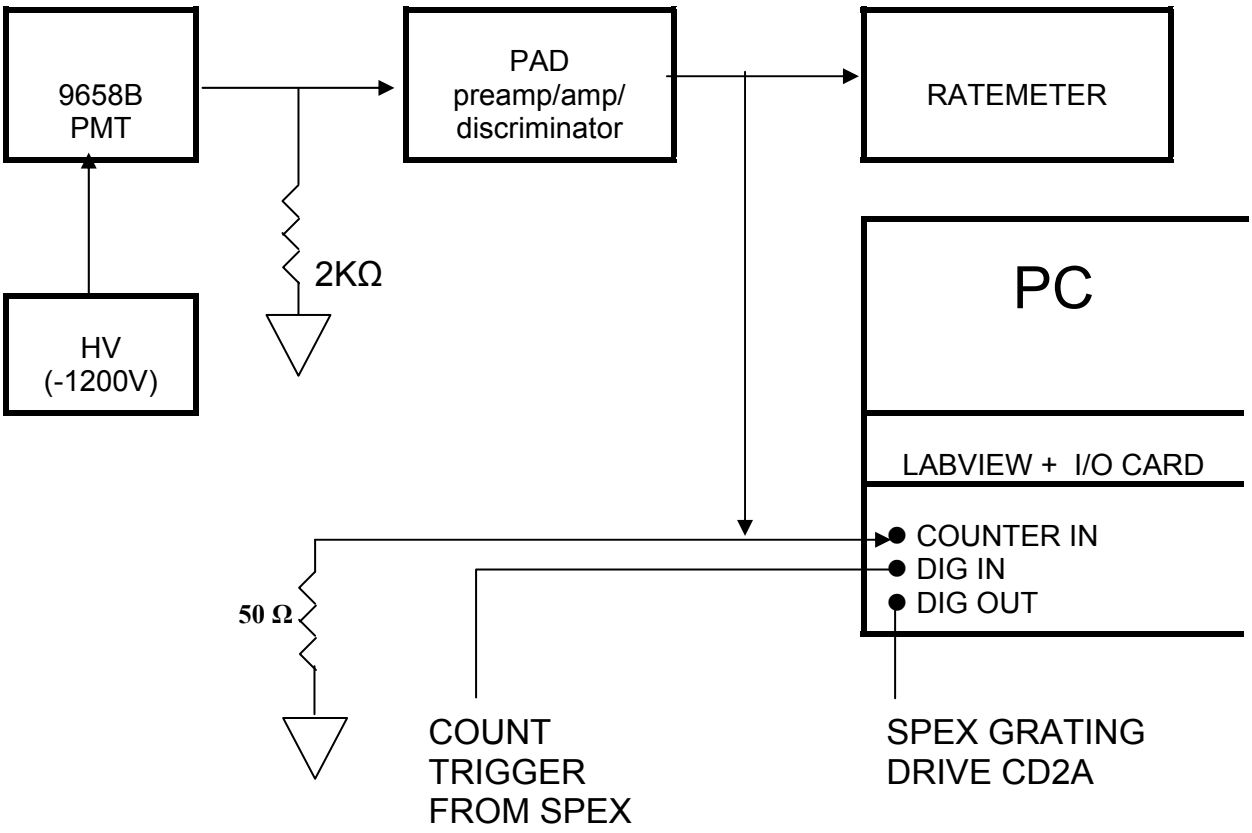
APPENDIX III

A. SPEX - Photomultiplier Detection, Single Photon Counting



The specifications of the 9658B are shown in Figs. A5-3,4; note that the bias voltage to the cathode is always negative, and the <u>maximum cathode bias HV = -2300 V.</u>

The PMT max count rate = $2.5x20^7$ cps, although the electronics probably will not count reliably above 100,000 cps.

DO NOT EXCEED -2000 V bias or a count rate of > 100,000/second!

The nominal gain at 1000 V is 5×10^7. The spectral response of the tri-alkali cathode (CsSb) is shown in Fig. A5-5.

TO PROTECT THE PM TUBE, ALWAYS START WITH THE SHUTTER CLOSED, AND OPEN IT SLOWLY.

Recommended initial settings:

PMT -1200V
PAD coarse gain = 16; fine gain = ~0.6; time constant = 0.5 sec
THRESHOLD 3 V

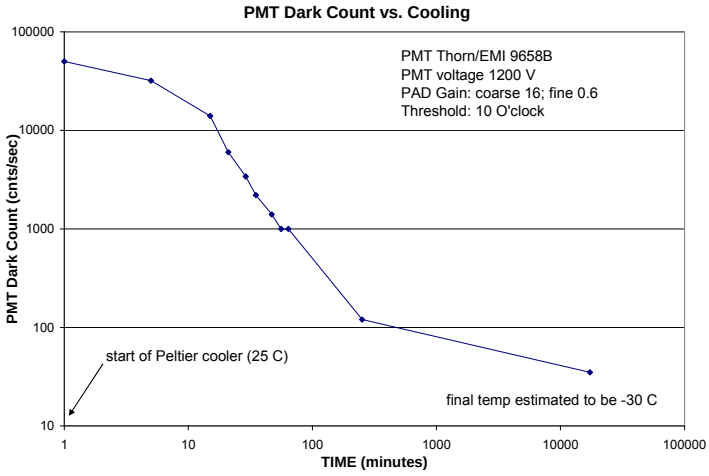
N.B.: 1) The input on the preamplifier stage of the PAD is high impedance so to avoid overloading the input; ALWAYS terminate the input from the PMT with an external resistance of about 2 kΩ.

