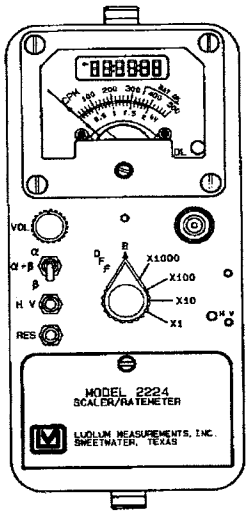
NEW LUDLUM PORTABLE ALPHA /BETA SCALER/RATEMETER December 1993



The Model 2224 is a portable micro-processor based radiation survey instrument used to measure and disciminate low level alpha/beta radiation when used with an alpha/beta scintillation or gas proportional detector. The data is displayed by an analog ratemeter and a six-digit liquid crystal display (LCD) counter. The ratemeter dial indicates 0 - 500 CPM with four linear range multipliers of X1 - X1000 producing an overall range of 0 - 500,000 CPM.

The ratemeter display options include alpha only, beta only, or alpha and beta together. Audible click per event tones can also be selected to discriminate beta (low pitch tone) from alpha (high pitch tone) via the side mounted speaker. The beta threshold, beta window, and alpha threshold are adjustable to optimize alpha/beta efficiency and count separation.

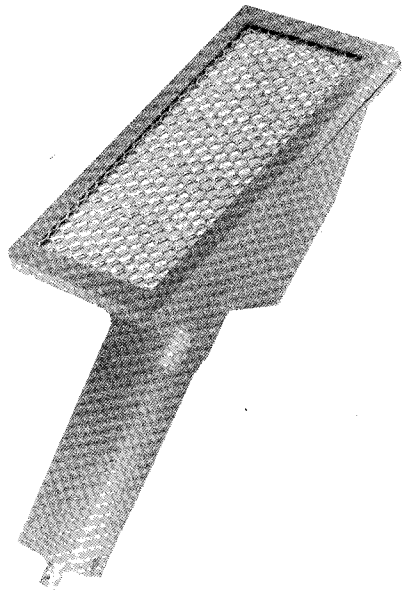
The LCD display is used to display the counts accumulated during the preset count time. There are 4 count times selectable via internal switches. These count times are 0.1 min., 0.5 min., 1 min., and 2 min. The counter is reset and started by pressing the COUNT button which is located on the handle. A regulated high voltage power supply adjustable from 200 to 2000 volts with detector overload detection is utilized to operate a wide range of scintillation detectors. Other operating features of the instrument include programmable audio divide by (beta channel only), a two-position switch (internal) for selecting the audio discrimination mode, an adjustable volume, push button battery test switch, and a push button high voltage test switch.

The Model 2224 can be used with a phoswich-type scintillation or a gas proportional detector. The phoswich scintillation detector utilizes Zinc Sulfide for alpha detection and a plastic scintillator for beta.

An optional phoswich detector which is compatible with the Model 2224 is the Model 43-89. The Model 43-89 is a 100 cm² open area alpha/beta scintillator. The Model 2224 is priced at $ 950.00.

MODEL 43-89

ALPHA / BETA RECTANGULAR SCINTILLATOR



DETECTOR: ZnS (Ag) powder deposited on rectangular plastic scintillator.
WINDOW: 1.2 mg/cm² aluminized mylar.
WINDOW AREA: Open area is approximately 100 cm².
EFFICIENCY: 30 % for Pu-239, 25 % for Am-241; 45 % for Sr-90 and Cl-36, and 10 % for Tc-99.(2 pi)
GAMMA SENSITIVITY: 20 - 25 cpm/μR/hr.
NON-UNIFORMITY: Less than 5 %.
PHOTOMULTIPLIER TUBE: 3.8 (1.5") diameter.
PROTECTIVE SCREEN: 0.25" stainless steel hex, 79 % open.
SIZE: 33 (12.25")LX 10 (4")H X 10(4")W.
WEIGHT: 0.68 (1.5 pounds).
FINISH: Computer beige polyurethane paint.
PRICE: $ 750.00

LMI TIPS: CABLE LENGTHS December 1993

Note: This part 2 of a two part series covering detector cable length variations. This part addresses G-M and special applications. Part one, presented in the June 1993 issue, covered Scintillation and Proportional Detectors.

Increasing or decreasing the coaxial cable lengths from a Geiger-Muller (G-M) detector to a counting instrument is more forgiving when compared to Proportional and Scintillation type detectors. Unlike the Scintillation or Proportional detector, increasing the coaxial cable length from 1 meter to two meters would not require re-calibration or detector operating voltage adjustment to compensate for the increase in cable capacitance. The large pulse amplitudes, typically 1-6 volts, produced by the G-M type detectors allow longer cable lengths to be substituted without reducing the signal below the counting instrument's threshold level.

