



## **Boston Electronics Corporation**

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# **High Speed Optical Multiscalers Gated Counters & Boxcar Modules**

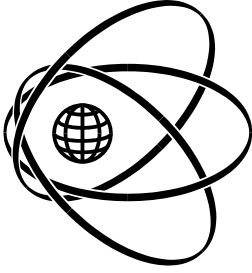
Photon Counters  
from Becker & Hickl

PC Based  
Systems



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Thank you for your interest in photon counters from Becker & Hickl GmbH, for whom Boston Electronics is exclusive North American agent. Becker & Hickl's principal business is in electronics for TCSPC, Time Correlated Single Photon Counting. The TCSPC technique is normally used for fluorescence lifetimes up from 2 picoseconds up to 2 microseconds, and photon migration measurements. If you are interested in TCSPC, request our separate publications on this technique.

Longer duration signals of whatever origin – laser radar, phosphorescence, luminescence, transient and kinetic phenomena - are processed with multiscalers, boxcars and the other devices described in this brochure.

We also supply appropriate fast photon-counting detectors and a variety of experiment control modules (model STP-340 stepping motor controller, model DDG-100 Digital Pulse/Delay generator, etc)

Manuals, application notes and prices (in euros) are available at [www.becker-hickl.com](http://www.becker-hickl.com).

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## **PC Based Photon Counting Systems**

### **Introduction**

Based on a wide variety of photon counting modules, Becker & Hickl delivers ready-to-use systems which contain one or more photon counting modules. Furthermore, combinations of different modules are available, and a step motor controller for experiment control can be added. Some examples for complex systems are described in this application note.

The following photon counting modules are available:

#### **Time-Related Single Photon Counting Modules**

- Recording of light pulses with a resolution down to 25 ps FWHM
- Time-Resolved Spectra with 25 ps Resolution
- Multi Detector Capability
- Short Measurement Times due to high Count Rates
- Optical Oscilloscope Capability
- Large Memory Versions for Image Scanning, Lifetime Imaging and Optical Tomography
- Versions for Fluorescence Lifetime Measurement of Single Molecules

#### **Gated Photon Counting Counters and Multiscalers**

- Up to 800 MHz Count Rate
- Multiscaling down to 250 ns / Channel
- Ultra-Low Background Count Rate by Gated Detection
- Steady State and Pulsed Emission Spectra
- Event Recording for Single Molecule Detection
- Bioluminescence Measurements

#### **Multichannel Photon Counters**

- Up to 32 Parallel Detector Channels with 100 MHz Count Rate

#### **Fast Multiscalers down to 5 ns / Channel**

- Luminescence Decay Measurements from ns to Seconds
- Ultra-Fast Acquisition, High Repetition Rates
- Time-of-Flight Measurements

#### **Step Motor Controllers**

- Monochromator Control and Sample Scanning

#### **Detectors and Preamplifiers**

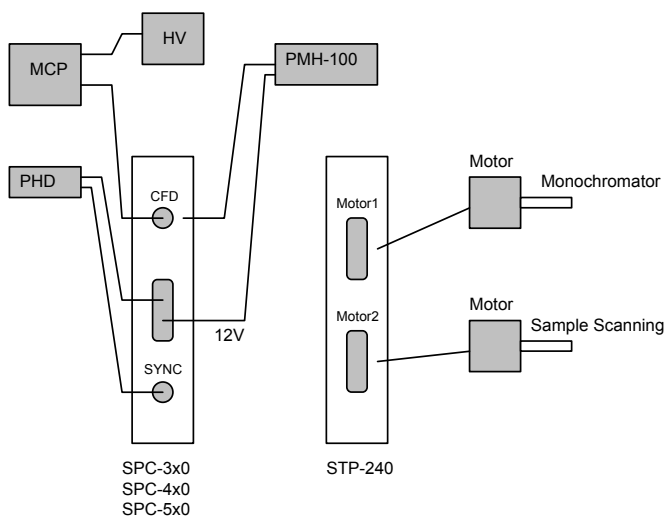
- PMT-Modules with internal HV Supply
- Ultra-Fast MCPs for TCSPC
- Preamplifiers with Detector Overload Detection
- Photodiode Modules for Gating and TCSPC Triggering

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## Time-Correlated Photon Counter with Step Motor Controller

A typical TCSPC (time-correlated single photon counting) system is shown in the figure below. It contains a time-correlated photon counting module (SPC-3, SPC-4 or SPC-5 module) and a step motor controller STP-240.



To achieve maximum time resolution, an MCP is used as detector. If maximum time resolution is not required, a PMH-100 detector is used. This is a rugged and easy-to use, but fast PMT module which is powered directly from the photon counting module. A fast photodiode module is used to synchronise the SPC module with the light source. Both the PMH-100 and the photodiode module are powered directly from the SPC module.

Typical applications of the system shown above are:

**Measurement of fluorescence decays or other optical waveforms down to 25 ps.** Due to the high count rates (8 MHz for SPC-4-versions) extremely short measurement times are achieved.

**Measurement of decay data of single Molecules (SPC-4-Versions).** Fluorescence decay data are collected for single molecules running through a capillary. Depending on the SPC module version, the data is stored as a set of subsequent decay curves in time intervals down to 1 ms or as independent information for each individual photon.

**Measurement of subsequent decay curves with wavelength stepping.** The full time and wavelength dependence of the sample is recorded as a set of decay curves for subsequent wavelengths.

**Measurement of decay curves with spatial scanning of the sample.** The spatial dependence of the sample emission is recorded set of decay curves for subsequent sample points. With the SPC-5-versions up to 16384 decay curves can be recorded in one measurement.

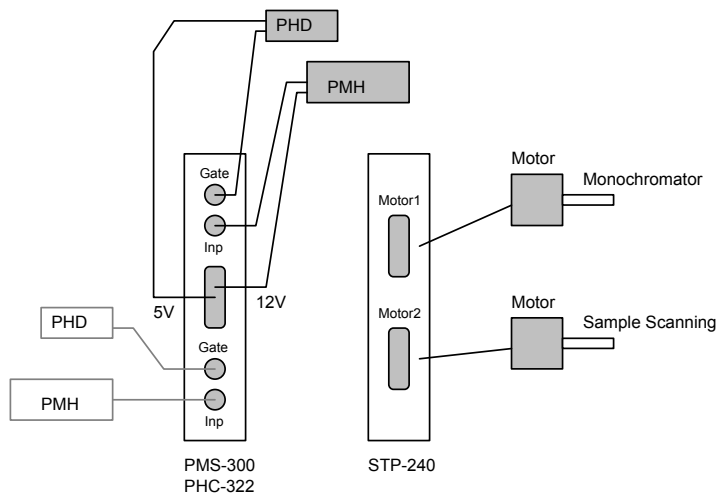
**Measurement of subsequent decay curves in programmed time intervals.** The variation of a sample with the time is recorded as a set of subsequent decay curves.

**Recording of time-resolved spectra in time windows down to 25 ps.** Up to eight spectra are recorded simultaneously for the same sample in different time windows.

**Optical Oscilloscope Applications.** All SPC modules provide an ‘Oscilloscope Mode’ which displays subsequently measured waveforms in intervals down to some 10 ms. Thus, optimising and adjusting your measurement setup is not longer a trial-and-error procedure.

## Gated Photon Counter / Multiscaler with Step Motor Controller

A typical Gated Photon Counting system is shown in the figure below. It contains a gated photon counter (PHC-322) or a gated photon counter / multiscaler (PMS-300) and a step motor controller.



To detect the light signals, one or two PMH-100 detectors are used. These are rugged and easy-to-use, but fast PMT module which are powered directly from the photon counting module. One or two fast photodiode modules are used to gate the PMS or PHC. As the PMH-100, the photodiode modules are powered from PMS or PHC module. Typical applications of the systems shown above are:

**Steady state emission spectra.** The high count rate of 800 MHz yields an exceptional high linearity up to extremely high peak intensities.

