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ОСВІТА, НАУКА ТА ВИРОБНИЦТВО: РОЗВИТОК ТА ПЕРСПЕКТИВИ

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RING COUNTERS

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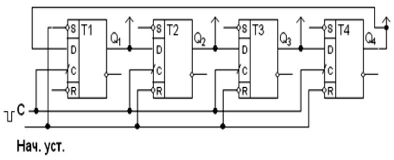
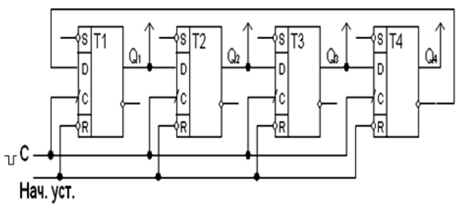
For the construction of ring counters [1], all types of shift registers can be used. The most simple is a ring counter on D flip-flops (Fig. 1a).

In the circuit, four flip-flops are closed in the ring by feedback from the output of the last flip-flop to the input of the first flip-flop [2]. Counting pulses are fed to the clock inputs of all triggers. On this basis, all ring counters are synchronous. By the pulse of the initial setting, the first trigger is set to 1, the rest to 0.



№ тн	Q_1	Q_2	Q_3	Q_4
0	1	0	0	0
1	0	1	0	0
2	0	0	1	0
3	0	0	0	1
4	1	0	0	0

Fig. 1.



№ тн	Q_1	Q_2	Q_3	Q_4
0	0	0	0	0
1	1	0	0	0
2	1	1	0	0
3	1	1	1	0
4	1	1	1	1
5	0	1	1	1
6	0	0	1	1
7	0	0	0	1
8	0	0	0	0

Fig. 2.

The input pulse in this counter plays the role of a propulsive pulse. The logical unit, when the next advance pulse is applied, is transmitted to the next trigger in the order. Reaching the end of the register, the logical unit is written to the first trigger, and the count is repeated. From the table (Fig. 1, b) it can be seen that the counting coefficient is four, by the number of flip-flops.

The advantage of ring counters is [1] the possibility of replacing with one device and a counter with a natural binary code, and a decoder, and a disadvantage is a large number of elements for large Ksch. The number of triggers is equal to the required number of counter states (N = n).

To increase the counting ratio in ring meters, additional logical connections are used. In ring counters with logical feedbacks, all possible combinations of trigger states can be obtained, except one-zero in all digits. Therefore, the counting coefficient can be brought to the value N = 2n-1 (where n is the number of flip-flops). But for such a counter a decoder is already needed.

In practice, Johnson's ring counter is often used. The Johnson counter, realized on four D-flip-flops, is shown in Fig. 2. The D-inputs of all flip-flops, except the first one, are fed signals from the outputs of the previous flip-flops. The D-input of the first flip-flop is fed with a signal from the inverse output of the last one (cross-link).

Unlike simple ring counters, the Johnson counter [2] has a count coefficient twice that of its constituent triggers. For example, if the counter is made up of four flip-flops (Figure 2, a), then it will have eight stable states (the table in Figure 2, b). As can be seen, when counting, the "first wave of units" propagates from the first trigger, and then the "wave of zeros" propagates. The output code of the counter is called the Johnson code.

Thus, after analyzing and comparing the characteristics of the ring counters, it is planned to use the Johnson counter for further studies of digital counting devices.

References

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