Title
MULTI-CHANNEL PULSE HEIGHT ANALYSER

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Introduction

Numerous articles have recently been published on nuclear pulse height analyses. This report describes an approach to the problem using existing scaling equipment (scale of 1024) as building blocks in a multi-channel analyser.

The essential operation of a pulse height analyser is to sort pulses of variable heights into channels, that correspond to finite ranges of pulse heights, and to scale down and record these pulses on mechanical registers. In the present case an anti-coincidence circuit and a coincidence circuit are used to produce the sorting action. Since the 1024 scalers have a gating tube in their input circuits, the addition of only a simple crystal anti-coincidence circuit was necessary to convert the units into analyser building blocks.

System Description

All discriminator inputs are cabled together. (See Figures 1 and 2). When a pulse is fed into the analyser, all discriminators will fire up to the channel corresponding to the height of the pulse. Each activated discriminator produces a positive coincidence pulse and a negative anti-coincidence pulse. A delayed timing pulse, generated in an auxiliary unit, is fed into the anti circuit of each scaler. The only condition under which the timing pulse will pass through the anti-coincidence circuit is when the discriminator of that scaler has not fired. The output of the anti-coincidence is cabled to the coincidence circuit of the unit below. If the discriminator of the unit below has fired the coincidence pulse will be counted in that channel.

By this means each channel counts only those pulses that are large enough to trip its discriminator but not large enough to trip the discriminator immediately above.

In all pulse height analyses it is necessary to wait until a pulse reaches its maximum height before it is measured. This is accomplished by delaying the timing pulse the rise time of the unknown pulse. This delay can be changed to correspond to the rise time in question. To insure that the input pulse maintains the correct height until after the coincidence has taken place, a pulse stretcher circuit consisting of a diode and a condenser is employed. The condenser is charged to the maximum value of the input pulse and discharged by the undershoot from the trailing edge of the timing pulse.

To facilitate the setting of the discriminator levels a pulse generator is used which gives extremely constant amplitude pulses. The pulses are divided by a switch attenuator so that any pulse height can be obtained to an accuracy of three significant figures.

Any channel widths desired can be set depending upon the energy spectrum to be analysed. The section of the spectrum which the analyser sees can itself be shifted by a single subtractor control. This potentiometer biases a cathode follower below cut off and thereby subtracts a constant voltage from all input pulses.

Results

Gamma spectra of Na^{22} and Cs^{137} were analysed at 120,000 counts per minute indicating an energy resolution of the whole system of 8.5 percent. It is well known that resolution is in part limited by the detector used. The particular crystal detector used in these results was tested in a single channel analyser and the same resolution was obtained. The Schmidt discriminators in the scalers were modified to rid them of their dependency upon tube g_m. Drift tests indicated less than 100 millivolts over a 72 period. The overall double-pulse-resolving-time of the system is two micro-seconds.

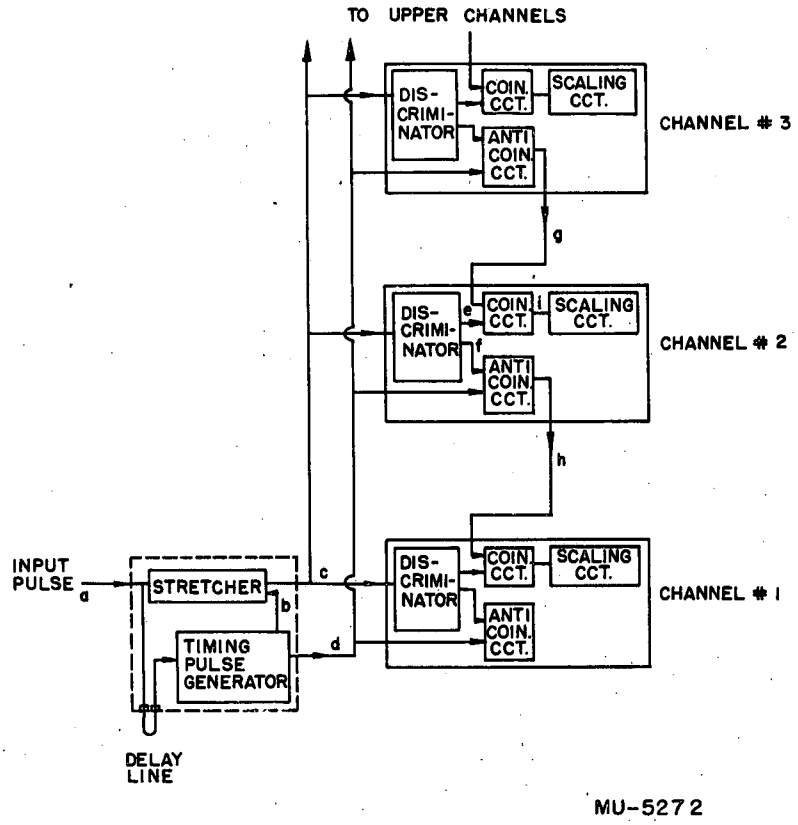
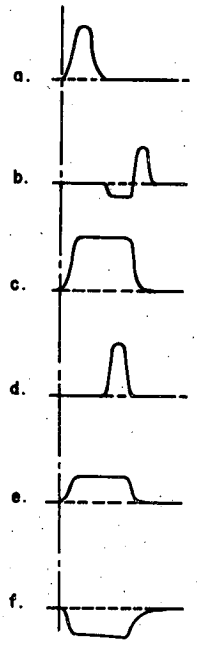

TO UPPER CHANNELS
DIS-CRIMI-NATOR
COIN. CCT.
SCALING CCT.
ANTI COIN CCT.
CHANNEL # 3
g
e
f
CHANNEL # 2
h
INPUT PULSE
a
STRETCHER
b
c
d
TIMING PULSE GENERATOR
DELAY LINE
CHANNEL # 1
MU-5272

Fig. 1



Input pulse, its height is proportional to the energy of the particle being counted.
Terminator pulse, which discharges the stretcher ending the scaler input immediately after timing pulse occurs.

Scale Input, a flattened pulse whose height is determined by pulse at point "a" minus amount subtracted by spectrum shifting control.

Timer pulse, a delayed pulse sent to all scalers for interrogation.

Discriminator (+) coincidence pulse.

Discriminator (-) anti-coincidence pulse.

MU-5273

Fig. 2