Pulse generator produces programable burst

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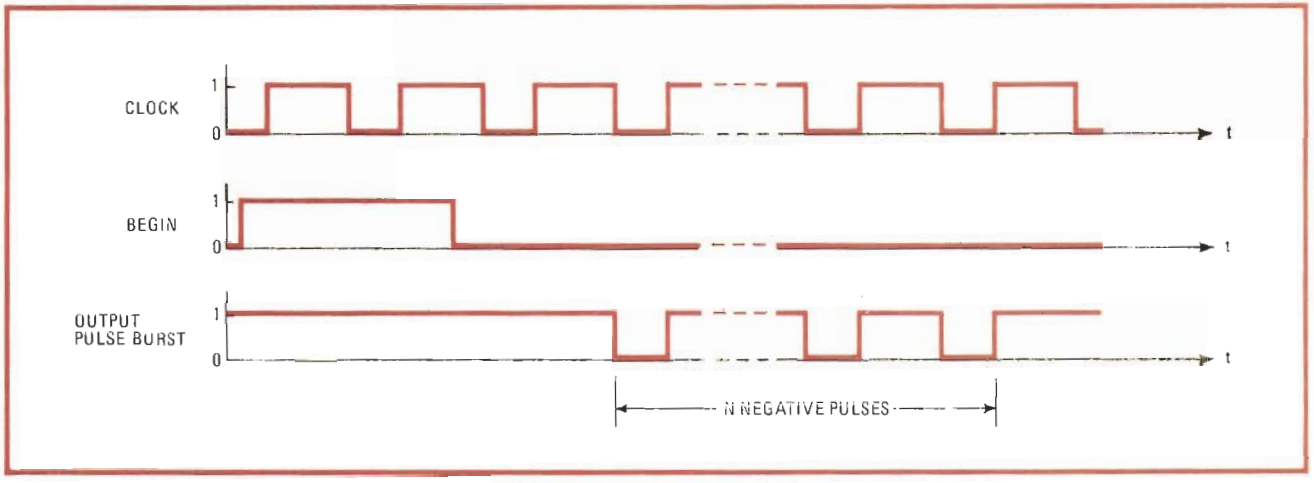
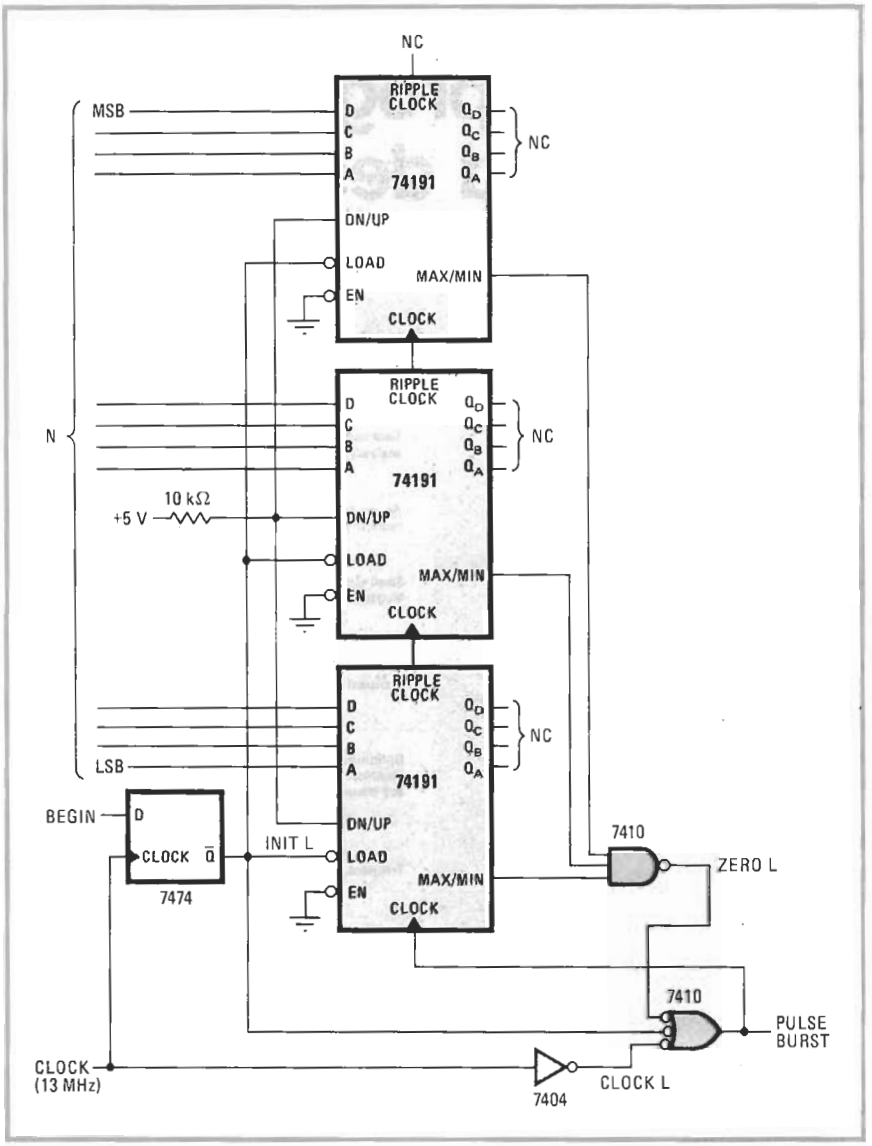
In debugging digital circuits it's often desirable to pass a predetermined number of pulses from a free-running clock and then stop, without producing any shortened pulses or glitches. There are also many systems, such as graphics interfaces, where such a capability may need to be built in. A programable pulse-burst generator is a circuit that fulfills this need.

