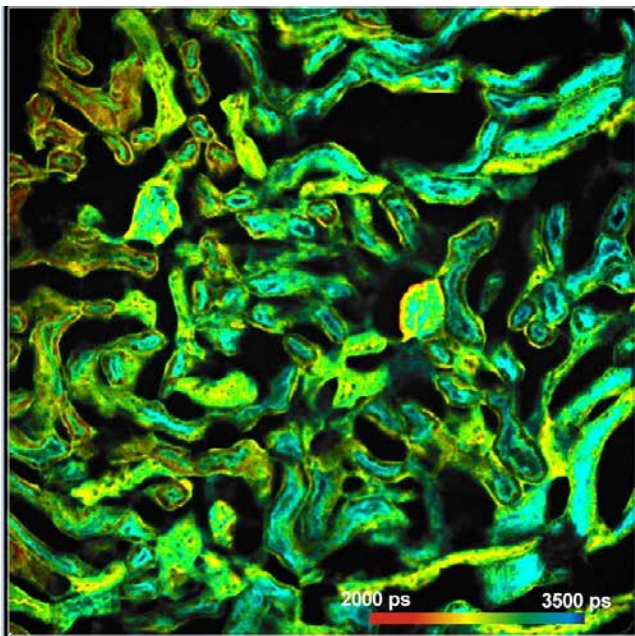
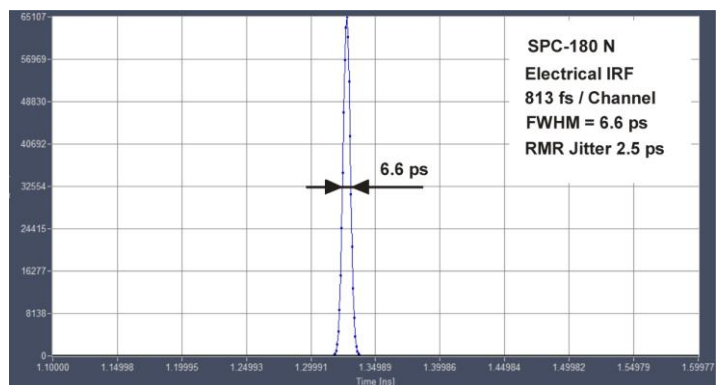
## High-Resolution Time-Correlated Single Photon Counting Module

- 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 Ca<sup>2+</sup> transients
- fNIRS and NIRS experiments
- Single-molecule spectroscopy
- Fluorescence correlation



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

worldwide.



# 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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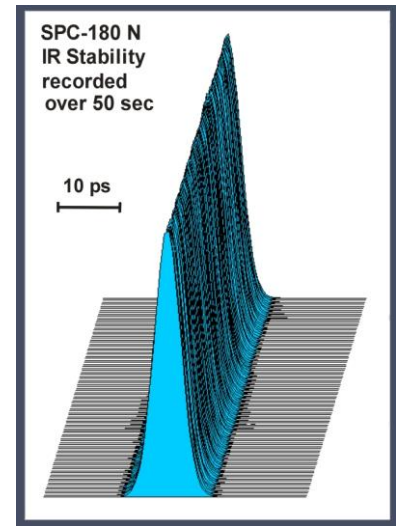
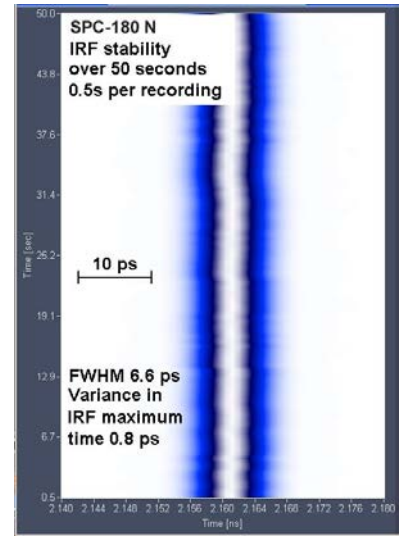
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# SPC-180NX