**Sample scanning.** The emission of the sample is recorded as a function of the position of the measured spot.

**Steady state emission spectra with pulse excitation and gated detection.** The gating reduces the detector background counts the extremely low values.

**Luminescence decay curves in the us range (PMS-300).** The high count rate of the PMS (800 MHz) allows to record more than 200 events for each channel in one sweep. Accumulation of several sweeps is free of dead time, therefore an extremely high repetition rate is achieved.

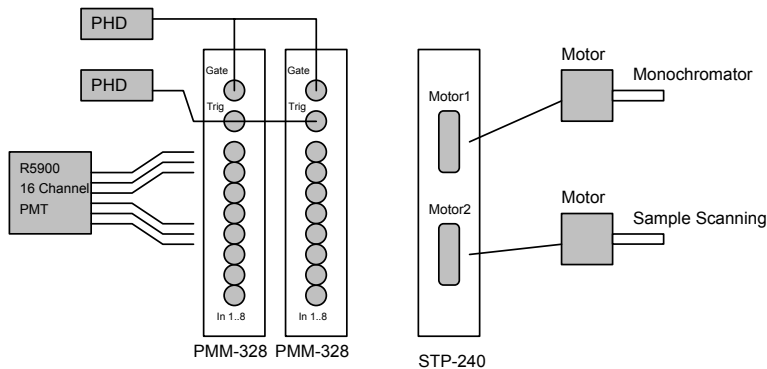
**Time-of-flight measurements with a resolution down to 250 ns (PMS-300).** The high count rate of the PMS (800 MHz) allows to record more than 200 events for each channel in one sweep.

Accumulation of several sweeps is free of dead time, therefore an extremely high repetition rate is achieved.

**Detection of single molecule or other particles (PMS-300).** The 'Event Mode' of the PMS-300 allows the recording of events like the transition of a single molecule or another particle through a laser focus. The background counts are suppressed by an adjustable 'Event Threshold'.

## 16 Channel Photon Counter / Multiscaler with Step Motor Controller

For application which require a high number of detector channels the PMM-328 Eight-Channel Photon Counter has been designed. A system with this device is shown in the figure below.



As a detector for the PMM-328 usually the R5900 from Hamamatsu is used. This is a PMT with 16 independent channels delivering one output signal each. The R5900 is available in a 1x16 and in a 4x4 configuration. To record the photons detected by the 16 PMT channels two PMM-328s are required. Again, a step motor controller STP-240 is included for monochromator control and sample scanning.

The applications of the system shown above are similar to these of the PHC / PMS system. However, due to the high number of counter channels the system has some interesting features:

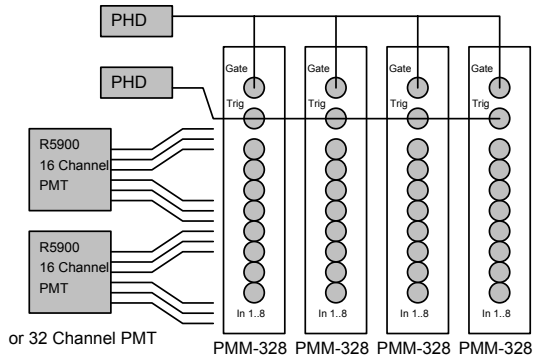
**Simultaneous measurement of 16 waveforms.** The PMM system records one waveform for each channel of the R5900. This can be used to investigate a sample at several wavelengths or at several points.

**High efficiency sample scanning.** 16 adjacent lines of a samples can be scanned simultaneously.

**Multi-photon counting.** A usual single channel photon counter can detect only one photon within its response time or within the response time of the detector. The system above can detect 16 photons at the same time - a stunning feature for a photon counter. To achieve multi-photon counting it is only required that the light is spread over all 16 channels of the R5900 and the results of the 16 counter channels are added.

## 32 Channel Photon Counter / Multiscaler

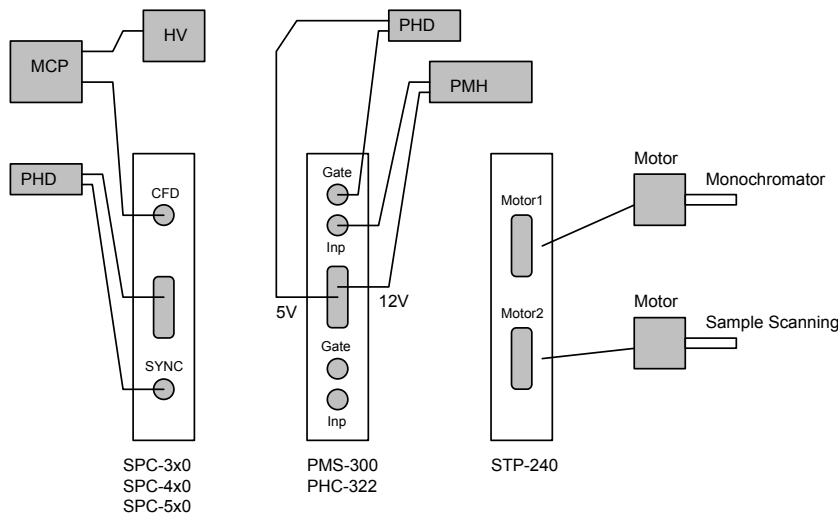
Up to four PMM-328 Eight-Channel Photon Counters can be combined in one system and operated with the same software.



With two R5900 PMTs or with a 32 channel PMT a 32 channel photon counting system can be built up. Systems of this type are used to simultaneously record up to 32 waveforms or to count several photons which appear simultaneously within the detector response time.

## Combined Time-Correlated and Gated Photon Counter

An extremely versatile system is shown in the figure below. It contains a time-correlated photon counting module (SPC-3, SPC-4 or SPC-5 module), a gated photon counter (PHC-322) or gated photon counter / multiscaler (PMS-300) and a step motor controller. The step motor controller is used both by the SPC and by the PMS / PHC module software.



To achieve maximum time resolution with the TCSPC part, an MCP is used as detector. For the Gated Photon Counting and Multiscaling part a PMH-100 detector is used. This is a rugged and

easy-to use, but fast PMT module which is powered directly from the photon counting module. Two fast photodiode modules are used for the synchronising of the SPC module and for gating the PMS or PHC. As the PMH-100, the photodiode modules are powered from the SPC and PMS or PHC modules.

The system can be used for

**Measurement of fluorescence decays or other optical waveforms down to 25 ps.** Due to the high count rates (8 MHz for SPC-4-versions) extremely short measurement times are achieved.

**Measurement of decay data of single Molecules (SPC-4-Versions).** Fluorescence decay data are collected for single molecules running through a capillary. Depending on the SPC module version, the data is stored as a set of subsequent decay curves in time intervals down to 1 ms or as independent information for each individual photon.

**Measurement of subsequent decay curves with wavelength stepping.** The full time and wavelength dependence of the sample is recorded as a set of decay curves for subsequent wavelengths.

**Measurement of decay curves with spatial scanning of the sample.** The spatial dependence of the sample emission is recorded set of decay curves for subsequent sample points. With the SPC-5-versions up to 16384 decay curves can be recorded in one measurement.

**Measurement of subsequent decay curves in programmed time intervals.** The variation of a sample with the time is recorded as a set of subsequent decay curves.

**Recording of time-resolved spectra in time windows down to 25 ps.** Up to eight spectra are recorded simultaneously for the same sample in different time windows.

**Optical Oscilloscope Applications.** All SPC modules provide an 'Oscilloscope Mode' which displays subsequently measured waveforms in intervals down to some 10 ns. Thus, optimising and adjusting your measurement setup is not longer a trial-and-error procedure.

**Steady state emission spectra.** The high count rate of 800 MHz yields an exceptional high linearity up to extremely high peak intensities.

**Steady state emission spectra with pulse excitation and gated detection.** The gating reduces the detector background counts the extremely low values.

**Luminescence decay curves in the us range (PMS-300).** The high count rate of the PMS (800 MHz) allows to record more than 200 events for each channel in one sweep. Accumulation of several sweeps is free of dead time, therefore an extremely high repetition rate is achieved.

