

## SIX CHANNEL LOW BACKGROUND ALPHA COUNTER

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Frequently, it is required to analyse a fairly large number of samples for weak alpha radioactivity in the field of radiation protection, health physics, environmental monitoring, food inspection, nuclear medicine, radiobiology and geological prospecting. The sample is always separated or enriched by some radiochemical processes and deposited to form a thin planar source, finally put it in a low background assembly for radioactivity measurement. In order to lower the minimum detection limit, the counting time is extended greatly, especially for weak alpha activity, always up to 24 hours. For this reason, a sort of practical instrument must be stable, reliable, low background, unsensitive to disturbance, easy to operate, able simultaneously to measure several samples, able to continuously operate longer than 24 hours and low production cost, that will suit the demand very well.

Silicon- gold surface barrier semiconductor detectors are chosen for alpha detectors, because which are more firm, less auxiliary circuits and smaller in size than scintillation counters, and less sensitive to disturbance, less auxiliary installation and smaller in size than grid ionization chamber. The instrument consisting of six detectors, might simultaneously and separately count six samples. Each detector look on to a planar source which is put into a shallow hole on a drawer.

The signal from the detector is fed to a charge sensitive amplifier, then to a linear complementary voltage amplifier and a discriminator. All these linear circuits are designed in a low power consumptive mode and allow to work at wide voltage range. The lasting current of each channel linear circuit is less than one milliamperere at 7-9 volts.

In order to reduce the noise, ordinary charge sensitive amplifier utilizes high mutual conductance FET (field effect transistor) and hence large drain current is needed. We use high  $\beta$  transistors with small steady current and get less noise to meet this instrument feature. The discriminator consist of a FET, a thyristor and a transistor. The input PN junction of the thyristor biases the FET. Once the FET is set into conducting sufficiently, it will trigger the thyristor. The detector and linear circuit of each channel is put into an electric magnetic shielding to reduce the interference from each other and the disturbance from outside.

The outputs of six linear circuit channels are fed to six storage counters, which are made of CMOS integrated circuit for reasons of saving power and reliability. Each storage counter has four decimal digits and a overflow signal. There are only one decoder and one display with liquid crystal for all six storage counters. They also share a self-test device and an auto-timing device, which bases on a quartz time circuit and the time interval are  $\frac{1}{2}$ , 1, 5, 10, 20, 60, 100, 400, 1000, 1400 minutes optionally.

Whole instrument is supplied by a set of six storage batteries or six dry cells, with neither voltage stabilizer nor step-up device, so that no extra power is expended. Non-linking with mains power obtain two advantage: to avoid disturbance from mains network, from which majority interference come; to avoid losing the data just in progress, this situation may happens in a mains supplied instrument, while the mains break off unexpectedly. Fresh recharged batteries will last 500 hours or longer. If the voltage supply lower below some level, a special sign will appear.

The outward appearance of the instrument is same as a NIM standard bin, with size 480mm(W)x240mm(H)x340mm(D). The effective sensitive size of detectors may be 12 mm, 16 mm or 20 mm in diameter optionally. The performance index of mean instrument background is 6, 8 or 10 counts per 24 hours respectively, and detection efficiency for planar  $2\pi$  source is larger than 60%, 65% or 70% respectively. The actual measured mean background is 2.4, 3.2, or 4.7 counts per 1400 minutes, and efficiency of 7 mm diameter

Pu-239 planar source is 65.4%, 74.2% and 79.1% respectively. Up to now, forty sets of six channel instrument are working satisfactorily.