1 Purpose

A simple setup has been constructed to allow aging tests on a set of 96 FMPMTs, their bases, and their preamplifiers. The aim is to be sure that there are no unsuspected reliability problems before starting with mass production and assembly of the bases.

2 Setup

Figure 1 shows the arrangement and labeling scheme for the PMTs. They are divided into eight groups of 12. The groups are labeled A-H. Within a group the PMTs are labeled 1-12. Each group has a separate LVPS and HVPS connection (at present the HVPS lines for groups A-D and H are bussed together). The LVPS lines are color coded: Red is +5 V, black is ground, and yellow is −5 V. There are three LEDs per group, arranged as shown in Figure 1. The three LEDs for each group are connected in parallel. There is a front panel LEMO connector for each group of LEDs. Signals from the preamplifier outputs are routed to two banks of LEMO connectors. The lefthand bank handle groups A-D and the righthand one handles groups E-H. The LEMO connectors are arranged in the same way as the PMTs, with groups A and E coming at the top of the banks.

At this point there are 59 PMTs in place. These are in Groups A-D and Group H (1 through 11). Groups E, F, and G and PMT H12 are not yet there.

3 Test Procedure

3.1 Overview

The idea behind the tests is to look for serious failures of the bases, FMPMTs, or preamplifiers. A typical failure might involve the loss of a dynode stage, in which case the PMT’s gain will drop by a factor of two or it will stop working altogether. Spotting such failures does not require high accuracy, although it does require that somewhat careful measurements are made since the unit-to-unit gain variations of the PMTs are considerably large than a factor of two.

A simple scheme using the signal averaging feature of the TDS460 digital scope has been devised. This scheme does not require a computer.

The idea is as follows: the PMT with the largest signal in its group is designated as the “reference PMT.” The output of the LED pulser is adjusted until the average signal from that PMT is (2000 ± 50) mV. The average pulseheights from the other tubes in the group are then recorded. If one of the non-reference PMTs experiences a significant (> 20%) gain change it will produce a pulseheight that is noticeably different from the previous measurement. If the reference PMT experiences a gain...
Figure 1: Labeling scheme for the PMT’s. The LEMO connectors on the front panel of the box follow the same scheme.
change, all the other PMTs in the group will appear to have changed in the opposite direction.

3.2 Detailed Procedure

1. Power supply setup:
   - Set the HVPS to 1500 V. The total current (59 PMTs) should be around 3.3 mA.
   - Set the LVPS to ± 5 V. The current should be about 1.2 A (59 PMTs). This is actually somewhat above the rating of the negative power supply now in use. It will need to be replaced if more PMTs are added to the setup.

2. LED pulser setup:
   - Set the output width of the pulser to 40 ns (FWHM).
   - Set the pulse period to 2 ms (500 Hz repetition rate).
   - Adjust the LED pulser pulseheight to about 2 V.
   - Connect the pulser output to the LED input for the group under test.

3. Scope setup:
   - Connect Channel 1 on the scope to the LEMO connector corresponding to the group’s reference PMT.
   - Set the oscilloscope to vertical and horizontal scales to 500 mV/div and 100 ns/div, respectively.
   - Go to the “Measurement” menu and select “V pk-to-pk”.
   - Set the bandwidth of the channel used to view the PMT output to 20 MHz. This is necessary because some PMTs have a large ~ 100 MHz pickup that will otherwise interfere with the measurement.
   - Go to the “Acquire Mode” menu and select the “Mode” submenu.
   - Select the “Average” option. Use the dial to adjust the number of averages to 200.

4. “Measurement loop:”
   - Adjust the LED pulser amplitude until the output of the reference PMT is (2000 ± 50) mV.
   - Measure and record the peak-to-peak signal size for the other PMTs in the group. The vertical scale can be adjusted for better precision on small signals. However, it is important to avoid having too many signals that are larger than fullscale since these will spoil the average. One way to avoid this is to select a vertical scale such that the average signal is between one and four divisions in size.