**Time-of-flight measurements with a resolution down to 250 ns (PMS-300).** The high count rate of the PMS (800 MHz) allows to record more than 200 events for each channel in one sweep. Accumulation of several sweeps is free of dead time, therefore an extremely high repetition rate is achieved.

**Detection of single molecules or other particles (PMS-300).** The 'Event Mode' of the PMS-300 allows the recording of events like the transition of a single molecule or another particle through a laser focus. The background counts are suppressed by an adjustable 'Event Threshold'.

## Multiphoton Counting Systems

‘I want to measure the intensity of femtosecond light pulses. The intensity is very low; therefore I would like to use a photon counter. The repetition rate of my laser is 1 kHz. I get several photons for each laser shot. Not many, but just more than one. And they come exactly at the same moment. How can I count them?’

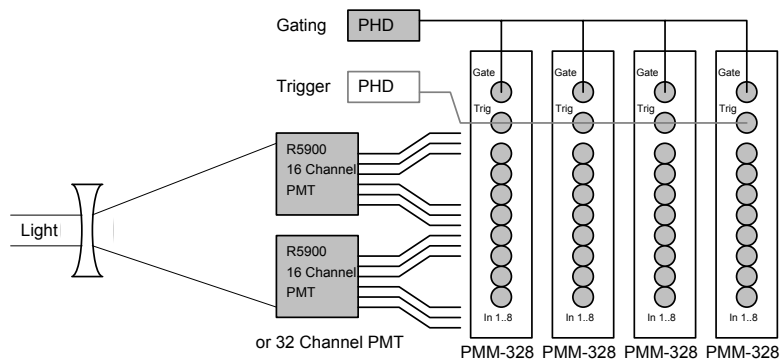
‘You can’t’, will be the answer. ‘The detector delivers a different pulse amplitude for each photon. Even if you measure the amplitude of the PMT pulse (e.g. by a boxcar integrator) you can’t get the exact number of photons’.

Is there really no way out?

## Multichannel Photon Counters

The PMM-328 Photon Counter / Multiscaler from Becker & Hickl has eight independent counter channels. Up to four PMM-328s can be combined in one system and operated with the same software. Thus, up to 32 independent counter channels are available. Normally, such systems are used to simultaneously record 32 independent waveforms or spectra. But what happens if we distribute a single light signal to the 32 detector channels?

The four-PMM-328 system is shown in the figure below. As a detector for the 32 channels two R5900s are used. These are 16 channel PMTs from Hamamatsu which are available in a 1x16 pixel or in a 4x4 pixel configuration.



If the probability to detect one photon in a particular detector channel and in a particular laser pulse is  $p$ , then the probability to detect two photons is  $p^2$ . Therefore, the result after counting the photons of many laser pulses is too small by a factor of  $1-p^2$ <sup>1</sup>. Although this error can be corrected because  $p$  can be derived from the counter result and the number of laser pulses,  $p^2$  should be held below 0.1. That means that  $p$  can be as high as 0.316, i.e. each detection channel can record about one photon for three laser

<sup>1</sup> To simplify the consideration the detection of more than 2 photons per channel and laser pulse is neglected.

pulses. Therefore, with the 32 channels of the system shown above about 10 photons can be detected for each laser pulse without having more than 10 % counting loss.

The table below shows the maximum number of photons per pulse for a different accuracy and for different counter configurations.

Accuracy (without Correction)	1 Channel	8 Channels 1 PMM-328	16 Channels 2 PMM-328	32 Channels 4 PMM-328
2%	0.14	1.13	2.26	4.52
5%	0.22	1.78	3.58	7.16
10%	0.316	2.53	5.05	10.1
20%	0.45	3.57	7.15	14.2

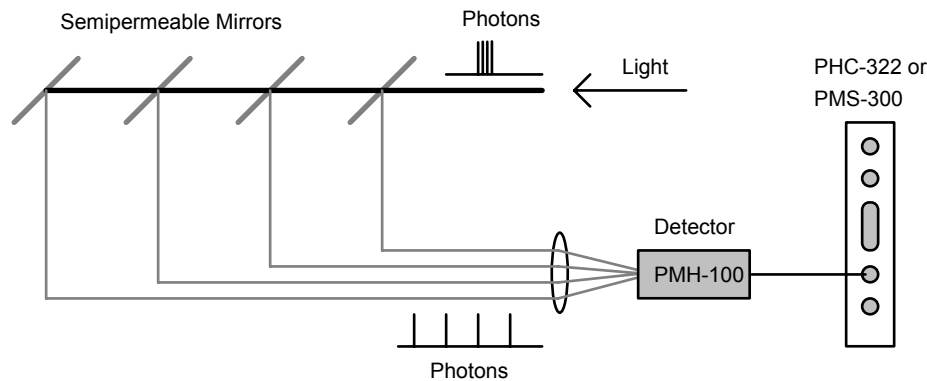
**Table1: Maximum number of photons per pulse for different number of channels**

Of course not only the PMM-328 but also the other B&H photon counters can be used for multichannel detection. However, due to the smaller number of channels (2 per module for the PMS-300 and the PHC-322) the effect is not as striking as for the PMM-328.

## Multiphoton Counting in one Counter Channel

The problem which we encountered at the beginning was the detection of several photons at the same moment. With the multichannel system described above these photons are spread over several detector and counter channels.

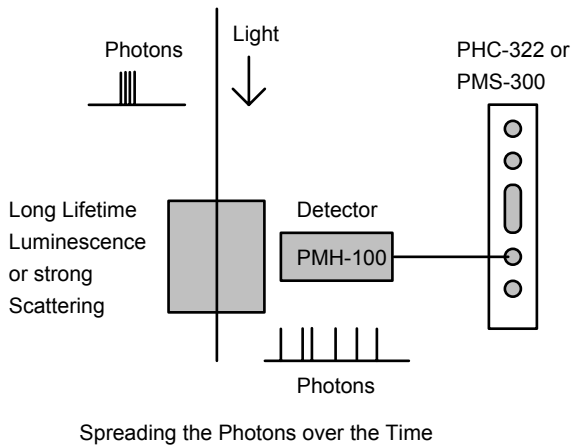
There is still another possibility to count the photons - to spread them over a longer time interval. One possible solution is shown in the figure below.



Spreading the Photons over the Time

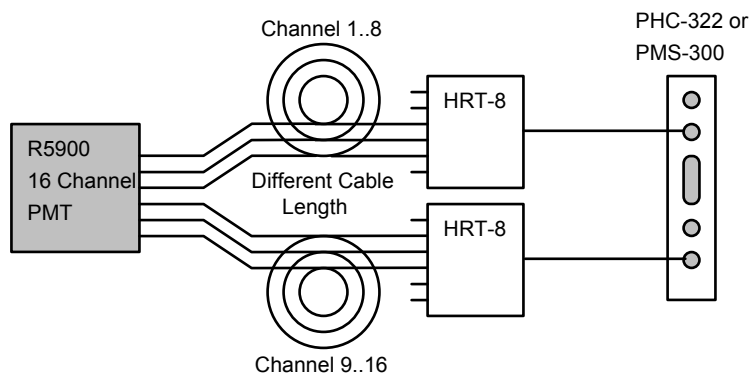
The measured light pulse is spread into several beams which are fed to only one detector. The path length for the individual beams is made different, so that the detector and the counter is able to resolve the photons. If a fast detector (PMH-100) and a fast counter (PHC-322 or PMS-300) is used individual photons can be detected if the propagation delay differences are as small as 5 ns.

If some loss of photons is not a concern, the time-spreading of the photons can also be achieved by set of light fibres of different length, a long-lifetime luminescence or by scattering. The optical set-up for the latter cases becomes very simple:



The benefit of this method is that the photons can be spread over very long time intervals. Therefore, a large number of photons can be detected for each laser pulse. Luminescence decay times of some us can easily be reached with inorganic crystals or even filter glasses (Schott GG17). If the resolution of the detector / counter system is assumed to be 5 ns the set-up is equivalent to a 200 channel system. There is no problem to record 50 to 100 photons per pulse with such a system.

