



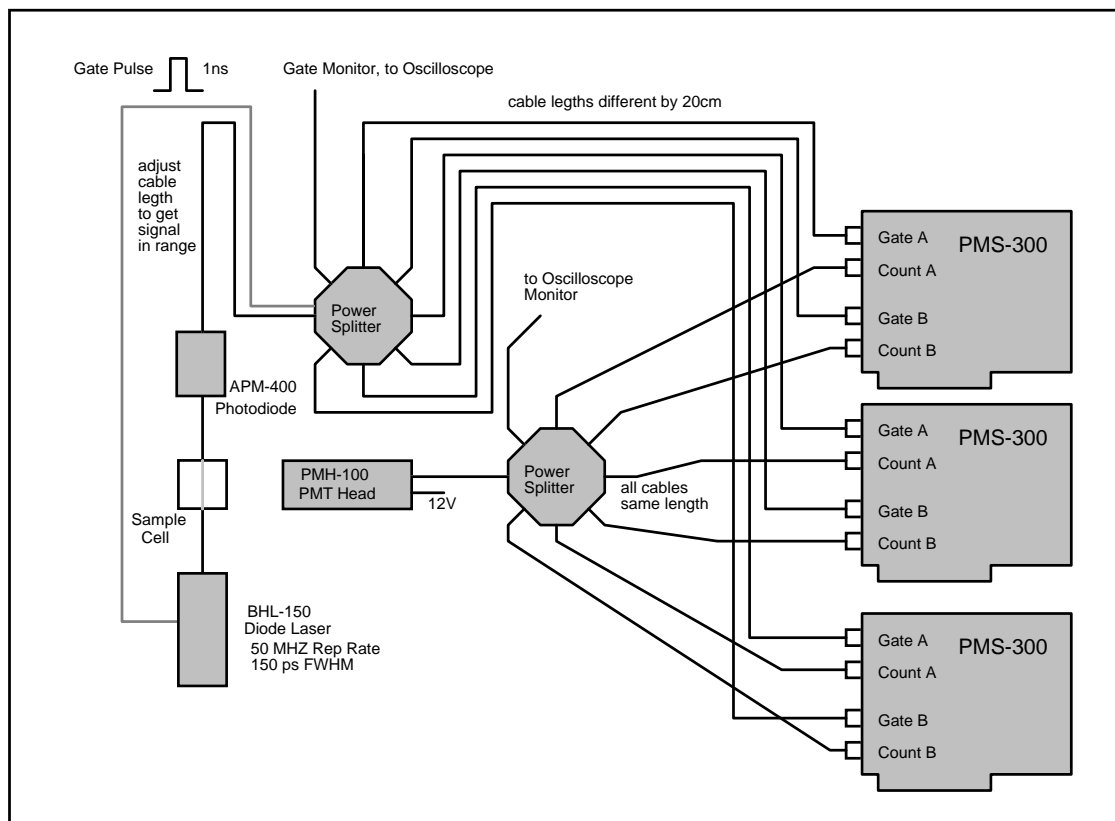
Nanosecond Time Resolution with the PMS-300

Recording the shape of a light pulse is usually managed by time-correlated single photon counting or by multiscaling. However, time-correlated single photon counting can record only one photon per pulse period, and multiscalers have problems to utilise high repetition rates. If a short measurement time is important a method is required which records several photons per signal period (as a multiscaler does) and accumulates at pulse high repetition rates (as the time-correlated single photon counting does). Furthermore, it should allow extremely high count rates.

For applications which get along with a few points to characterise the pulse shape a simple, but efficient recording system can be built up with several PMS-300 Gated Photon Counter / Multiscaler modules.

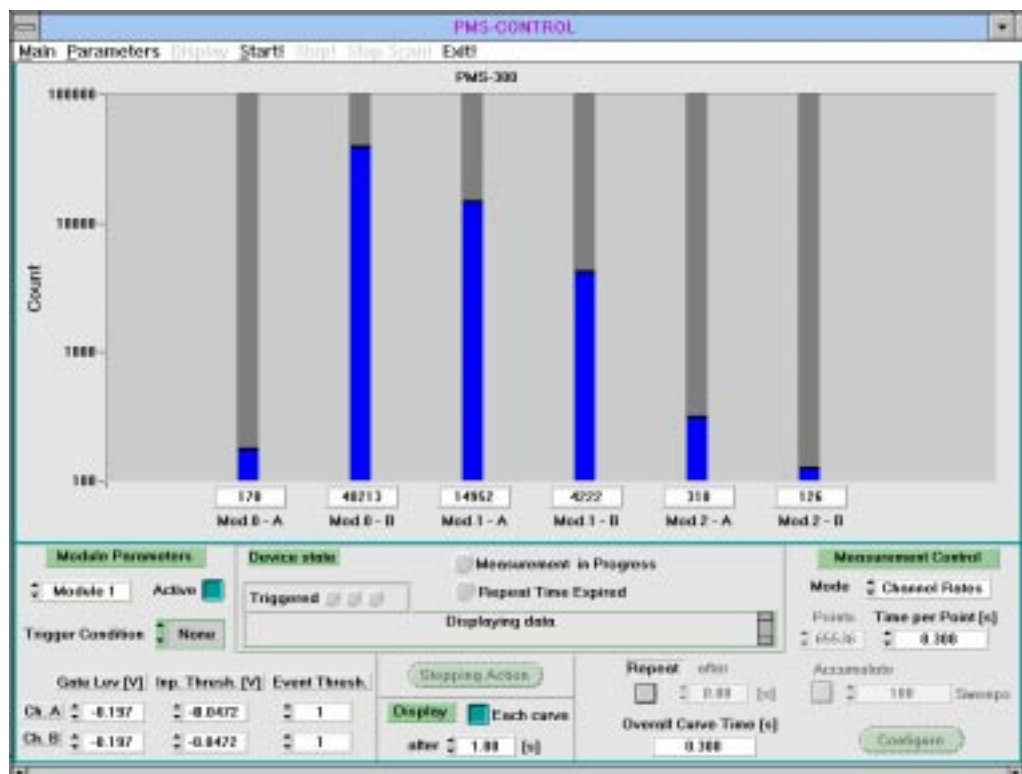
The PMS-300 collects photons with a count rate of more than 800 MHz. It has two counter channels which can be independently gated by a signal of less than 1 ns pulse width. Up to four PMS-300 modules can be operated in one computer and controlled by the same software.

