FTD-MT-24-364-68

FOREIGN TECHNOLOGY DIVISION

THE PECULIARITIES OF SIMPLE BINARY COUNTERS USING ELM-50 AND ELM-400 ELEMENTS

by

N. L. Prokhorov

FTD-MT-24-364-68

EDITED MACHINE TRANSLATION

THE PECULIARITIES OF SIMPLE BINARY COUNTERS USING ELM-50 AND ELM-400 ELEMENTS

By: N. L. Prokhorov

English pages: 4

THIS TRANSLATION IS A RENDITION OF THE ORIGINAL FOREIGN TEXT WITHOUT ANY ANALYTICAL OR EDITORIAL COMMENT. STATEMENTS OR THEORIES ADVOCATED OR IMPLIED ARE THOSE OF THE SOURCE AND DO NOT NECESSARILY REFLECT THE POSITION OR OPINION OF THE FOREIGN TECHNOLOGY DIVISION.	PREPARED BY: TRANSLATION DIVISION FOREIGN TECHNOLOGY DIVISION WP-AFB, OHIO.

FTD-MT-24-364-68

Date 27 Sep 19 68

This document is a machine translation of Russian text which has been processed by the AN/GSQ-16(XW-2) Machine Translator, owned and operated by the United States Air Force. The machine output has been post-edited to correct for major ambiguities of meaning, words missing from the machine's dictionary, and words out of the context of meaning. The sentence word order has been partially rearranged for readability. The content of this translation does not indicate editorial accuracy, nor does it indicate USAF approval or disapproval of the material translated.

DATA HANDLING PAGE

01-ACCESSION NO.	98-DOCUMENT LOC	39-TOPIC TAGS
TM8501731		binary logic, count rate meter, digital analog converter, industrial automatic control, logic design, logic element, shift register
09-TITLE THE PECULIARITIES OF SIMPLE BINARY COUNTERS USING ELM-50 AND ELM-400 ELEMENTS		
47-SUBJECT AREA 09		

42-AUTHOR/CO-AUTHORS	10-DATE OF INFO
PROKHOROV, N. L.	-----67
43-SOURCE SCHETNYYE SKHEMY NA MAGNITNYKH LOGICHESKIKH ELEMENTAKH. MOSCOW, IZD-VO ENERGIYA (RUSSIAN)	68-DOCUMENT NO. FTD-MT-24-364-68
	69-PROJECT NO. 6050202

63-SECURITY AND DOWNGRADING INFORMATION	64-CONTROL MARKINGS	97-HEADER CLASN
UNCL, 0	NONE	UNCL

76-REEL/FRAME NO.	77-SUPERSEDES	78-CHANGES	40-GEOGRAPHICAL AREA	NO. OF PAGES
1886 1433			UR	4
CONTRACT NO.	X REF ACC. NO.	PUBLISHING DATE	TYPE PRODUCT	REVISION FREQ
	65-AM7028881	94-00	Translation	NONE

STEP NO.	ACCESSION NO.
02-UR/0000/67/000/000/0016/0018	

ABSTRACT This pamphlet is intended for designers of logical diagrams for automatic control of various industrial processes. The pamphlet is devoted to the construction and design methods of various forms of direct, feedback, and reversible binary counters using ELM-50 and ELM-400 magnetic logic elements. These counters are developed at the Insitute of Automation and Telemechanics (technical cybernetics) and are mass produced presently by the Kalininsk Electric Equipment Works. No personalities are mentioned. Orig. art. has: 7 references.

U. S. BOARD ON GEOGRAPHIC NAMES TRANSLITERATION SYSTEM

Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

* ye initially, after vowels, and after ъ, ь; e elsewhere. When written as ё in Russian, transliterate as yё or ё. The use of diacritical marks is preferred, but such marks may be omitted when expediency dictates.

THE PECULIARITIES OF SIMPLE BINARY COUNTERS USING ELM-50 AND ELM-400 ELEMENTS

The logic circuits of computing flip-flops and binary counters considered in the preceding paragraph in principle can be realized both on magnetic logic elements ELM-50 and ELM-400. However, the collection of functionally stable logic elements in ELM-50 and ELM-400 systems is varied. Therefore, construction of the same logic circuit can require a different number of elements, depending upon the selected system of elements.

Let us consider concre e peculiarities in the application of elements of the ELM-50 and ELM-400 system for the construction of simple binary counters.

a) Simple Binary Counters on ELM-50 Elements

For the creation of direct and reverse computing flip-flops, necessary for the construction of binary counters, in the ELM-50 system elements of equivalence and nonequivalence have been developed [4].