The spreading of the photon pulses can also be achieved electronically. However, the equivalent number of channels is limited in this case. The set-up is shown in the figure below.



The photon pulses from the outputs of a 16 channel detector are delayed by cables of different length. Then, the signals from eight channels each are combined into one signal by a HRT-8 module. (This module is normally used to connect eight detectors to one SPC-3, SPC-4 or SPC-5 time-correlated single photon counting module.) The combined signals are counted by the two counter channels of one PHC-322 or PMS-300 module.

# MSA-1000

## 1ns 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

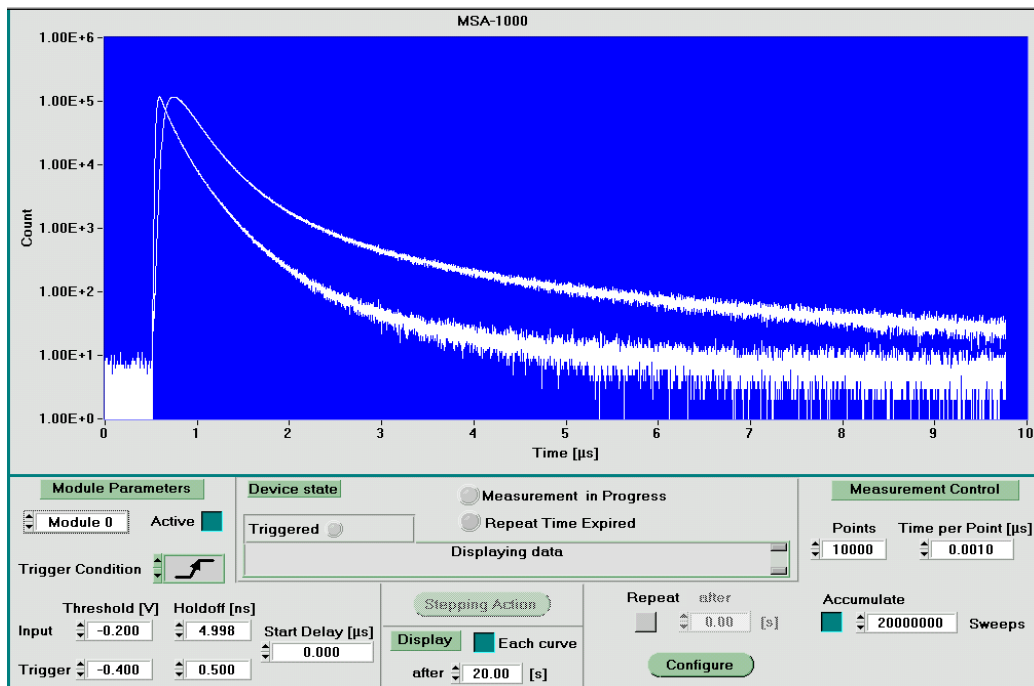
Time / channel 1 ns

Count rate up to 1000 MHz

Up to 128 k points / curve

Software for Windows 95 / 98 / 2000 / NT

The MSA-1000 is an ultra-fast multiscaler for photon counting, Lidar 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-1000 exceptionally useful for a wide variety of high-repetition rate signal recording applications.



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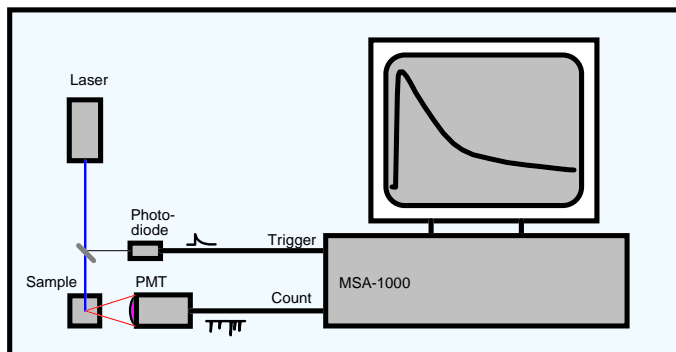
# MSA-1000

## Specification

Time per Channel	min. 1 ns
Count Rate	up to 1000 MHz
No of Points / Curve	up to 128 k
Overall Recording Length	up to 131 $\mu$ s
Accumulation (up to 256 events/point)	Hardware, no dead time between recording cycles
Accumulation (> 256 events/point)	Software
Count Input Impedance	50 $\Omega$
Count Input Amplitude	$\pm 20$ mV to $\pm 1$ V
Count Input Threshold	0 to $\pm 200$ mV, $\pm 8$ bit resolution
Min.Count Input Pulse Width	800 ps
Trigger Input Impedance	50 $\Omega$
Count and Trigger Input Connectors	SMA
Trigger Input Amplitude	$\pm 20$ mV to $\pm 1$ V
Trigger Input Threshold	0 to $\pm 1$ V, $\pm 8$ bit resolution
Min. Trigger Pulse Width	800 ps
Data Readout	subsequent data points are read by subsequent input instructions
Typical readout rate (Pentium 166 MHz)	1 $\mu$ s/point (C++, read 1 point and store into a data array)

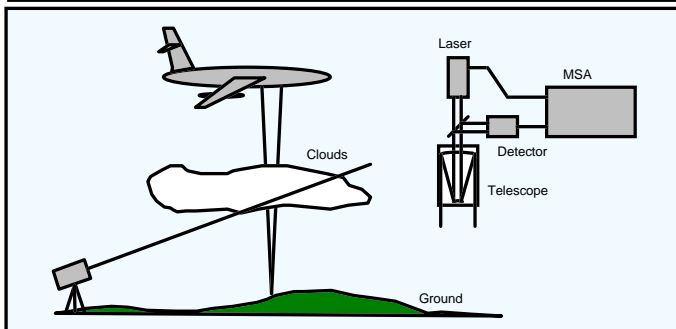
## Luminescence Decay Measurements

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



## Lidar Measurements

Laser pulses are sent through a telescope and backscattered light from distant objects is detected. Due to the high accumulation speed of the MSA-1000 very high repetition rates and short overall measurement times are achieved.



