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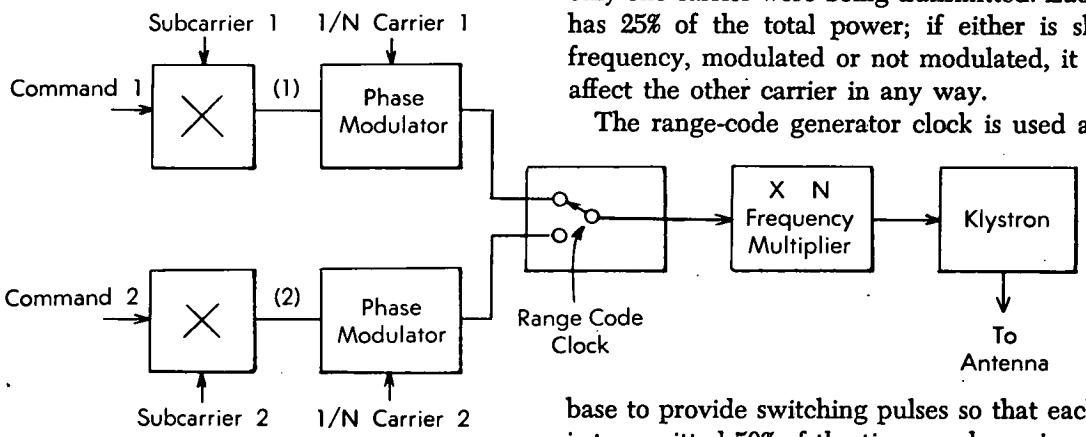
NASA TECH BRIEF

NASA Pasadena Office

Two-Carrier Command Modulation System

The problem:

To transmit two high-power PCM signals from a single transmitter in such a manner that the efficiency is high, the two signals can be manipulated independently with no interference between them, and the receiver is not affected by spurious signals.



The solution:

Utilize two carriers, with each phase-modulated by a subcarrier which, in turn, is modulated by data bits; switching between the two carriers is alternated at a high rate (relative to the subcarrier frequencies). The resulting composite signal is multiplied up to the desired frequency and used to drive the power amplifier (klystron) which feeds a transmitting antenna.

How it's done:

The two carriers are switched alternately to the transmitter and fed in such a way that they do not interact. Since each signal is, in effect, turned off and on at the switching frequency, each is amplitude-modulated by a square wave. If both signals are modulated by data-modulated subcarriers as shown in the diagram, and if the subcarrier frequencies are low compared to the switching rate, the resulting spectrum includes two carriers, each modulated by its own subcarrier and with a form exactly as though only one carrier were being transmitted. Each carrier has 25% of the total power; if either is shifted in frequency, modulated or not modulated, it does not affect the other carrier in any way.

The range-code generator clock is used as a time base to provide switching pulses so that each carrier is transmitted 50% of the time; each carrier will have 25% of the power, and the other 50% will be in the sidebands about each carrier at the odd harmonics of the switching frequency. When it is required that a ranging code be transmitted, or that commands and a ranging code be transmitted simultaneously, the modulated command subcarrier and the ranging code are added, with the proper relative values to allocate the modulation power between them as desired, to phase-modulate the carrier. This sum of the two modulating waveforms would appear at point 1 or 2 in the diagram. The properties of the ranging code are not changed, and the spectrum of the range-code modulated carrier is essentially the same without switching.

(continued overleaf)

Note:

Requests for further information may be directed to:

Technology Utilization Officer
NASA Pasadena Office
4800 Oak Grove Drive
Pasadena, California 91103
Reference: TSP 73-10273

Patent status:

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning non-exclusive or exclusive license for its commercial development should be addressed to:

NASA Patent Counsel
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