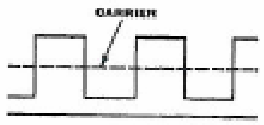
Frequency or Phase Modulation?

THERE was recently some correspondence in the columns of *The Wireless World** concerning the correct description of a system of modulation introduced by Armstrong, one writer referring to it as "frequency or, as it is sometimes called, phase modulation," and others writing to prove mathematically that they are really the same or really different. If, instead of sinusoidal modulation, one assumes rectangular modulation, that is, something approaching what would with ordinary amplitude modulation be represented by the diagram, the essential difference between the two is brought out very clearly.



If phase modulation is being employed, the sudden jumps should correspond to sudden changes of phase, i.e. the rotating vector should *spring suddenly* forward or backward, but, having sprung, should then continue to rotate at the same speed as before; if it does not, then the frequency has also been modulated.

If on the other hand frequency modulation is being employed, the vector undergoes no sudden displacement but merely changes its angular velocity, rotating successively at speeds above and below that of the unmodulated carrier by definite amounts. It is, of course, a necessary consequence of the higher frequency that the phase advances, since the vector at any moment is in advance of the position that it would have otherwise occupied. This is no reason, however, for confusing it with phase modulation, since it is the frequency that depends directly on the depth of modulation and undergoes the sudden changes in the case illustrated; the gradual change of phase is a secondary phenomenon. To decide whether any actual practical case is the one or the other, it is only necessary to ask what happens to the rotating vector if the output is modulated rectangularly.

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* June 15th and 29th, and July 20th, 1939.

Thre has ben some comment in the Wikipedia from an uninformed individual who contends Prof. Howe may never have existed. The above is a copy of the original Howe paper from 'The Wireless Engineer', Nov. 1939. pp 547.

The frequency resulting from a rectangular phase change input is: $F = F_{carrier} + \Delta f$.
Δf can be calculated from the basic relationship $\omega t = \Phi = 2\pi ft$.

This can be rewritten in derivative form as $\Delta f = \Delta\Phi/2\pi\Delta t$. The rise and fall time t is fixed by the the circuit parameters. During the rise and fall times (edges), there is a large $\Delta\Phi/\Delta t$., which causes a large Δf of very short duration.(about 1 RF cycle), which is elininated by the narrow bandpass filters. At all other times, $\Delta\Phi$ is zero and the frequency is constant, $F = F_{carrier}$. A phase detector using $F_{carrier}$ as a phase reference will detect the phase changes as positive and negative voltages. A required bandpass filter delay time (group delay) can also be calculated from the same relationship:

$$T_g = \Delta\phi / 2\pi\Delta f$$

Eq 6.1

If $\Delta\Phi$ in the filter is zero, there is no group delay time T_g, or frequency change caused by the filter. The relationships are shown in Eq. 6.1 and further discussed in chapter 7 of the UNB Textbook..