The CPU, Type 4004, is designed to work with other members of Intel's MC5-4 microcomputer set. The other ICs in this kit of standard building blocks are the 4001 ROM, 4002 RAM and the 4003 shift register (SR).

The minimum system configuration consists of one CPU and one 256×8 bit ROM. For one-of-a-kind applications, and electrically-programmable ROM can be used in place of the mask-programmable 4001. The MCS-4 microcomputer is fabricated with silicon gate, low-threshold MOS technology.

Packaged in a 16-pin ceramic DIP, the CPU chip consists of a 4-bit adder, a 64-bit (16×4) index register, a 48-bit (4×12) program counter and stack, and address incrementer, an 8 bit instruction register and decoder, and control logic.

Forty five instructions are included in the 4004's repertory. All timing, control and arithmetic operations are implemented internally.

Information flows between the 4004 and the other chips through a 4-line data bus. A system built with the MCS-4 set can have up to 4k×8-bit ROM words, 1280×4 bit RAM characters and 128 I/O lines without requiring any interface logic. With the use of external gates the computer size can be increased even further.

The MCS-4 uses a 10.8 μsec instruction cycle. The basic instruction execution requires 8 or 16 cycles of 750-kHz clock. Addition of two 8-digit numbers requires 850 μsec.
Custom systems using this 4004 chip are implemented by microprograms stored in a ROM. The idea of microprogramming a process to implement a special controller is not new. IBM's system 360 computer and HP's 2100A desk calculator are two examples of both large and small systems that have exploited the inherent design and production advantages of microprogramming. In desktop calculators about 35% of the logic is associated with doing arithmetic. The other tasks are keyboard encoding, printing results, displaying status and general control. These functions can be done by microprogramming rather than by additional random logic. Microprogramming can even be used for keyboard switch de-bouncing and for converting 4-bit BCD code to 7-segment lamp code. Many features may be added to systems using this chip by providing additional ROMs.

This approach provides a flexible and modular technique for system design in which memory devices are used instead of logic devices. The major limitation to its application is speed. While an IC logic can make a decision in about 5 nsec, and combinatorial networks allow many decisions to take place in parallel, this computer chip performs decisions sequentially at 10.8 µsec per instruction.

The instruction repertoire of the 4004 consists of 16 machine instructions, 14 accumulator group instructions and 15 I/O and RAM instructions. A partial listing of the instruction set includes:

**DATA MOVES**

- Register to register
- Register to memory
- Memory to register

**ARITHMETIC & LOGICAL**

- Add
- Subtract
- Encode
- Complement
- Shift
- Rotate
- Increment
- Decrement

**CONTROL**
The MCS-4 microcomputer set is available from Intel Corp. 3065 Bowers Ave., Santa Clara, CA 95051. Prices for the individual members of the set are:

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<th>Part No.</th>
<th>Quantity</th>
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<th>100-999</th>
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</table>

*(excluding mask charges)*

**Related articles:**

- [Intel 4004 is announced, November 15, 1971](#)
- [Intel is founded, July 18, 1968](#)
- [60 years of EDN](#)