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

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



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# MSA-300

## 5ns Photon Counter / Multiscaler

Ultra-fast accumulation

High repetition rate

No dead time between sweeps

No dead time between channels

Fast on-board discriminators

Input pulse width down to 800 ps

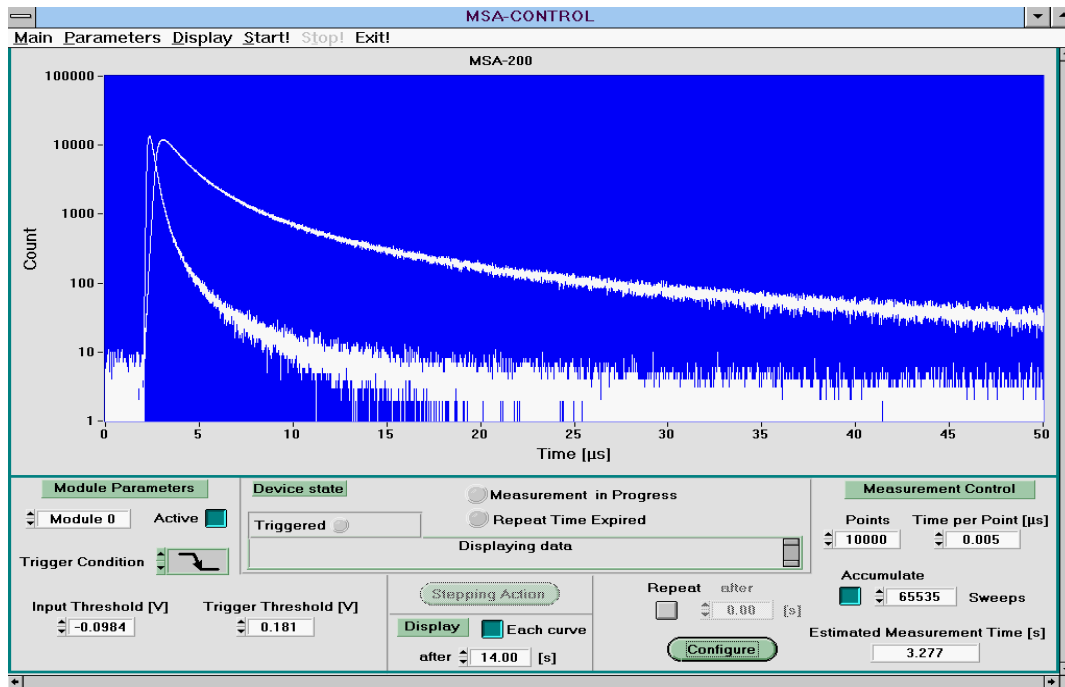
Time / channel down to 5 ns

Count rate up to 100 MHz

Up to 512 k points / curve

Software for Windows 95 / 98 / 2000 / NT

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



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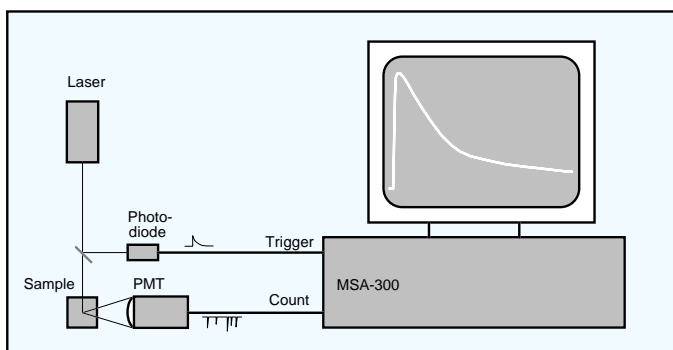
# MSA-300

## Specification

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

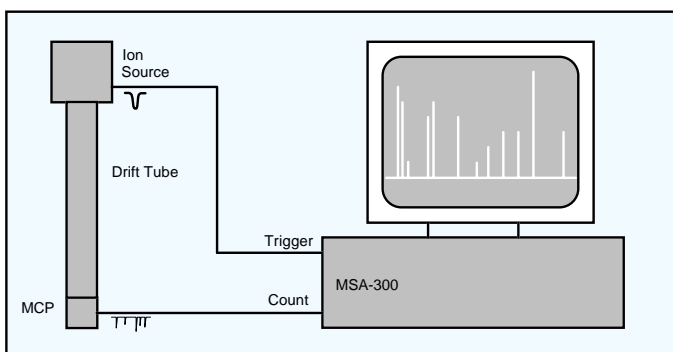
## Luminescence Decay Measurements

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



## Time-of-Flight Measurements

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



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

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



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<http://www.becker-hickl.com> [info@becker-hickl.com](mailto:info@becker-hickl.com)

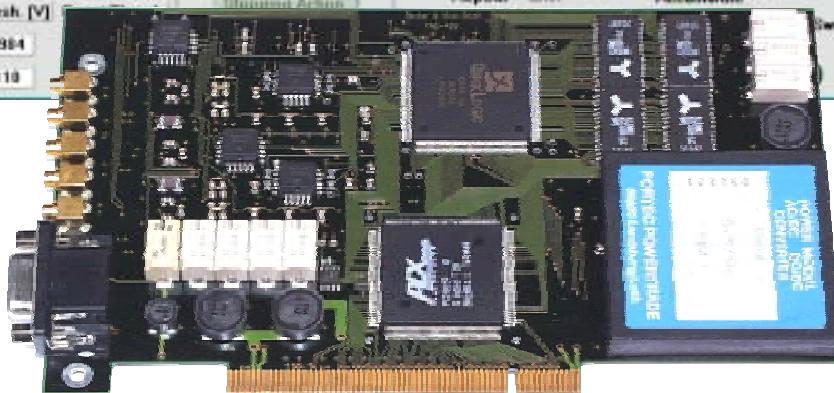
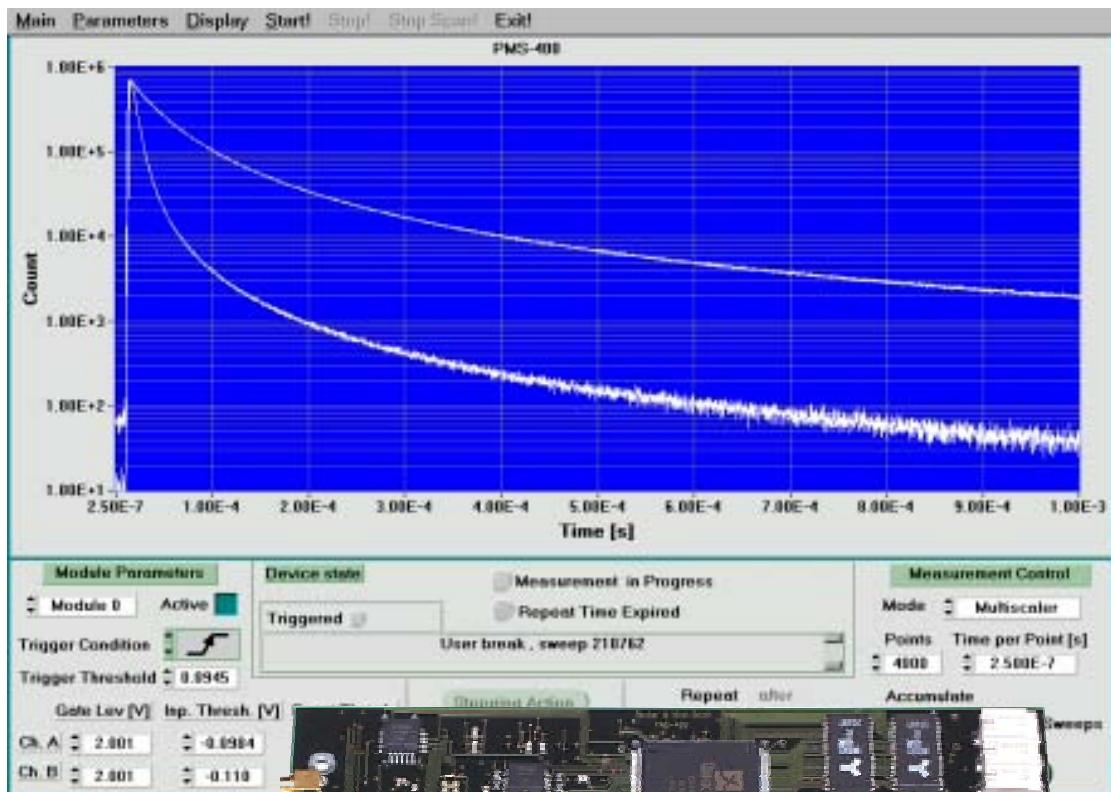
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Massachusetts 02445 USA  
Tel: (800) 347 5445 or (617) 566 3821, Fax: (617) 731 0935  
[www.boselec.com](http://www.boselec.com) [tcspc@boselec.com](mailto:tcspc@boselec.com)



# PMS-400

## 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
- On-Board Discriminators, Timing and Control Logics
- PCI Board, Software for Windows 95, 98, 2000 and NT
- Parallel Operation of Several Modules Supported



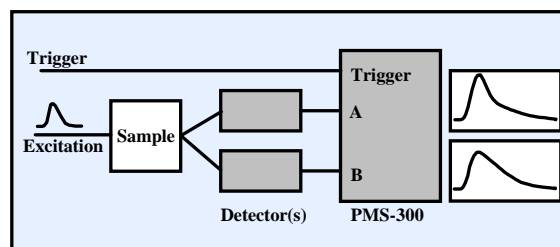
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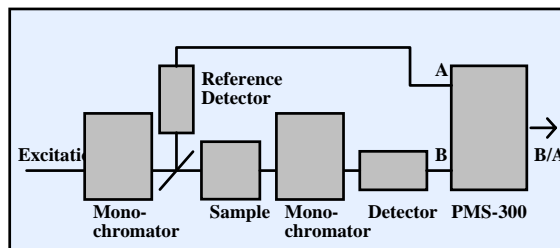
## Optical Transient Waveform Recording

