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MEMORY ANALYSIS OF MICROCONTROLLER PROGRAMS

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There are three main types of memory used in microcontrollers. Program memory is a non-volatile memory designed to store program code and constants. This memory does not change its contents during program execution. Data memory is used to store variables during program execution. Microcontroller registers This type of memory includes internal registers of the processor and registers used to control peripheral devices [1,2]. Program memory. One of the types of non-volatile memory is usually used to store programs: ROM (disposable software ROM), EPROM (electrically programmable ROM with ultraviolet erasure), EERROM (ROM with electric recording and erasure, this type also includes modern Flash-memory chips' or ROM (reusable ROM). All of these types of memory are non-volatile, which means that the contents of the memory are stored after the microcontroller is turned off. This memory is necessary because the microcontroller does not contain any mass storage devices (magnetic disks) from which the program is downloaded to computers. The program is constantly stored in the microcontroller [3].

During execution, the program is read from this memory, and the control unit (command decoder) provides its decoding and perform the necessary operations. The contents of the program memory cannot be changed (reprogrammed) during program execution. Therefore, the functional purpose of the microcontroller cannot be changed until the contents of its program memory are erased (if possible) and reprogrammed (filled with new commands).

It should be noted that the bit size of the microcontroller (8.16 or 32 bits) is specified according to the bit size of its data bus. In Harvard architecture, commands can be larger than data to allow the entire team to be read in one measure. For example, PIC microcontrollers, depending on the model, use commands with a bit rate of 12, 14 or 16 bits. In AVR microcontrollers, the command always has a bit rate of 16 bits. However, all of these microcontrollers have an 8-bit data bus.

In devices with Princeton architecture, the bit size of the data, of course, determines the bit size (number of lines) of the bus used. In Motorola 68HC05 microcontrollers, a 24-bit command is housed in three 8-bit program memory cells. To fully sample such a command, three cycles of reading this memory are required. When it is said that the device is 8-bit, it means the bit size of the data that can be processed by the micro-controller [4,5].

ROM memory is used when the program code is entered into the microcontroller at the stage of its production. Preliminarily, the program is debugged and tested, and then transferred to the manufacturer, where the program is transformed into a mask drawing on a glass photo template. The resulting photo template with a mask is used in the process of creating connections between the elements that make up the memory of programs. Therefore, such memory is often called reusable ROM. ROM is the cheapest type of non-volatile memory for mass production. However, it has a number of significant drawbacks that have led to the fact that in recent years, this type of memory is almost not used. The main disadvantages are the significant cost of time and money to create a new set of photo templates and their implementation in production. Of course, this process takes about ten weeks and is cost-effective when producing tens of thousands of devices. Only at such volumes of production the advantage of ROM in comparison with E(E)ROM is provided. There is also a limitation related to the possibility of using such microcontrollers only in a certain field of application, because its program provides a rigidly fixed sequence of operations, and can not be used to solve any other problems. EPROM electrical program memory consists of cells that are programmed by electrical signals and wiped with ultraviolet light. The ROM memory can only be programmed once. This memory, of course, contains fusible jumpers that burn out during programming. Nowadays, such memory is very rarely used.

The EPROM memory cell is a floating-gate MOS transistor surrounded by silicon dioxide (SiO2). The transistor stack is connected to ground and the source is connected to the supply voltage by a resistor. In the erased state (before recording) the floating gate does not contain a charge, and the MOS transistor is closed. In this case, a high potential is maintained at the source, and a logical unit is read when accessing the cell. Memory programming is reduced to writing to the corresponding cells of logical zeros. Programming is carried

out by applying high voltage to the control gate. This voltage must be sufficient to provide a breakdown between the control and floating gates, after which the charge from the control gate is transferred to the floating.

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THEORY AND PRACTICE OF APPLICATION OF EPILAMIC COATINGS

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The efficiency of agricultural machinery depends mainly on its reliability – the ability to perform specified functions with minimal labor costs and material resources for a long time. The main indicator that determines the efficiency and resource of equipment is the intensity of wear of friction parts. By choosing the