



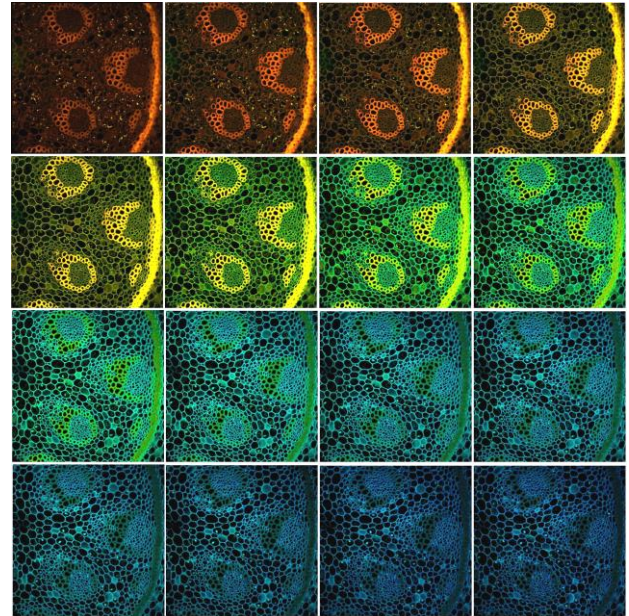
SPC-150N

TCSPC / FLIM Module

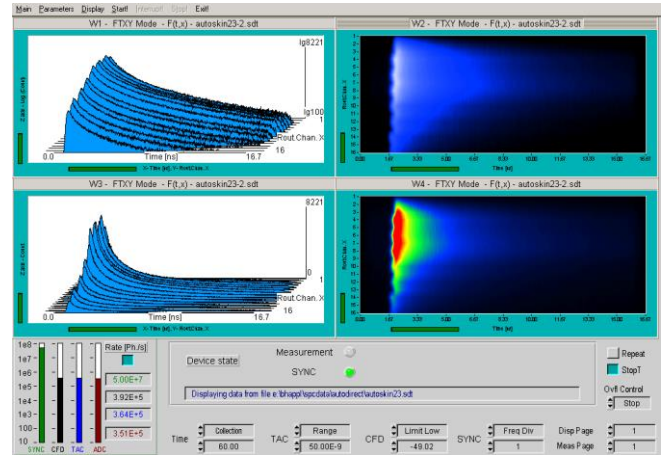
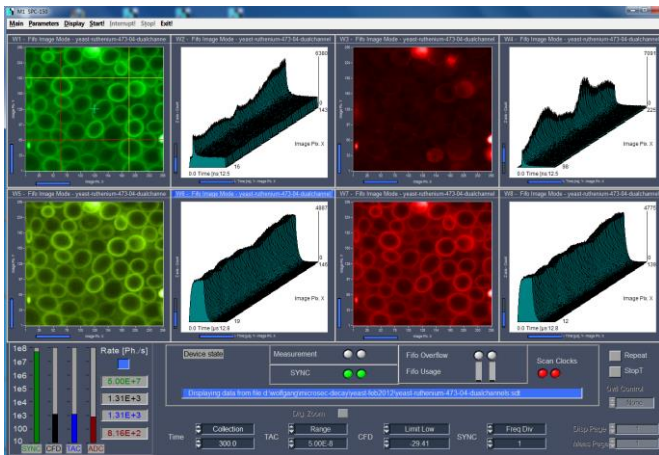
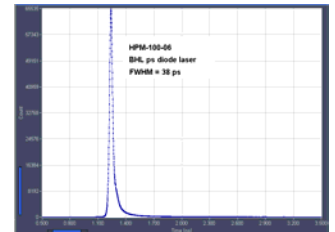
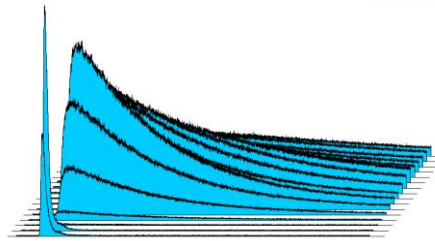
Time-Correlated Single Photon Counting Module

