



Protecting Photomultipliers

Due to their high gain and extremely light sensitivity photomultipliers (PMTs) can easily be damaged by applying excessive light to the photocathode and thus exceeding the maximum output current. Although the PMT need not immediately be killed by such an accident, significant degradation of performance and reduction of lifetime can result. Especially ultra-fast MCP-PMTs are extremely sensitive to excessive output currents.

In photon counting applications the PMT output signal is, often via an AC coupled amplifier, connected to a fast counter. The counter counts the pulses which occur due to the detection of single photons. To assure safe operation of the PMT, the count rate is monitored, and, if a certain count level is exceeded, the light intensity is reduced. This is, however, not a safe method to protect the PMT against overload. The reasons are explained by the figure below.

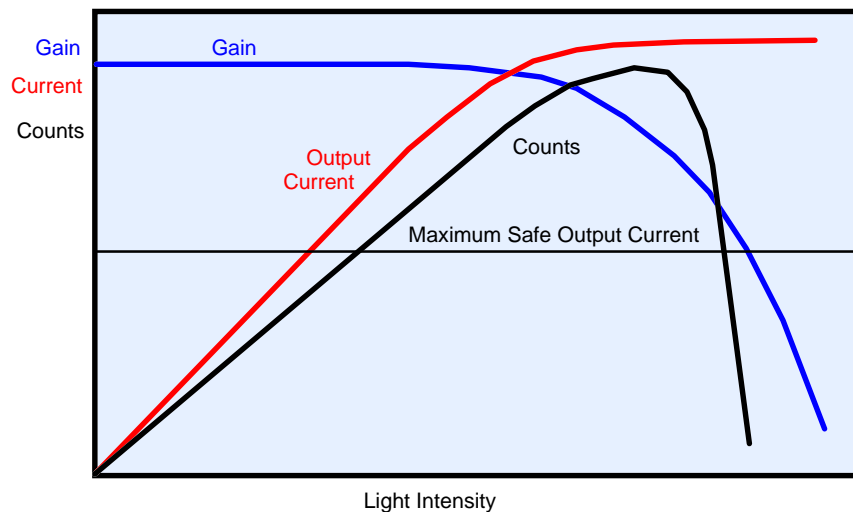


Fig. 1: Gain, Output Current and Count Rate as a Function of Intensity

If the maximum safe output current is exceeded and the light intensity is further increased the gain of the PMT decreases and the output current saturates. The gain decrease is caused by changes of the dynode voltages and (for MCPs) by saturation of the microchannels. If the gain decreases below a critical value the amplitude of the single photon pulses drops below the discriminator threshold of the counter and the counting ceases. Therefore, to assure safe operation of the PMT the output current should be monitored rather than the count rate.

To provide maximum safety against overload the HFAC series amplifiers have been designed. These amplifiers contain a AC coupled GHz bandwidth amplifier for the single photon pulses and a sensitive DC amplifier which measures the average output current of the PMT. If the maximum rating for the particular PMT or MCP is exceeded an overload warning LED turns on and an TTL overload signal is activated. The overload warning remains active even if the PMT or MCP is so heavily overloaded that the count rate ceases. The amplifier is shown in figure 2.



Fig. 2: HFAC Amplifier

In many applications the optical warning is sufficient for the operator to reduce the intensity. However, the 'Overload' signal from the amplifier can be used to automatically remove the overload condition. A simple example is shown in the figure below.

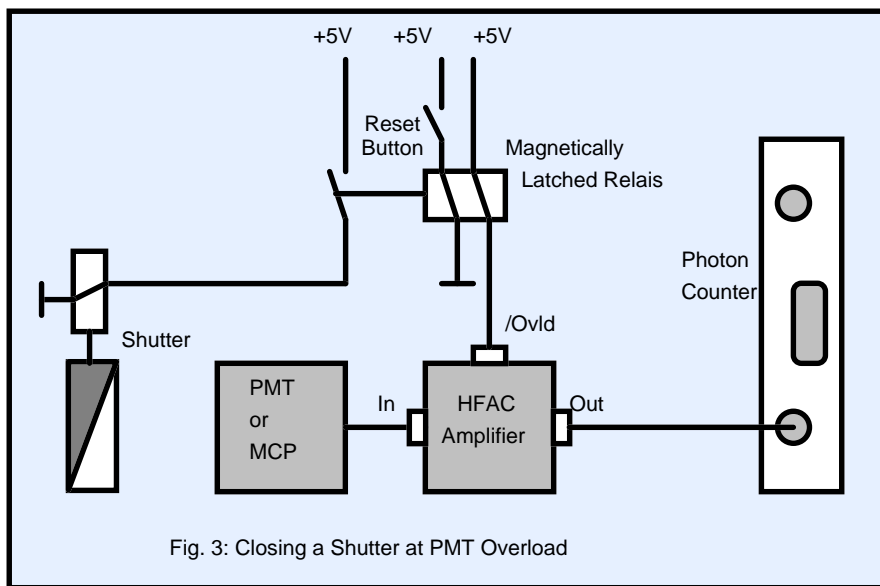


Fig. 3: Closing a Shutter at PMT Overload