A general "rule of thumb" for the maximum cable length between most G-M detectors and the counting instrument is 150 ft. (46 meters). Variations in the instrument input sensitivity and input impedance may increase or decrease the maximum cable length. Problems symptoms and precautionary measures to watch for when increasing G-M detector connecting cable lengths are:

Problem Symptoms: Non-linearity problems when the detector is exposed to radiation fields near the upper operating range of the detector. Detector pulse output may decrease or even appear "dead" (overload paralysis) when exposed to radiation fields above the upper operating range of the detector.

Precautionary Measures: When increasing cable lengths, check detector/instrument calibration for non-linearity at the detector's upper operating range. If detector appears to be non-linear, perform an operating voltage/count rate plateau in 25 volt increments up to the maximum detector operating voltage limit. Determine if the operating voltage can be increased to improve counting linearity but still remain below maximum voltage limit. For dose equivalent readouts up to and including 10 R/h (0.1 Gy/h), expose the detector to 100 times the full scale, maximum decade reading to confirm that overload paralysis does not occur (ie; full scale reading = 1000 mR/h, expose detector to 100 R/h and ensure readout remains above full scale reading). For maximum readouts and detector limits greater than 10 R/h, expose detector to 10 times the upper detection range to confirm that overload paralysis does not occur.

Detector operating voltage may be increased to compensate for pulse amplitude loss the same as with the scintillation and proportional detectors, but the overall improvement is much less and the maximum detector operating voltage usually restricts the voltage range. Input sensitivity can also be decreased to compensate for amplitude losses; however, caution must be observed to ensure that the counter threshold is set above the multiple pulsing region.

There are methods other than parameter adjustments for cable length compensation. Increasing detector operating voltage or decreasing the input sensitivity for some applications is often an impossible solution to cable length variations. Instruments, such as the Ludlum Model 3500 Gate Monitor series have extreme cable length variations (typically from 100-1000 ft.) from the scintillation detector(s) to the control console which makes parameter adjustment impractical.

The input capacitor (decoupling the HV from signal) to the input amplifier is typically 100 picofarads (pf) for most of the LMI instruments. If the cable capacitance is 100pf then 50% of the signal will be attenuated by cable capacitance and 50% will be transferred to the input amplifier through the input capacitor (100pf). If the cable length is increased and cable capacitance increases to 1000pf (0.001 if), 90% of the signal would be dropped across the cable capacitance and 10% would be transferred to the input amplifier. Therefore, the solution to the cable length problems is to select an input capacitor to match the cable length capacitance.

As with most problem solutions, there are restrictions to increasing the input capacitance - the recovery time of the counting circuitry is increased as the input capacitor is increased. Scintillation and Proportional non-linearity problems may begin to appear between 50,000-100,000 CPM. Multiple pulsing (pulse over-shoot in amplifier circuitry) problems may occur if capacitance is increased too large for G-M detector applications. Precautionary measures could be taken in ensuring that the detector operating voltage (H) is completely discharged when connecting/disconnecting coaxial cable(s) from the instrument to prevent a large transient from destroying the input amplifier. Consult LMI engineering department when the counting instrument H and threshold parameters can no longer be adjusted to compensate cable length before modifying the instrument(s).

COAXIAL CABLE LENGTH LIMITATIONS FOR RADIATION DETECTORS December 1993

The detector cable lengths specified below are used with standard LMI instruments (Survey Meters and Scaler/Ratemeters) with input sensitivities around 10-35 millivolts. Model 3500 series Gate Monitors specially modified instruments incorporate special circuitry which compensates for extended cable lengths. Lower input sensitivities, Photomultiplier Tube gain (for scintillation detectors), instrument input impedance, and detector impedance may increase or decrease the maximum detector operating cable length.

DETECTOR	MAXIMUM* CABLE LENGTH ft./meters	PROBLEM SYMPTOMS AND PRECAUTIONARY MEASURES
Geiger-Mueller (G-M)	150 ft./ 46 meters	Non-linearity problems when the detector is exposed to radiation fields near the upper operating range of the detector. For survey meters with dose equivalent readouts, place the G-M detector in a radiation field 100 times (for full scale/decade readings $\leq$ 10R/h and 10 times the upper limit for fields greater than 10 R/h) greater than the full scale/decade instrument operating point to ensure detector count does not decrease as radiation field intensity is increased.
Scintillators	50 ft./ 115 meters	Lower than normal counting efficiencies for low energy isotopes when increasing detector cable length. Confirm that the detector is operated in the plateau region when cable length is changed by plotting detector operating voltage/count rate operating curve.
Proportional (Including Neutron)	25 ft./ 8 meters	Same problems symptoms and precautionary measures as the scintillation detectors. The detector breakdown or saturation region remains the same for Proportional detectors, regardless of the cable length; therefore, ensure that the detector operating point is below the breakdown region (50-100 volts below). Gamma rejection point should be checked when shifting the operating voltage on Neutron Detectors.
Air Proportional	6.5 ft./ 2 meters	Same problems symptoms and precautionary measurements as the Proportional detectors above.

*The cable lengths above are *suggested* maximum cable lengths for LMI instruments in their standard design configuration; the cable length may be extended by modification to some of the instruments. Consult LMI engineering department for more information for a specific application.