Improved version of SPC-150 TCSPC module
 Input discriminator bandwidth 4 GHz
 Improved resolution for ultra-fast detectors
 Ultra-high IRF stability
 Multi-detector / multi-wavelength capability
 FLIM by bh Megapixel Technology
 Mosaic FLIM mode
 Multiscaler imaging mode
 Photon distribution and parameter-tag modes
 Parallel operation of 2, 3 or 4 modules
 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

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
 Double-exponential FRET imaging
 Recording of Ca²⁺ transients
 fNIRS and NIRS experiments
 Single-molecule spectroscopy
 FCS, FCCS, PCH
 Anti-bunching experiments



ti = 1000 ps █ █ █ █ ti = 5000 ps



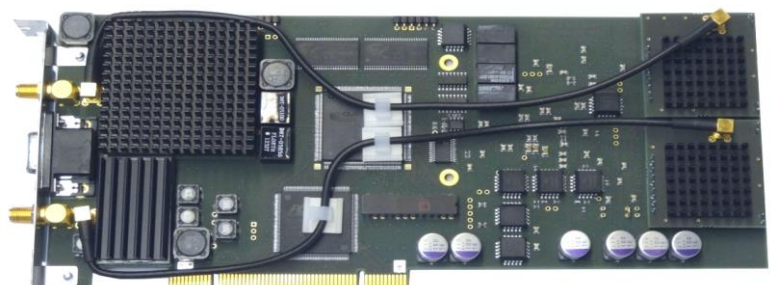
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SPC-150N

TCSPC / FLIM Module

Photon Channel

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

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

Synchronisation Channels

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

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

Time-to-Amplitude Converters / ADCs

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

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

Data Acquisition (Histogram Mode)

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

on-board multi-dimensional histogramming process
 100ns, independent of computer speed
 10 MHz
 5 MHz
 4096 1024 256 64 16 4 1
 16x16 64x64 128 x 128 256x256 512x512 1024x1024 2048x2048
 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
 Programmable Hardware Sequencer, unlimited recording by memory swapping, in curve mode and scan mode
 pixel, line and frame clocks from scanning device
 1 bit TTL
 TTL

Data Acquisition (FIFO / Parameter-Tag Mode)

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

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

Data Acquisition, FIFO 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
 PCI
 1
 approx. 12 W from +5V, 0.7 W from +12V
 240 mm x 130 mm x 15 mm

Related Products

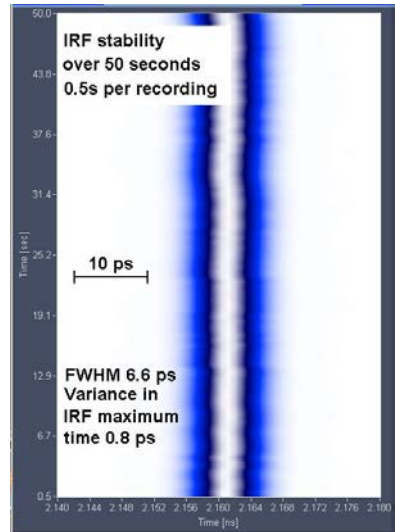
SPC-150NX, SPC-150NXX TCSPC Modules
 Simple-Tau 150 compact TCSPC systems
 Simple-Tau 154 compact 4-channel TCSPC systems
 DCS-120 confocal scanning FLIM system

HPM-100 GaAsP and GaAs hybrid detectors
 PML-SPEC and MW-FLIM multi-wavelength detectors
 PMC-150 cooled PMT modules
 id-100 SPAD detector modules

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

Related Literature

W. Becker, Advanced time-correlated single photon counting techniques. Springer 2005. Please contact bh for availability.
 W. Becker, The bh TCSPC Handbook, 7th edition. 891 pages, 1155 references. Available on www.becker-hickl.com. Contact bh for printed copies.
 PML-16-C 16 channel detector head for time-correlated single photon counting. User handbook. Available on www.becker-hickl.com
 DCS-120 Confocal Scanning FLIM Systems, handbook. Available on www.becker-hickl.com
 Modular FLIM systems for Zeiss LSM 510 and LSM 710 laser scanning microscopes, handbook. Available on www.becker-hickl.com. Contact bh for printed copies.
 BDL-SMN picosecond diode lasers, handbook. Available on www.becker-hickl.com
 Please see also www.becker-hickl.com, 'Literature', 'Application notes'



More than 25 years experience in multi-dimensional TCSPC. More than 2000 TCSPC systems worldwide.