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



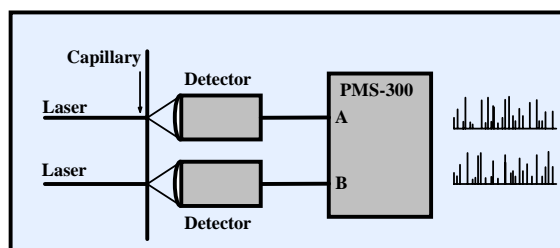
## Recording of Luminescence Spectra

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



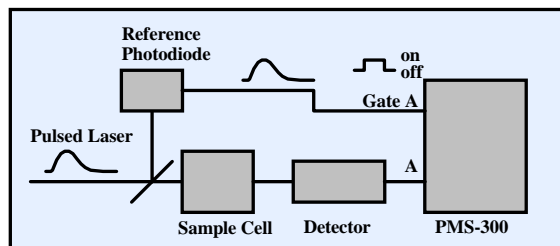
## Single Molecule Detection

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



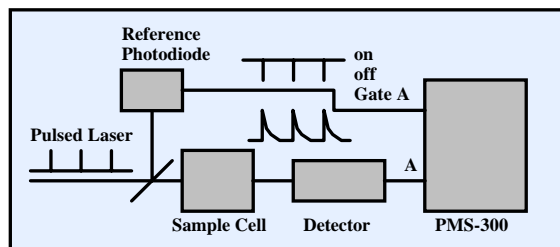
## Gated Detection

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



## Gating off Scattering Pulses

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



## Specification (Typical Values)

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

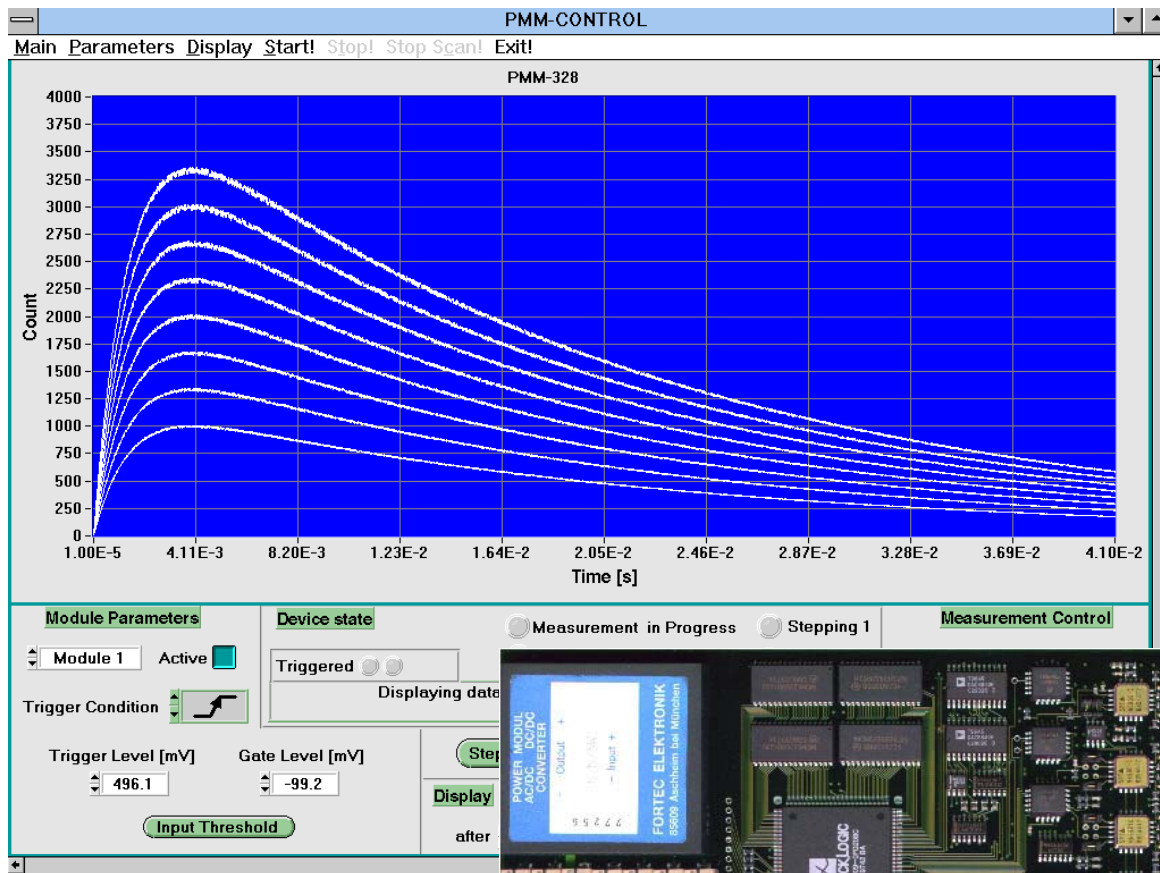
For manual, application notes and software please see [www.becker-hickl.de](http://www.becker-hickl.de)



# PMM-328

## 8 to 32 Channel 100 MHz Photon Counter / Multiscaler

- 8 Counter Channels per Module, 32 Counter Channels with 4 Modules
- 100 MHz Channel Count Rate
- 16 bit Counter Resolution
- Up to 32 k Points / Channel
- Multiscaler Operation down to 250 ns / Point
- Gated Photon Counting down to 2 ns Gate Width
- Optional Step Motor Controller for Experiment Control



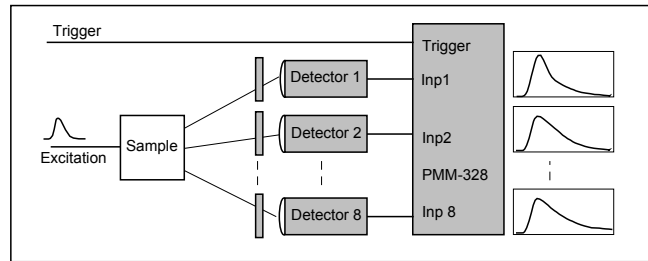
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# PMM-328

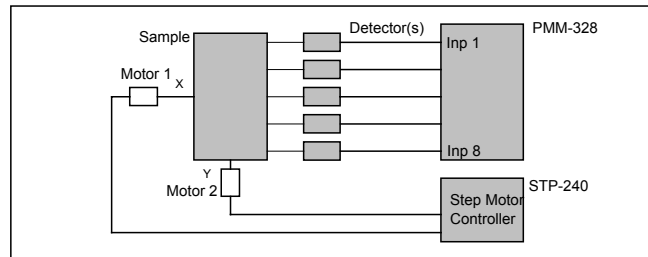
## Multichannel Optical Waveform Recording

The waveform of the light is recorded with a channel resolution down to 250ns. Up to eight light signals can be recorded simultaneously in one module.



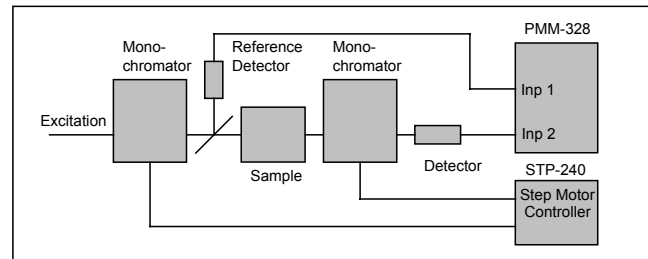
## Sample Scanning

A sample is scanned in X-Y direction by two step motors controlled by the STP-240 step motor controller. Up to eight light signals can be recorded in one PMM module.



