

Notes on NPS LV Power Distribution

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The NPS dividers employ powered preamps, which require +3V, GND and -3V. This bipolar supply setting guarantees that the preamps can output signals of 1 V peak amplitude with enough headroom and without any impact on linearity, while maintaining excellent stability, low noise and low power.

There are two approaches under consideration to distributing low voltage to a row or column of PMT dividers: one cable per divider or one cable powering a string of dividers. A summary of relevant parameters is as follows:

A) Power per PMT Divider

Preamp Power: +3 V, -3 V @ 18 mA, each = 108 mW

HV Power: -605 V @ 405 μ A = 245 mW

Regulators: 2 x 0.5 V (drop out) x 18 mA = 18 mW

TOTAL = 371 mW per PMT Divider.

B) Cable Losses

Divider Pitch: 2 cm

Divider-to-Divider Cable Length: 4 cm

Cable Length for 36 units in a column/row: 35 x 4 cm = 140 cm (does not include length of cable from distribution PCB to first unit).

Cable: 6 conductor, 24 AWG, 3M 1825 or similar (7 x 32 stranded Copper).

Cable Single Conductor Resistance: 83 Ohm/km = 0.83 mOhm/cm

Cable Pinout: 2 x +3 V, 2 x GND, 2 x -3 V

Cable 2-conductor resistance, derated: 0.83 mOhm/cm x 0.5 / 0.7 (deration factor) = 0.6 mOhm/cm

Voltage drop between adjacent units: 4 cm x 0.6 mOhm/cm x 18 mA = 43.2 μ V

Voltage drop from first to last unit: 35 units x 43.2 μ V/unit = 1.5 mV

TOTAL = 1.5 mV across 36 PMT Dividers – Negligible.

Summary

The use of linear regulators on each divider allows for uniform performance across all the dividers with better noise and stability performance. The power dissipation increases by only about 5% of the HV and preamp power, so it is desirable to include them in the final design. Power dissipation for this new design is about 26% lower than the original divider power budget of 500 mW per divider.

Power distribution with a single cable per divider or per 36 units is a matter of preference as the cable losses are negligible. Additional losses are to be expected per unit at the connectors and also due to the cable lengths from LV distribution PCBs but these are still negligible.