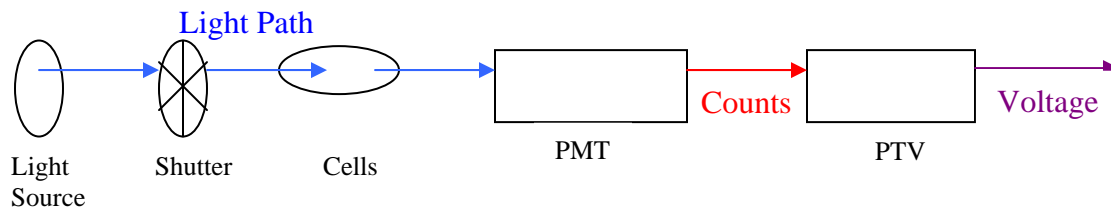


Photon Count to Analog Voltage Converter

IonOptix, LLC

The purpose of the PTV is to provide power and control for the PMT, to count the number of photons intercepted by the PMT, and to convert that number into a proportional analog voltage.



Photon Counting

The PTV is connected to the PMT through the nine pin DIN connector on the back of the device. Every 1 ms, the internal counters are read into the microprocessor and the FIFO memory chip and are reset.

Boxcar Averaging

The integration time is selected with the rotary switch on the front panel of the PTV. Photon counts are always collected for a 1 ms period. The output voltage actually represents a running average of the current point with the points from selected number of ms before it. Assume, for example, the integration time has been set to 100 ms. Initially, no voltage will be output for 100 ms, while the device collects the first 100 data points. The voltage output immediately after the initial collection period is the average of those first 100 points. After that initial period, the average is adjusted every ms by including the newest data point and discarding the oldest data point when computing the average. This is different from a true integration time, in that for a true integration time of 100 ms, the output would only be adjusted every 100 ms. In a side by side comparison, the true integration time recording would show a series of steps, whereas the boxcar averaging shows ramps, but at the edge of the steps of the integration time, the data-points from both methods will be exactly the same, since both will reflect the



average of the last 100 points. The output voltage should, therefore, only be sampled at a rate equal or slower to the integration time. Changes that occur faster than the integration time will show up as events of a much longer duration and a much lower intensity, than the events actually were. Integration time therefore needs to be set significantly lower than the rate of the real biological changes to be recorded. It is also necessary to realize that when a shutter is first opened, data shouldn't be sampled until at least a full period of integration time has passed, as the voltage during that time will include counts collected when the shutter was closed.

Analog Voltage

The Analog output can be read through the "PTV OUT" BNC on the back panel of the PTV. The output voltage is proportional to the average frequency of the counts. It is determined by the voltage range selected by an internal jumper, the maximum input frequency selected within the firmware, the integration time selected by the front panel rotary switch, and the counts read from the counters and FIFO. Available voltage ranges are 0V to 5V, -5V to 5V and 0V to 10V (can be changed by a jumper). Available maximum frequencies are 4 MHz, 8 MHz and 16 MHz (requires chip firmware change). Our PMT's generally have a maximum frequency of about 5 MHz, but occasionally can go up to 10 MHz or have a maximum frequency of less than 5 MHz. Default settings are -5V to 5V and 8 MHz.