In the ELM-50 system, the circuits of counters (Figs. 8 and 9) [Figs. 8 and 9 not available] are equivalent from the point of view of the quantity of elements utilized and functional stability, since the connecting elements AND and OR in this system are functionally stable.

The selection of this or that counter circuit is determined by the concrete conditions of use.

From the point of view of using flip-flop circuits on ELM-50 elements, often of great interest is the possibility of obtaining of a rigid memory, i.e., a memory which remembers its own state during switch off and subsequent switch on of the feed voltage.

In principle, a rigid memory is only possessed by circuits which are composed of elements which have repetition characteristics [5]. If in the circuits there are elements which have the characteristics of an inverter, then such a memory after switch off and subsequent switch on of the feed voltage can be in any position. This is explained by the fact that the flip-flop circuits on inverters are completely symmetric and their switched on state physically does not differ from the switched off state. In every case one of the cores is in the saturated state, while the other periodically is magnetically reversed. Here, if the time missed is a multiple to the amount of periods of feed voltage $t = kT$, then the circuit will continue its work without a change. If, however, time $t = kT + t_1$ is missed, where $t_1 \approx T/2$, then the conditions of the inverters will switch and switching of the flip-flop will occur. In this case special zero protection is often necessary; this is recommended in plant instructions concerning the use of elements of the ELM-50 system to bring all flip-flops to the zero position.

b) Simple Binary Counters on ELM-400 Elements

In the ELM-400 system only inverters have functional stability. The repeaters are designed only for work among the inverters and cannot form independent networks.

Circuits of direct and reverse binary counters in this system are unequivalent in the number of elements required.

The logic circuits of connecting elements AND, necessary for the construction of direct binary counters, require a greater number of elements in the inverter system than the logic circuits OR. Therefore, for binary counters in the ELM-400 system reverse cells are accepted. The block diagram of Fig. 6d [Fig. 6 not available] was selected as being basic for the cell of the binary counter, in which the function of nonequivalence is carried out on the inverter and on the element of equivalence, which was specially developed for computing circuits in the ELM-400 system.

Such a circuit of the i-th digit of a binary counter, in which the transition element is made according to the OR diode layout, is shown in Fig. 10. Here b_{i-1} is the input signal in the form of a pass of a single pulse, b_i is the signal of transfer to the following (i + 1)-th digit and x_i is the output signal of the digit in direct code (true representation).

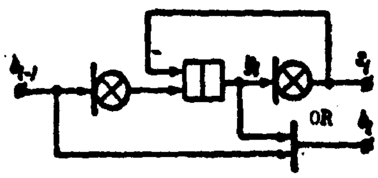

Fig. 10.

From the diagram of Fig. 9b, it is clear that in a binary counter which is assembled from such digits, each preceding cell is loaded through OR diode circuits utilized instead of the OR magnetic logic elements, to all subsequent cells. Such a binary counter can have no more than four or five digits, after which, for amplification, it is necessary to place the repeater on two inverters, although here a delay appears in the operation of the digits.

Figure 11 shows the circuit of a digit of a binary counter, in which amplification of the transfer signal occurs in each division. A binary counter assembled on such cells will be sequential, which must be considered during decoding.

Figure 12 shows a reverse cell of a binary counter which realizes the logic function of equivalence with feedback along one of the inputs. The cell does not contain an element of equivalence in evident form, but it is constructed of four magnetic inverters and

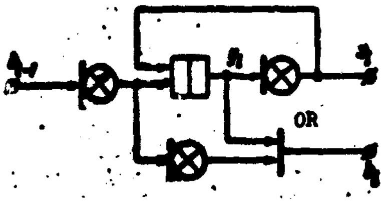

Fig. 11.

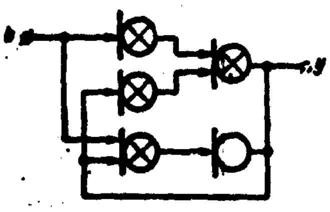

Fig. 12.

one magnetic repeater to equate the phases of feedback signals.

It is necessary to note that binary counters on cells constructed according to the diagrams of Figs. 10 and 11, although they are reverse, can count both in direct and in reverse binary codes, since they have both direct x_i and reverse $y_i = \bar{x}_i$ outputs.

All memory circuits in the ELM-400 system of elements are rigid, in spite of the use of inverters. This is attained by the use of a stabilizing power supply, carried out on magnetic material with a rectangular hysteresis loop. Such a source itself memorizes the magnetic state at the moment of switch off of feed voltage, and during subsequent switch on of feed it compensates the difference of pass time $t_1 < \frac{T}{2}$ by its earlier saturation.