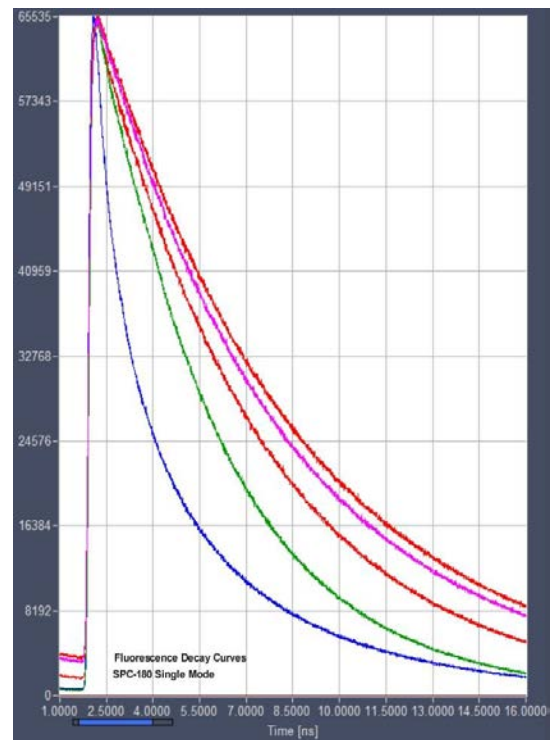
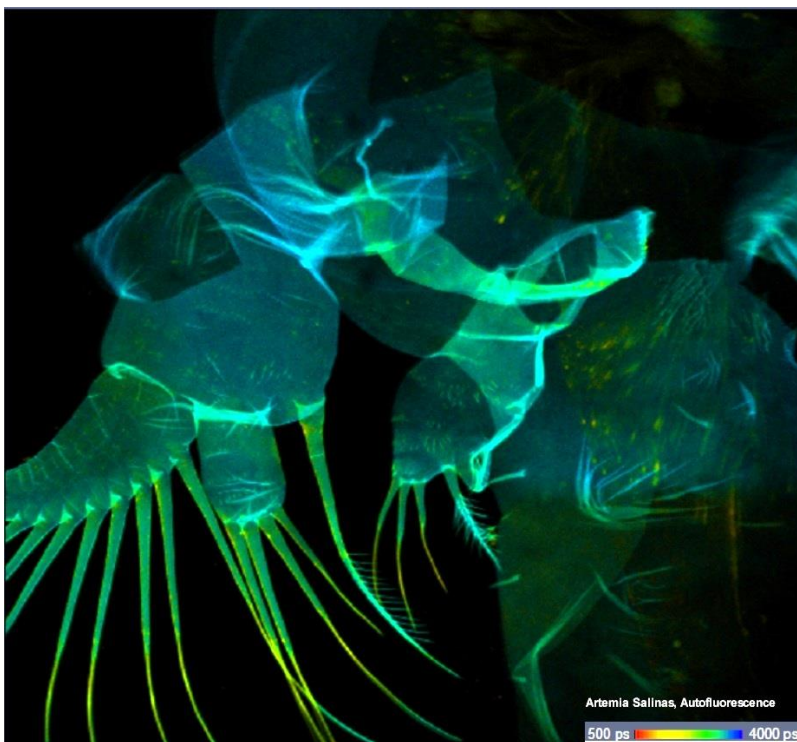
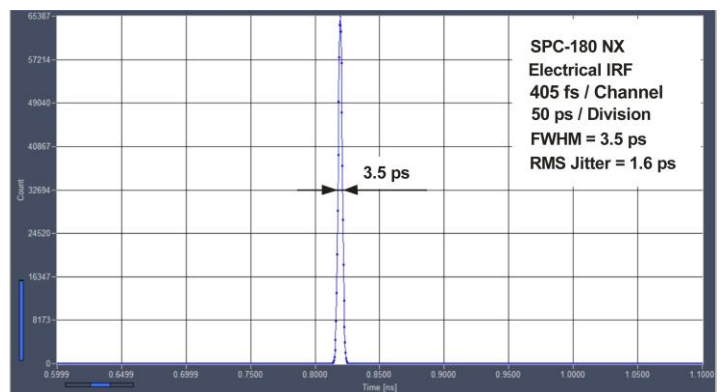
# TCSPC / FLIM Module

