of a given burst-out ratio will be overscale. Similarly, at low frequencies there will be more time available to reduce gain, and higher burst-out ratios can be accommodated within scale.

As amplitude (the second variable) increases, the ability of the system to record each sample at true amplitude decreases. (All samples are recorded-- overscale samples are recorded as full scale of the gain range in use.)

Where a given sample falls is a matter of chance. Yet, this sample location affects the ability of the system to accommodate the succeeding sample. A sample just under half scale, for example, requires the system to wait another sample interval before changing gain range. On the other hand, if the sample is just over half scale, gain range is shifted at once--substantially improving the chance of being able to accommodate the next sample.

A generalized mathematical analysis of the effect of these variables follows.

First, the line between complete recording and the possibility of one overscale will be analyzed. This case occurs (on the channel controlling the gain) when the last sample digitized is a very small interval below half scale, as diagrammed in Figure 4. The burst-out ratio (that will not exceed full scale) is $\frac{b}{1/2Y}$.

Given:

Y = Digitizer Full Scale

b = Burst-Out Amplitude

t_1 = Time of first sample considered

t_2 = Time of second sample considered

ω = Burst-out fundamental frequency

From the equation of a sine wave,

$y = b \sin \omega t$
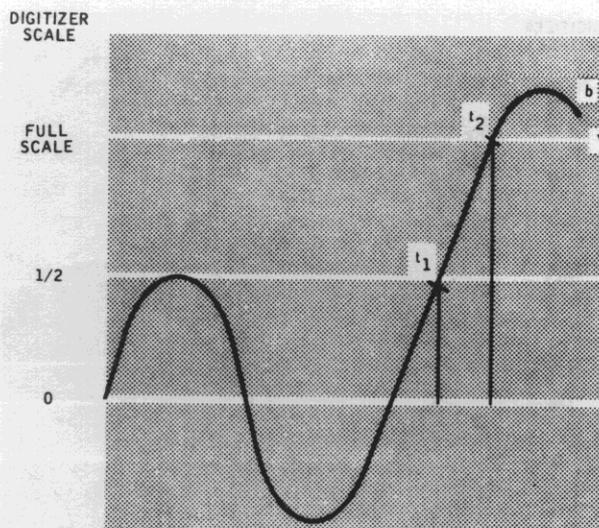
$Y = b \sin \omega t_2$

FIGURE 4

This diagram illustrates the case which occurs when the last sample digitized is just below half scale.

Transposing terms,

$$\frac{b}{1/2Y} = \frac{1}{1/2 \sin \omega t_2}$$

This equation may be reduced to the following, expressed in terms of frequency:

$$\frac{b}{1/2Y} = \frac{\sqrt{5 - 4 \cos \omega \times 10^{-3}}}{\sin \omega \times 10^{-3}}$$

Next, the line between a possible overscale and a certain overscale will be analyzed. This case occurs (on the channel controlling the gain) when the last sample digitized is a very small interval above half scale, as diagrammed in Figure 5. Since the sample is above half scale, the amplifier down-ranges before the next sample is taken, as represented by the solid line in the diagram. The dotted line represents what would have been the path of the burst-out on the original gain range. The burst-out ratio, consequently, is $\frac{2b}{1/4Y}$.