Counter banks stagger radar's pulse rate

by Prakash Dandekar
Tata Electric Companies, Bombay, India

In many radar applications, the instantaneous pulse-repetition frequency must be varied in an orderly fashion to improve the read-out accuracy of the system's moving-target indicator. Considerable circuitry is usually required to achieve the so-called staggered operation, but as shown here, two sets of synchronous counters can be easily connected to control the prf over any range, while providing superior MTI performance.

Normally, designers resort to transmitting pulses at each of three selected periods only, in order to simplify circuitry. Specifically, a popular technique is to transmit a group of three 1-microsecond pulses spaced at 1, 1.1, and 1.2 milliseconds repeatedly. When this is done, however, the filtered output of the MTI is not uniform and so—aside from causing discontinuities in the curve of MTI filter output versus target velocity—this method creates blind velocity points, or ranges over which velocity cannot be determined accurately.

With this circuit, a perfectly smoothed response is achieved by increasing the number of staggered pulses per given time. Thus in this case, a group of 200 pulses, each having a time between pulses of $(1{,}201-M)$ micro-seconds, where M denotes the Mth pulse of 200, are generated.

As shown, 12-bit counters A_1–A_3, comprising the main counter chain, advance at a 1-megahertz rate. When the counter reaches its maximum, the carry output of A_3, serving as the synchronous output, is generated.

The same signal is used to preset the main counter to a 12-bit binary number, N, which is determined by the state of the offset counter A_4–A_6. Because A_4–A_6 is also clocked, this unit is incremented with every sync pulse, so during each cycle the main counter is initialized at a higher value than it was previously. Thus the repetition time is reduced by 1 μs on each pass.

Note that the offset counter is initialized at a minimum value of $B51_{16}$ (see A–D inputs of A_4–A_6) and advances to a maximum of $C18_{16}$ $(= 2^{12})$ before it is reset by logic gates G_1–G_3. Thus, the difference between the counter's maximum and minimum is 200 counts, meaning the instantaneous pulse-repetition rate will vary from 1,200 to 1,001 microseconds. The maximum and minimum values may be easily changed, however, so that any pulse-repetition frequency range can be set.

When the counter reaches 3,096, corresponding to a rate of 1,001 μs, A_4–A_6 is loaded with $B51_{16}$. The rate becomes 1,200 μs once more, and the cycle is repeated. □

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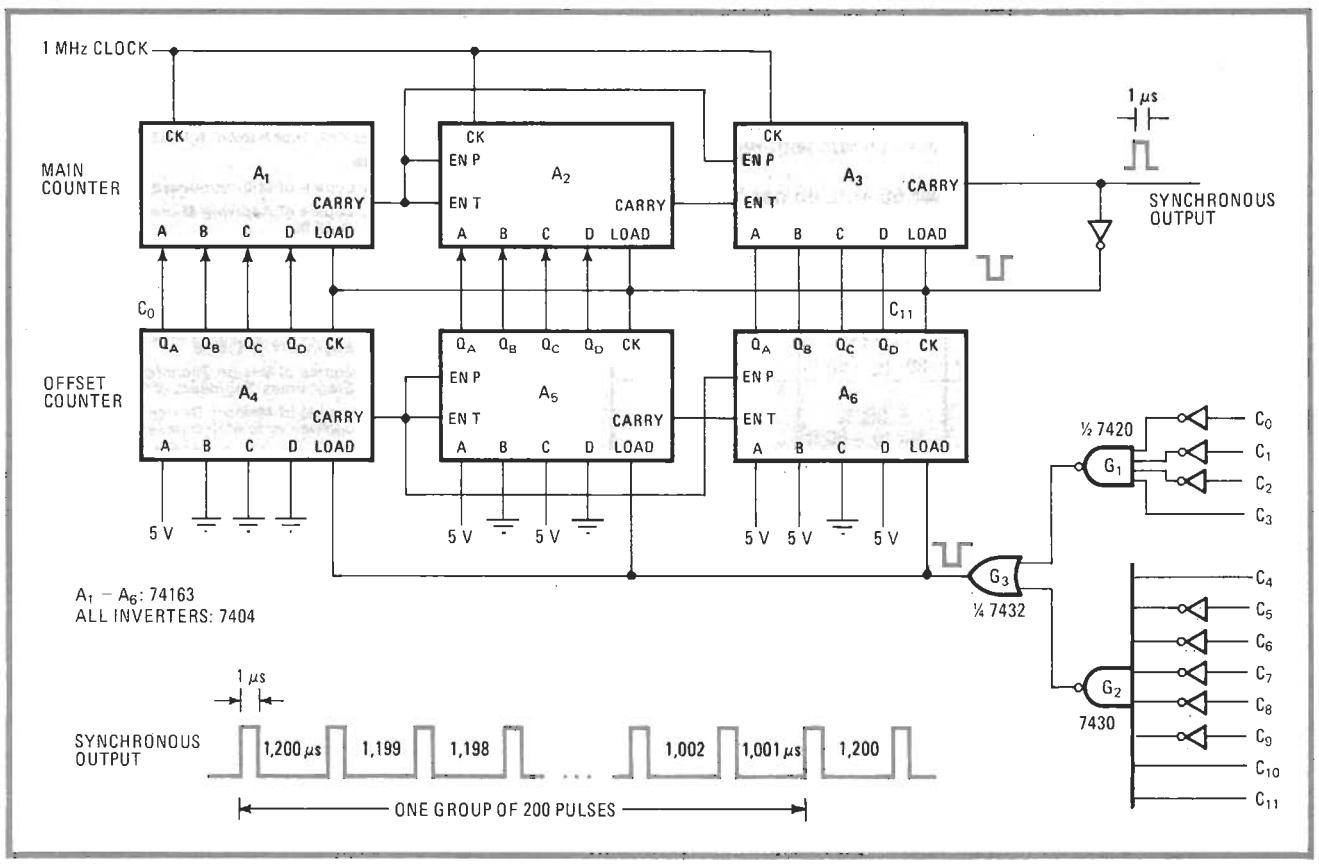

Smooth staggering. Two 12-bit counter chains generate a group of repeating N pulses spaced at $(1{,}201-M)$ μs, where M denotes the Mth pulse of N. for incremental staggering of the radar-pulse rate. Master clock sets absolute value of maximum pulse-repetition frequency.