In the figure below, three PMS modules are gated by 1 ns pulses which are delayed by 1 ns from channel to channel. The detector pulses are fed to all counter inputs. Thus, the first channel counts the photons within the first ns, the second channel within the second ns etc. The result is a six-point representation of the light pulse shape.



The gate pulses can be derived from the excitation light by a fast photodiode or - if a diode laser is used - from the laser diode controller. To detect the photons, a PMH-100 detector head is used which delivers pulses with sufficient power to operate all six counter channels. Another PMT can be used if an appropriate preamplifier is used. A reflection-free distribution of the gate and detector pulses is accomplished by two 1:7 power splitters.

A typical result is shown in the figure below.



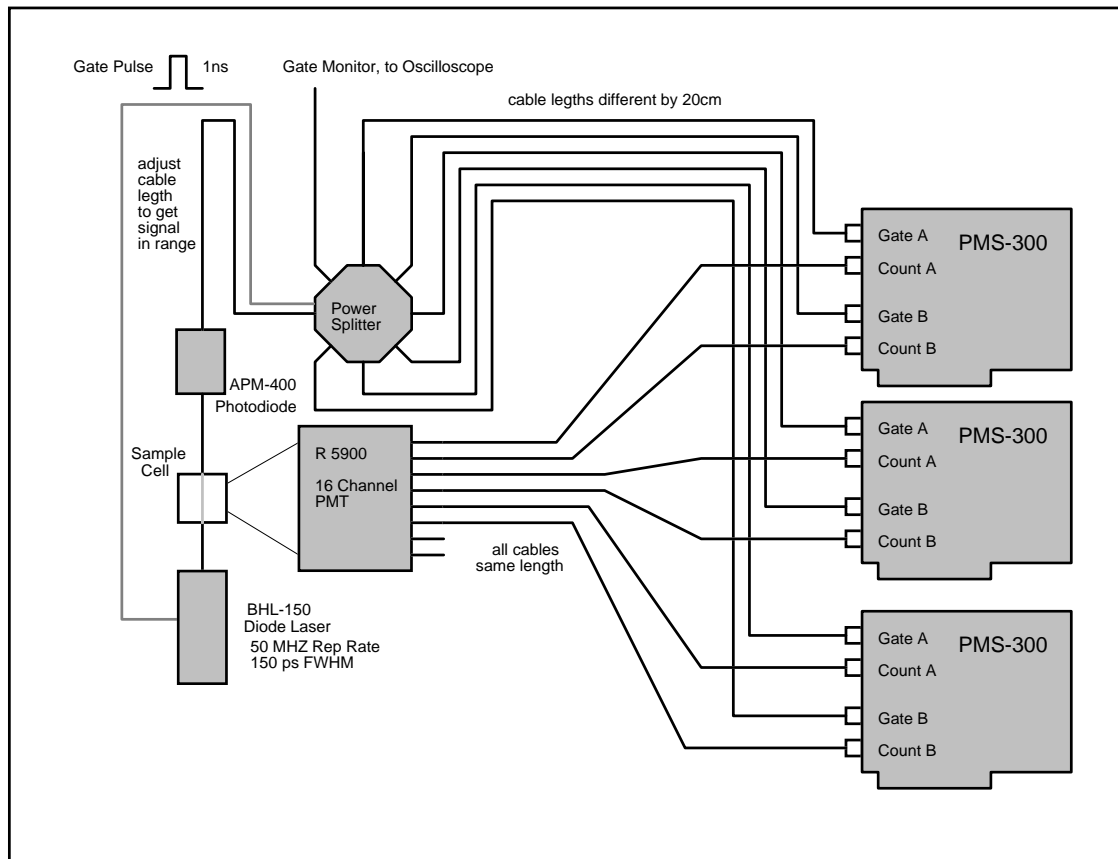
Several variations of the shown setup are possible.

To record many waveforms in very short intervals the 'Multiscaler' mode of the PMS can be used. In this mode the photons are collected within specified collection time intervals and the results of subsequent intervals are stored as independent curves for each counter channel. Up to 65536 curve points can be stored for each channel. Thus, 65536 pulse shapes (consisting of 6 points each) can be recorded in one measurement.

If the light intensity and the pulse repetition rate allows sufficiently high count rates the collection time intervals can be made very short. With an average count rate of 10^6 photons per second 1000 photons (or 166 photons per counter channel) are collected in 1 ms. This gives a satisfactory accuracy for many applications. The short collection time is ideal for fast scanning applications.

The maximum count rate of the setup is limited by the detector rather than by the counter speed of the PMS-300. Although some PMTs allow peak count rates of 100 MHz and more this is not sufficient to record several photons in one signal period. This is, however, desirable for low repetition rate measurements.

To increase the detector peak count rate a multichannel PMT can be used. An example with the Hamamatsu R 5900 16 channel PMT is given in the figure below.



Because the channels of the R 5900 are widely independent several photons can be detected in each pulse period. This considerably increases the counting efficiency for low repetition rate applications.