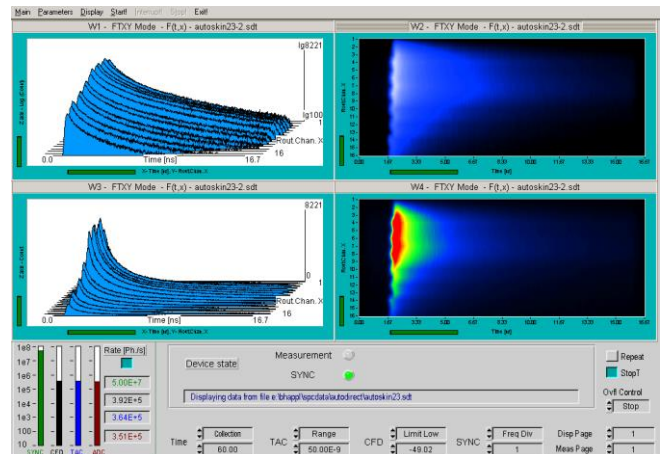
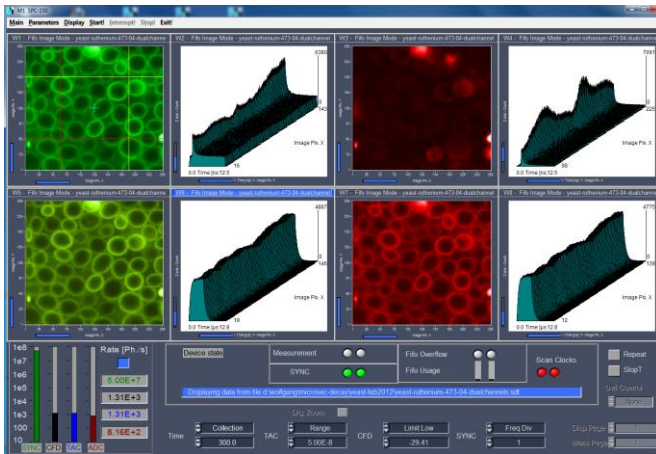
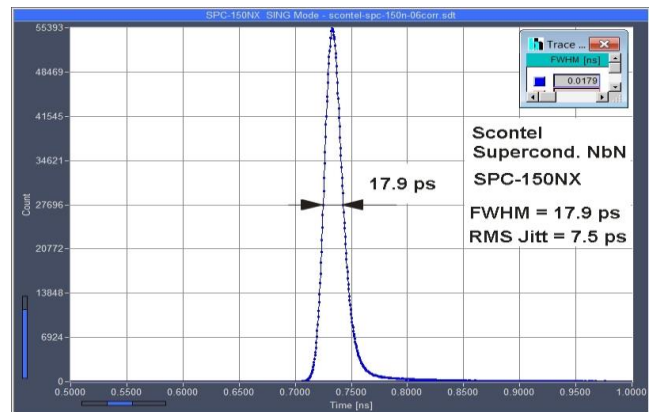
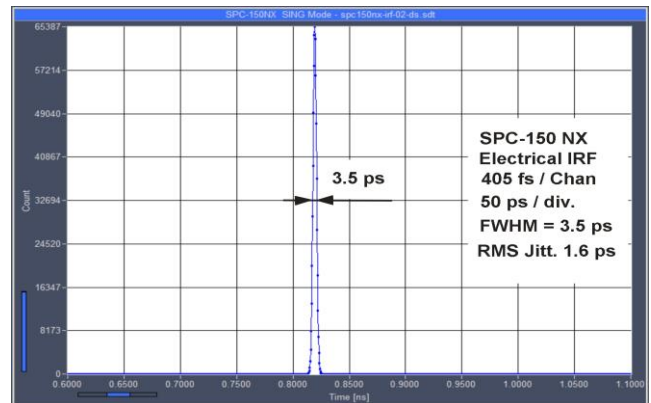
SPC-150NX