## 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  $\text{Ca}^{2+}$  transients  
fNIRS and NIRS experiments  
Single-molecule spectroscopy  
Fluorescence correlation



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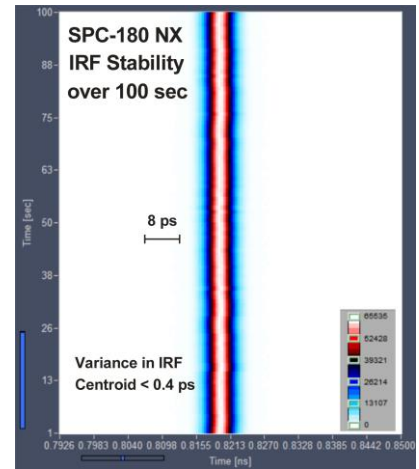
# SPC-180NX

# 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

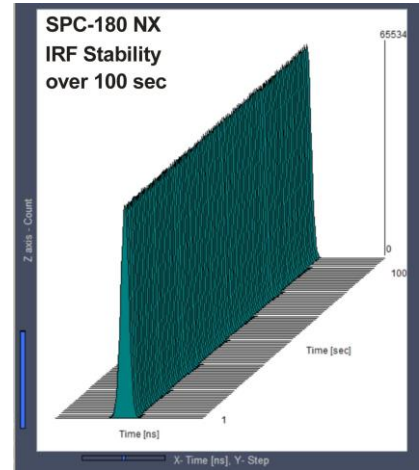
Principle  
 TAC Range  
 Biased Amplifier Gain  
 Biased Amplifier Offset  
 Time Range incl. Biased Amplifier  
 Min. Time / Channel  
 ADC Principle  
 Diff. Nonlinearity, Electrical

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  
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## 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  
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 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  
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 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  
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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

