THE CAPACITOR SIGNAL-ENHANCER

Signal enhancers - general

Amplifiers which have to deal with microvolt signals invariably introduce noise which, at these levels, may be comparable in amplitude with the signal itself. If the signal is recurrent and a pre-pulse is available to provide a phase reference, the signal enhancer may be used to extract the original signal from the noise.

In principle, each signal received is progressively sampled at a large number of points - usually between 100 and 1000. The information obtained is fed to a store where it is added to data already in storage derived from previous signals. Any coherent parts of the signal - i.e. the wanted pulse - add each time, while random parts - i.e. the noise - partially cancel out with the result that the wanted pulse contained in the store grows at a faster rate than the noise.

If the store is scanned after 'n' signals the resulting display has a signal to noise ratio $n^{\frac{1}{2}}$ times greater than the signals at the input.

The Capacitor Signal-Enhancer

This particular unit makes use of the capacitor as a charge storage and integrating device and contains a store consisting of 128 polystyrene capacitors.

A current generator converts the signal voltage at the input into a proportional current which is fed into each of the capacitors in turn as the signal proceeds. This is done by means of a 128-way, solid-state switch driven from an orthodox 7 bit binary chain and sectional decoding matrix.

The pre-pulse triggers a gated oscillator which then pulses the system through one cycle resulting in a single sweep of the capacitors.

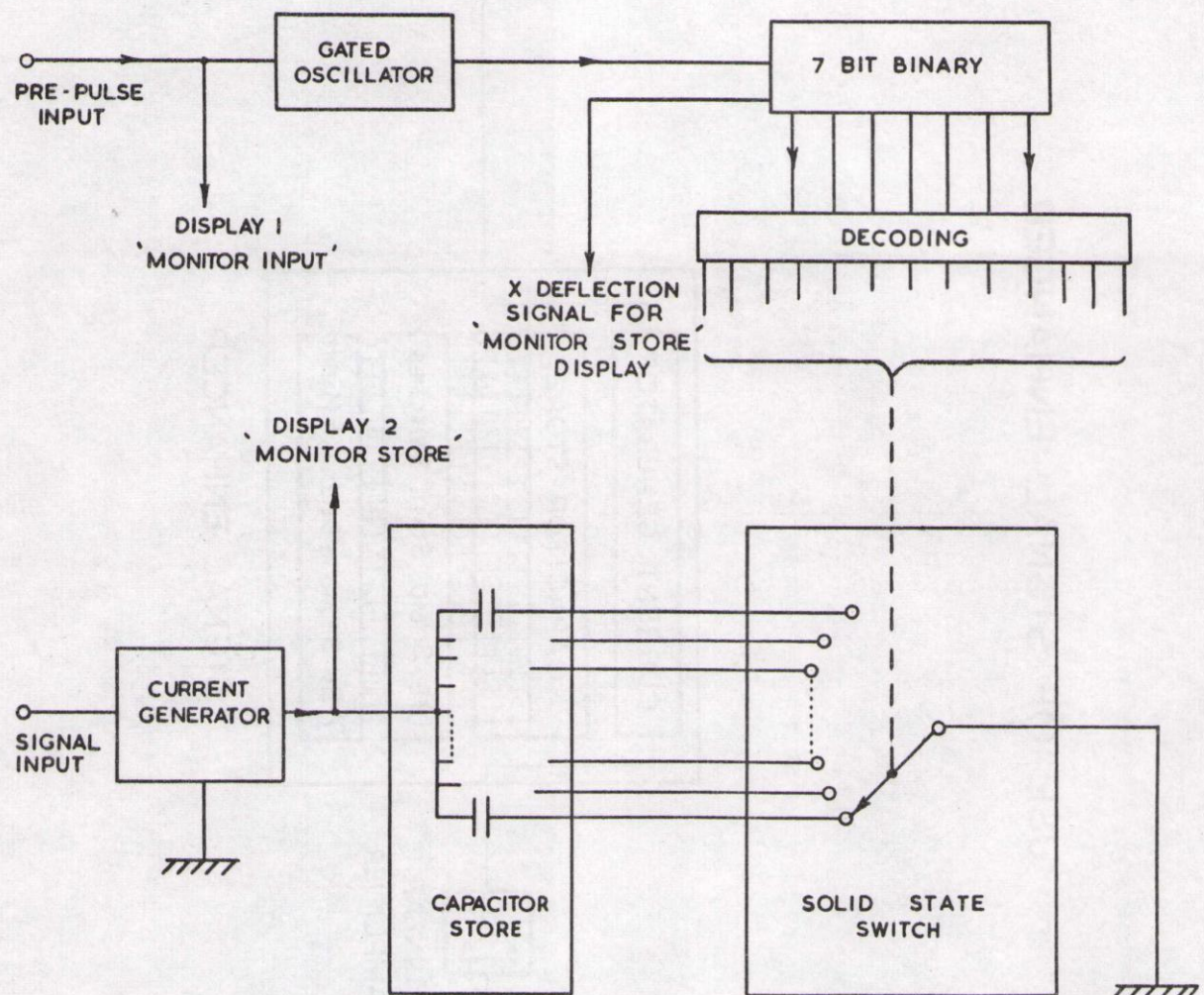An x deflection signal for the store display is also derived from the binary chain.

Monitoring of the charges in the capacitors is done automatically by simply displaying the capacitor voltages as the store is scanned, so that growth of the pulse may be observed as the signals come in.

When the capacitor voltage limits have been reached photographs may be taken and the store may be cleared by means of a switch which, in effect, short circuits the capacitors in turn.

Points of Interest

Non-rising base-line due to bi-directional capacitor charging.

Signal input voltage limits .... $\pm$ 8 volts.

Storage capacitors .... 0.5 µF, polystyrene.

Typical capacitor currents .... 2 µA.

Final capacitor voltages .... within $\pm$ 8 volts.

Worst-case loss of volts due to charge
                                    leakage .... 2 mV per second.

Measurement time for worst-case voltage
                                    loss of 5% .... 3 1/3 minutes

Constant current transistors .... mm 2711 mm 2712
            (collector leakage current less than 10 nA).

Switching diodes .... IN 3595
            (leakage current less than 1 nA).

For the demonstration a pulse from a signal generator is displayed
before, and after, being mixed with artificially generated noise.   The
resulting signal is fed into the signal enhancer where the third display shows
the output waveform, which may be compared directly with the original pulse.

CAPACITOR SIGNAL-ENHANCER.— SIMPLIFIED BLOCK DIAGRAM.

USE OF SIGNAL ENHANCER

SIGNAL DISPLAYED
ON OSCILLOSCOPE
AFTER 100 SCANS

CURRENT GENERATOR

CAPACITOR STORE

128 SOLID STATE SWITCHES

7-BIT BINARY & DECODING MATRIX

SIGNAL ENHANCER

LINEAR
AMPLIFIER

REPETITIVE
NOISY SIGNAL
FROM
EXTERNAL PROTON BEAM