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
 Electrical IRF width 3.5 ps, FWHM
 Internal timing jitter 1.6 ps RMS
 Time-channel width down to 407 fs
 Ultra-high IRF stability
 Input discriminator bandwidth 4 GHz
 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
 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



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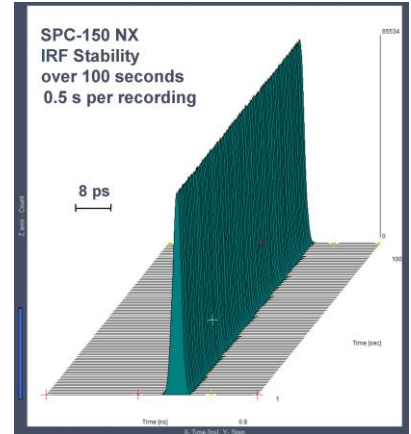
SPC-150NX

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

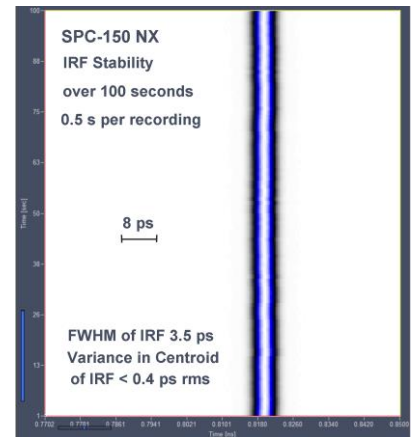
Principle
 TAC Range
 Biased Amplifier Gain
 Biased Amplifier Offset
 Time Range incl. Biased Amplifier
 min. Time / Channel
 ADC Principle
 Diff. Nonlinearity, electrical

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
 407 fs
 50 ns Flash ADC with Error Correction
 < 0.5% rms, typ. <1% peak-peak

Data Acquisition (Histogram Modes)

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

on-board multi-dimensional hardware histogramming process
 100 ns, independent of computer speed
 10 MHz
 5 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)
 FIFO buffer Capacity (photons)
 Macro Timer Resolution, internal clock
 Macro Timer Resolution, clock from SYNC input
 Routing
 External event markers
 Count Enable Control
 Experiment trigger

Parameter-tagging of individual photons and continuous writing to disk
 Decay function, FCS, Cross-FCS, PCH, MCS traces
 Multi-tau algorithm, online calculation and online fit
 unlimited
 100 ns
 10 MHz
 typ. 4 MHz
 unlimited
 12 / 12 / 4 bit
 $2 \cdot 10^8$
 50 ns, 12 bit, overflows marked by MTOF entry in data stream
 10 ns to 100 ns, 12 bit, overflows marked by MTOF entry in data stream
 4 bit TTL
 4 bit, TTL
 1 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 System
 Bus Connector
 Used PCI Slots
 Total power Consumption
 Dimensions

PC Pentium, multi-core, >8GB RAM, Windows 10
 PCI
 1
 approx. 12 W from +5V, 0.7 W from +12V
 240 mm x 130 mm x 15 mm

Related Products

SPC-150N, SPC-150NXX TCSPC modules
 Simple-Tau 150 compact TCSPC systems
 Simple-Tau 154 compact 4-channel TCSPC systems

HPM-100 GaAsP and GaAs hybrid 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

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, The bh TCSPC Handbook, 7th edition (2017). Available on www.becker-hickl.com. Please contact bh for printed copies.