2) Note that the PMT voltage, amplifier gain and discriminator settings are interdependent (changing one will affect the others)! A good rule of thumb: the "dark count" with no light entering the PMT should be about 25 cts/sec. Remember that this count arises from normal thermionic emission from the photocathode, and thus is dependent on the PMT temperature (see figure on “PMT Dark Count vs. Cooling”).

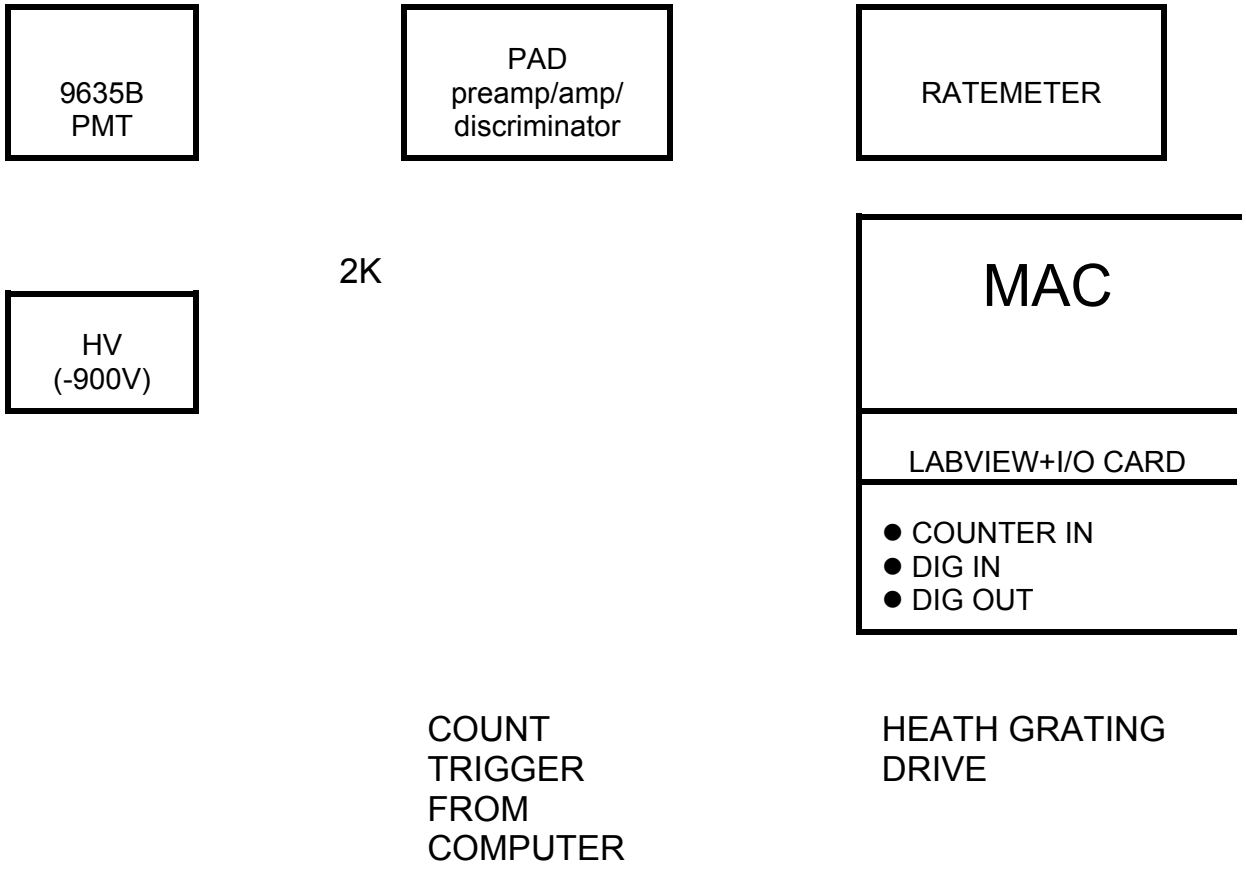
3) The advantage of using pulse counting as opposed to straight DC current detection is that pulse counting allows the use of a threshold discriminator which can be set to discriminate against small noise pulses from the amplifier electronics and against pulses which originate from dynode stages other than the first stage, the photocathode. I. e., this is a low-limit threshold setting on the pulse’s height; some electronics also include an upper-limit threshold setting.

4) The EMI 9653 has an extended red response photocathode. As a consequence of the low work function, the tube has a large dark count at room temperature. We shall normally use this PMT in its thermoelectrically cooled housing which cools the photocathode to about -10 °C.

5) The graph to the right show how the dark count decreases when the PMT Peltier cooler is started up. Photoelectron emission from the photocathode with the low workfunction will have significant thermionic emission at room temperature. Thermionic emission decreases significantly when the photocathode (actually the entire PMT) is cooled to about -30 °C.



B. Heath - Photomultiplier Detection, Single Photon Counting
(Note: this section requires updating)



The specifications of the 9635B are shown in Figs. A4-3,4. Note that (as with the 9658B) the bias voltage to the cathode is always negative, and the maximum cathode bias HV = -2300 V.

The PMT max count rate = $2.5x20^7$ cps, although the electronics probably will not count reliably above 100,000 cps.

DO NOT EXCEED -2000 V bias or a count rate of > 100,000/second!