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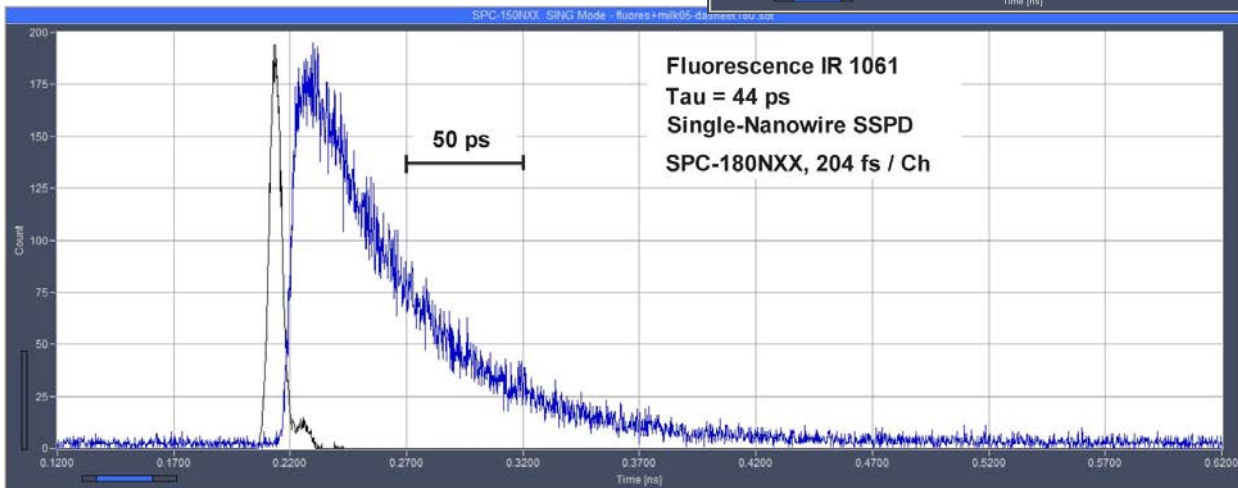
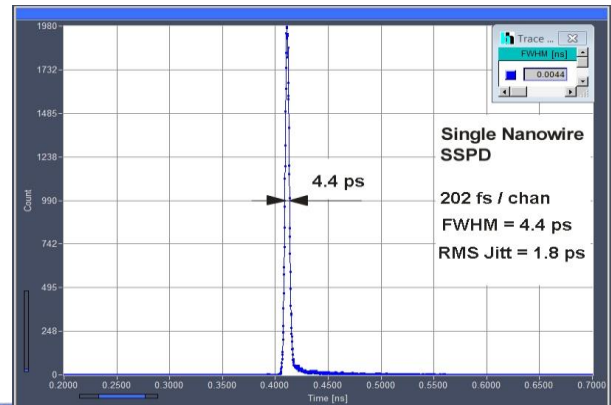
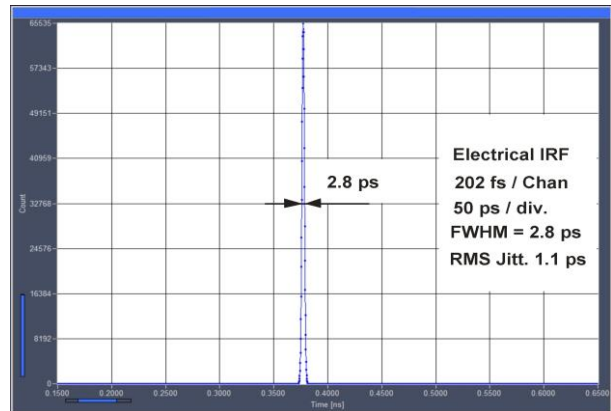
# SPC-180NXX

# 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 Ca<sup>2+</sup> 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.



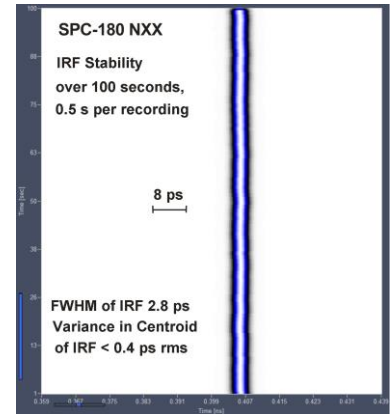
# SPC-180NXX

# 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

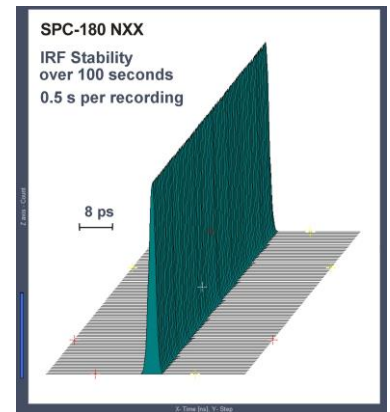
Constant Fraction Discriminator (CFD)  
 4 GHz  
 <3 ps, FWHM  
 1.1 ps, RMS  
 <0.4 ps RMS over 100 seconds  
 - 30 mV to - 500 mV  
 200 ps  
 0 to - 250 mV  
 - 100 mV to + 100 mV



## 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)  
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## 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  
 $2^{16}-1$   
 none / stop / repeat and correct  
 0.1 us to 100,000 s  
 10 ms to 100,000 s  
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## 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  
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 Count Enable  
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Parameter-tagging of individual photons and continuous writing to disk  
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 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](http://www.becker-hickl.com)  
 W. Becker, The bh TCSPC Handbook, 9th edition (2021). Available on [www.becker-hickl.com](http://www.becker-hickl.com). Contact bh for printed copies.

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