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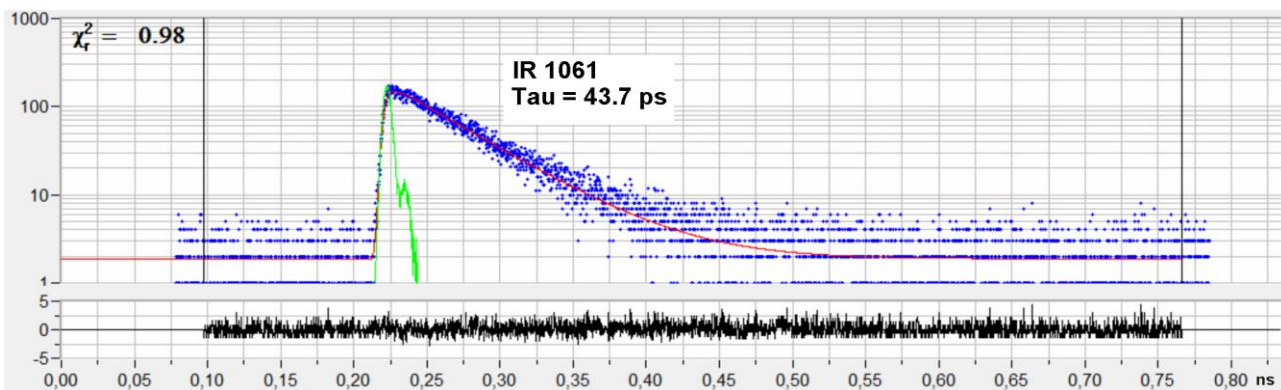
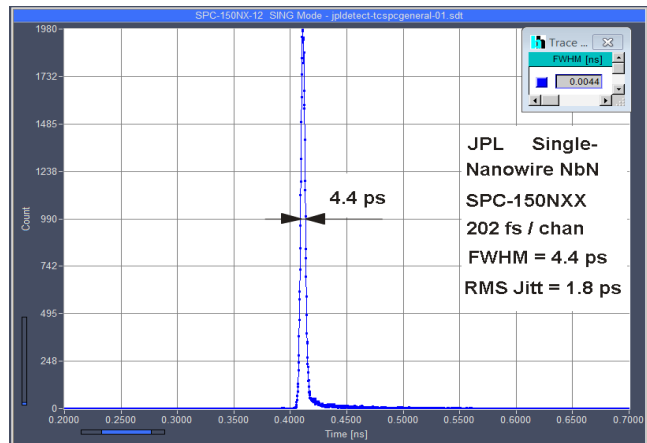
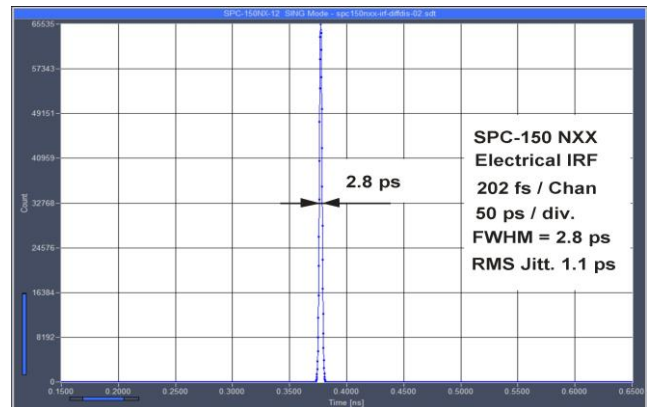
SPC-150NXX

Ultrafast TCSPC Module

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

- Ultra-high time resolution
- Electrical IRF width < 3 ps FWHM
- Internal RMS timing jitter 1.1 ps
- IRF with nanowire NbN detectors < 5 ps FWHM
- 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
- 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
- Fast-acquisition 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 25 years experience in TCSPC. More than 2000 TCSPC systems worldwide.



SPC-150NXX

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
 $2^{16}-1$
 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
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 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 / Macrotimer / Routing)
 FIFO buffer Capacity (photons)
 Macro Timer Resolution, internal clock
 Macro Timer Resolution, clock from SYNC input
 Routing
 Count Enable control
 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
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 10 MHz
 typ. 4 MHz
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 12 / 12 / 4 bit
 $2 \cdot 10^6$
 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

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1024 x 1024	512 x 512	256 x 256	128 x 128

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Computer System
 Bus Connectors
 Used PCI Slots
 Total power Consumption
 Dimensions

PC Pentium, multi-core, >8GB RAM, Windows 10
 PCI
 1
 approx. 12 W from +5V, 0.7 W from +12V
 240 mm x 130 mm x 15 mm

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 Simple-Tau 154 compact 4-channel TCSPC systems

HPM-100 GaAsP and GaAs hybrid 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, 7th edition (2017). Available on www.becker-hickl.com. Contact bh for printed copies.

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