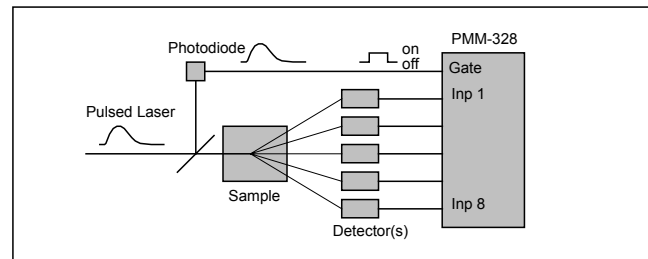
## Measurement of Luminescence Spectra

The luminescence and the excitation light are recorded simultaneously. Corrected excitation spectra are obtained by calculating Inp1 / Inp2.



## Gated Detection

The gate is opened during the laser pulse only. Background events outside the laser pulse are suppressed.



## Specification

Counter Channels per Module	8
Input Pulse Polarity	positive or negative
Input Threshold	$\pm 10$ mV to $\pm 200$ mV, Resolution 8 bit
Minimum Input Pulse Width	800 ps
Maximum Count Rate	> 100 MHz
Counter Resolution	16 bit
Memory Channels	32 k for each counter channel
Gate Input Pulse Polarity	positive or negative
Gate Threshold	$\pm 10$ mV to $\pm 200$ mV, Resolution 8 bit
Minimum Gate Pulse Width	2 ns
Time / Point (Multiscaler)	250 ns to 100 000 s
Collection Time	200 ns to 100 000 s
Software	for Windows 3.1 / 95 / 98 / NT

For Detectors, Preamplifiers, Photodiode Modules, Optical Trigger Devices, Step Motor Controllers please see individual data sheets.

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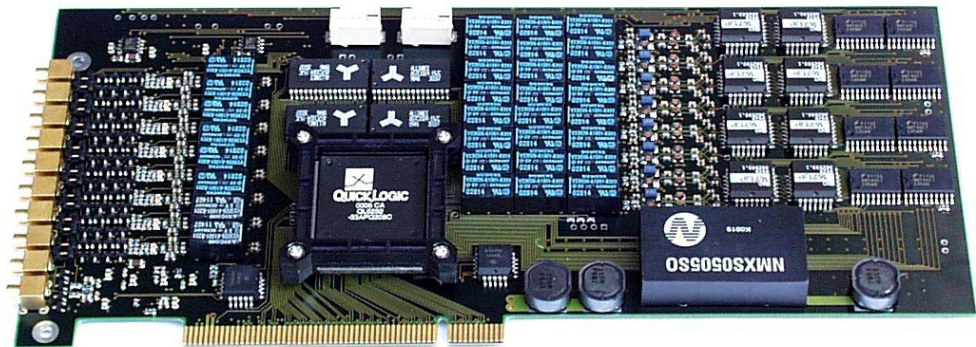
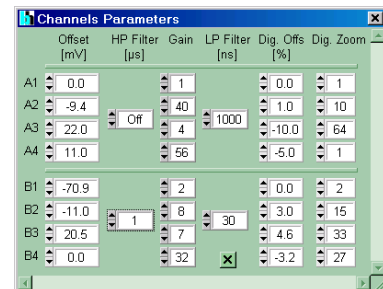
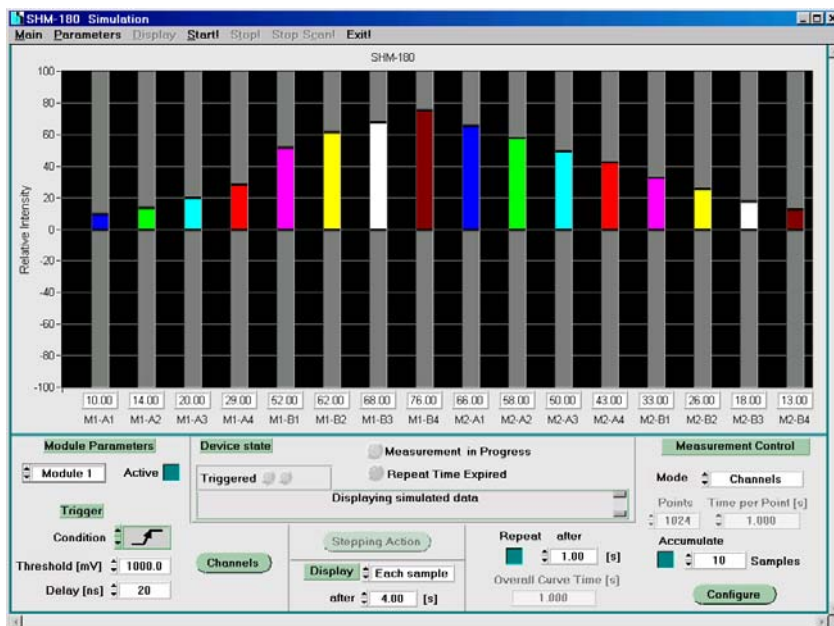
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 measurement  
 and  
 control systems

# 8 Channel Sample & Hold Module SHM-180

Parallel sampling of signals from PMT arrays, multi-anode PMTs, or photodiode arrays

- ◆ 8 parallel sampling channels in one SHM-180 module
- ◆ Up to 32 channels in four parallel SHM-180 modules
- ◆ On-board sample delay generator
- ◆ Low noise due to selectable input filtering
- ◆ Wide, adjustable input voltage range
- ◆ 12 bit single-shot conversion accuracy
- ◆ Accumulation of up to 65.535 samples
- ◆ Accumulation rate up to 1 MS / s
- ◆ Operation software for Windows 95, 98, NT4 and 2000

New Product



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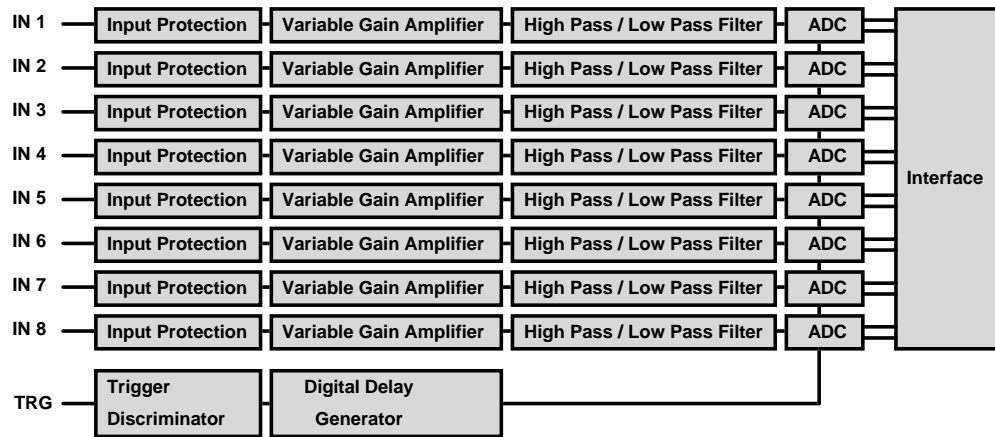
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UK Representative:  
Photonic Solutions PLC  
sales@psplc.com  
www.psplc.com

# 8 Channel Sample & Hold Module SHM-180

## System Architecture



### Signal Channels

Input Impedance	1 k $\Omega$ or 50 $\Omega$ , jumper selectable
Input Coupling	DC or AC, jumper selectable
Input Connectors	MCX
Low Pass Filter	30 ns - 100 ns - 300 ns - 1 $\mu$ s
High Pass Filter	1 $\mu$ s - 10 $\mu$ s - 100 $\mu$ s - 'off'
Channel Gain	1 to 56
Full scale input voltage	$\pm$ 45 mV to $\pm$ 2.5V
Max. Sample Rate	1 MS/s
ADC Resolution	12 bit

### Trigger Input

Input Impedance	50 $\Omega$
Input Coupling	DC
Input Connector	MCX
Trigger Threshold	-1 V to +1 V
Min. Trigger Pulse Width	1 ns
Max. Trigger Input Frequency	100 MHz
Max. Trigger Rate	1 MHz

### Sample Delay Generator

Delay Range	0 to 655 $\mu$ s
Delay Step Width	10 ns
Delay Jitter	2.5 ns
Delay Stability	< 50 ppm

### Multi Module Systems

Number of modules operable parallel	4
-------------------------------------	---

### Operation Environment

Computer System	PC Pentium
Bus Connector	PCI
Power Consumption	approx. 10 W at +5V
Dimensions	PCI card, 235 x 110 mm

### Related Products and Accessories

PMT modules, pin and avalanche photodiode modules, integrating photodiode modules, preamplifiers, step motor controllers, delay generators, programmable pulse generators, ps Diode Lasers, gated and time-correlated photon counters, photon-multiscalers. To control detectors and shutters please see DCC-100 detector controller. Please download or call for individual data sheets and manuals.