This kind of generator should have n input lines to set N, the number of pulses to be passed. It should also have a begin input to begin a pulse burst, a clock input for the free-running input clock, and a pulse-burst output for the programed number of output pulses. The circuit should behave as shown in Fig. 1. The begin input is not synchronized with the clock, but it is assumed to be asserted for at least one clock period. The pulse-burst output is normally high; after begin is asserted and then de-asserted, N negative pulses are produced at this output in synchronization with the clock input.

A circuit that has the desired behavior has been built



1. Controlled pulse burst. Applications such as circuit debugging require generation of a predetermined number of pulses. Basic timing is provided by a free-running clock, and the pulse burst is initiated by a begin signal that lasts for at least one clock period. Note that the negative output pulse sequence follows the first rising clock pulse after the begin command goes low.



2. Compact circuit. This arrangement has 12 input lines, and therefore can produce pulse bursts of any length less than 2^{12}; for example, if the binary input number N is 000000000100, the output burst consists of four negative pulses. The circuit shown uses few packages. It operates at clock rates up to 13 MHz at room temperature and up to 10 MHz under any conditions. Adding more counters enables it to produce longer pulse bursts, while changing the counter type adapts it for BCD inputs.

from commercially available MSI counters (see Fig. 2). In this circuit n = 12, so that any burst of length less than 2^{12} can be generated. Three 74191 up/down counters are used to form a 12-bit down-counter. A D-type flip-flop is used to synchronize the begin and the clock inputs. The flip-flop output labelled init L (where L indicates active low) is used to load the counters with the number N and to hold the pulse-burst output high while the counters are being loaded. When the begin signal is removed, the counters count and the pulse-burst output passes pulses as long as the zero-low signal is high. The zero-low signal is derived from the max/min outputs of the counters and is used to hold the pulse-burst output high when the counters have counted down to zero. Thus, if the counters are loaded with N, exactly N negative pulses are passed before the counters count down to zero. Note that the circuit behaves properly even for N = 0.

For the circuit to work properly, all changes of zero-low must take place while clock-low is low. This sets a minimum time that the clock input must be high—about 50 ns typically for the parts shown. This time is computed as the sum of the delay of the 74191 counter clock to the max/min terminal and two TTL gate delays.

The generator can be extended to handle longer bursts by simply cascading more 74191 counters and using a wider NAND gate to produce the zero-low signal. The cascading can always be done with the ripple-carry outputs as in Fig. 2 without degrading the maximum system speed because only the least significant counter is active when the critical transition of the zero-low signal from high to low is made. At this time, the max/min outputs of all other counters have long since been high; on all other transitions, the max/min output of the next lower-order counter goes low before any max/min output goes high, holding the zero-low signal high.

The programable pulse-burst generator of Fig. 2 can be made to accept binary-coded-decimal inputs by simply substituting 74190 BCD counters for the 74191s. Positive pulses can be produced instead of negative by simply inverting the pulse-burst output. □

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