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DESIGN OF LOW-NOISE VACUUM-TUBE PULSE AMPLIFIERS FOR SEMICONDUCTOR-DETECTOR SPECTROSCOPY

Correspondence

Mr. Blankenship gives, in the above,¹ an expression for the minimum noise effective charge, which can be written in general form as follows:

$$Q_{\text{eff min}} \propto \sqrt{C_t} \sqrt[4]{R_s/R_p}$$

This formula indicates which parameters are of major significance and in what way. The minimum effective charge corresponds to the optimum time constant for the shaper circuit, which can be written as:

$$\tau_{\text{op}} \propto C_t R_p \sqrt{R_s/R_p}$$

This optimum condition is frequently too difficult to fulfill, resulting in too large time constant. This can occur in particular when the detector has high capacitance and when the valve

used has low transconductance. The quotient R_s/R_p does not differ materially for different valves, and if R_s is large, R_p will also be large.

In such cases, in order to evaluate the noise effective charge, we must consider the general expression:

$$Q_{\text{eff}} \propto \sqrt{C_t^2 R_s/t + t/R_p}$$

When t is sufficiently lower than τ_{op} this becomes:

$$Q_{\text{eff}} \propto C_t \sqrt{R_s/t}$$

This expression clearly indicates that Q_{eff} varies linearly with C_t and that the tangent of Q_{eff} as a function of C_t is proportional to $\sqrt{R_s/t}$.

From the above it is seen that for large C_t and time constants on the order of $1 \mu s$, valves such as the E810F are better than E88CC, having greater transconductance and hence lower R_s .

¹ J. L. Blankenship, IEEE Trans. on Nuclear Science, vol. NS-11, pp. 373-381, June 1964.

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