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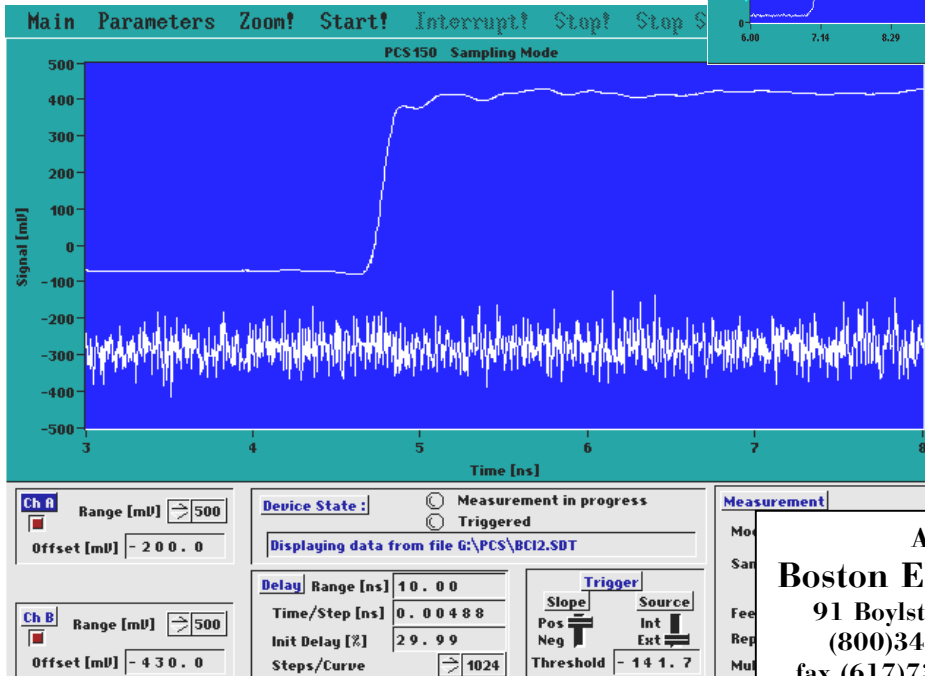
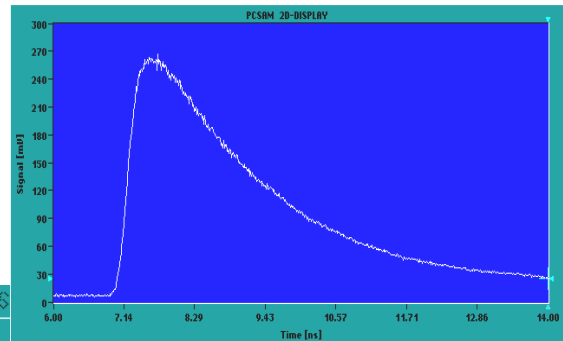


# PCS-150

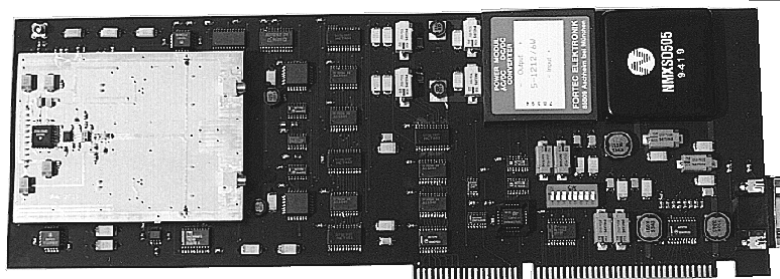
# PCI-200

## High Speed Boxcar Modules

- Gate Width 120 ps for PCS-150
- Gate Width 2 ns to 50 ns for PCI-200
- 2 Synchronously Sampling Signal Channels
- Internal Delay Generator
- Delay Stepping down to 5 ps
- Boxcar Measurements in the sub-ns Range
- Recovery of Signals from Noise
- Scanned Delay Mode: Recording of Waveforms
- Fixed Delay Mode: Single Point Analysis



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[info@becker-hickl.de](mailto:info@becker-hickl.de)



# PCS-150

# PCI-200

	PCS-150	PCI-200
No. of Signal Channels		2
Gate Width (PCS-150)	120 ps	2 ns to 50 ns
Input Impedance		50 $\Omega$ (SMA Connector)
Input Voltage Ranges		50 100 200 500 mV
Amplitude Resolution		9 10 11 12 bit (without averaging)
Amplitude Resolution		12 bit (100 samples averaged)
Internal Noise (rms)	1 mV	< 0.25 mV
Channel Arithmetics		A+B, A-B, A*B, A/B
No of Samples Averaged		1 to 4096
Averaging Modes		Repeated Sampling or Boxcar Mode
Delay Range		10 ns to 20 us
Delay Step Width		5 ps to 312 ns
Virtual Sample Rate		up to 200 GS/s
X-Axis Resolution		64 to 1024 points
Scan Modes		Fixed Delay and Scanned Delay
Trigger		external or internal on channel A
Ext. Trigger Input		50 $\Omega$ (SMA Connector)
Trigger Input Frequency		0 to 500 MHz
min. Trigger Pulse Width		1 ns
Trigger Threshold		-1V to + 1V
Max. Internal Trigger Rate		up to 100 kHz dep. on mode and PC speed
Dimensions		120 x 337 mm
Power Consumption		typ. 12 W at + 5 V

## Accessories

AC coupled preamplifiers up to 2.2 GHz, DC coupled preamplifiers up to 250 MHz, high speed pin and avalanche photodiode modules, low noise integrating photodiode modules, PMT modules, optical trigger devices, step motor controllers, DLL and DOS library for user specific programming

## Also Available:

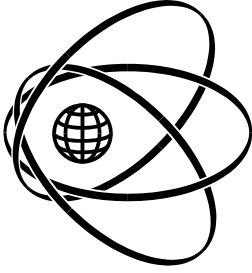
Stand alone boxcar devices BCI-150 and BCI-200 with IEEE interface, gate width 120 ps or 2 ns to 50 ns.

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Thank you for your interest in photon counters from Becker & Hickl GmbH, for whom Boston Electronics is exclusive North American agent. Becker & Hickl's principal business is in electronics for TCSPC, Time Correlated Single Photon Counting. The TCSPC technique is normally used for fluorescence lifetimes up from 2 picoseconds up to 2 microseconds, and photon migration measurements. If you are interested in TCSPC, request our separate publications on this technique.

Longer duration signals of whatever origin – laser radar, phosphorescence, luminescence, transient and kinetic phenomena - are processed with multiscalers, boxcars and the other devices described in this brochure.

We also supply appropriate fast photon-counting detectors and a variety of experiment control modules (model STP-340 stepping motor controller, model DDG-100 Digital Pulse/Delay generator, etc)

Manuals, application notes and prices (in euros) are available at [www.becker-hickl.com](http://www.becker-hickl.com).

Related products that we offer include

- ❑ Laser Radar Transient Recorders from Licel
- ❑ Laser Radar APD receiver modules from Licel
- ❑ Photon counting PMTs and MCP-PMTs from Hamamatsu
- ❑ Picosecond Laser Diode sources from B&H
- ❑ Fluorescence lifetime spectrometers from Edinburgh Instruments
- ❑ FLIM upgrade kits for scanning confocal microscopes from B&H
- ❑ Picosecond fluorescence lifetime microscopes from JenLab

Ask for complete product literature, available as .pdf files or by good old postal mail (remember that?)