High-Speed Fixed Memory

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1. *Introduction*

It is effective to use an inexpensive fixed memory as the auxiliary memory device of a high speed computer, and it should be desired that its reading speed may catch up with the operating speed of the computer. The detailed consideration and examination regarding to a memory system are performed, which is characterized by using a kind of transformer with a shorted winding as one memory element. This system can operate in an extremely short time by comparatively small driving current.

2. *Fundamental Principle*

Ferrite cores are arranged in a matrix as indicated in Fig. 1. Common driving wires W_d in the horizontal way and common reading wires W_r in the vertical way are passed through each of these cores once and three times respectively. Each core is also wound by a short-wire which is shorted or opened according to the information to be stored. When

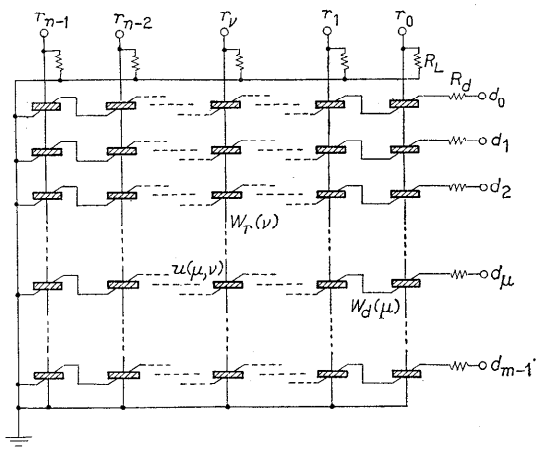

Fig. 1. Memory matrix using small pulse transformers

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an address signal is applied to a terminal d and the driving current flows through the winding $W_d(\mu)$, outputs induced on the reading wires of the cores which intersect to $W_d(\mu)$ are transmitted to the terminals $r_0, r_1, \cdots, r_{n-1}$, where no voltage change appears from the cores in the shorted state.

As the short-wire is separated from the other windings, and the induced output is based on close magnetic cupling, the delay between the driving input and the induced output is short. This fact is profitable to a high speed operation.

3. *Experiment*

The characteristics of cores are as follows.

Material: $\mu=530$, $Q=1.9$ (at 5 MC).

Dimension: 4 mm (outer diameter)$\times$2 mm (iner diameter)$\times$1 mm (thickness), toroidal form.

400 pieces of the cores are arranged in a 20×20 matrix, and held on a printed board by the short-wires, the both ends of which are soldered to the copper foil on that board. The space between the both ends of the short-wire is 0.4 mm and becomes to be short-state by painting a conductive resin. (The measured resistance of the painted part is about 10 mΩ.)

Input signal which is 5 MC in repetition frequency, 50 nsec in pulse width and 100 mA in peak current is applied to one of the driving windings, and output pulses on the reading windings of the open-state cores attain to over 0.6 V. Maximum noise voltage at the terminal becomes 0.2 V. The measured delay time on the driving and reading winding passing through 20 cores is 2 nsec and 8 nsec respectively. The total time including the delay of the selection circuit and of the read-out amplifier is measured under 60 nsec.

4. *Conclusion*

Intending to realize a simple fixed memory device which has the short reading time and does not require a large driving current, the author researched the memory element using a kind of transformer. Many problems are still left to construct a fixed memory of large capacity, especially concerning the stray capacitances in the selection circuit and between driving and reading wires.