AP-70

APPLICATION NOTE

Using the Intel MCS®-51 Boolean Processing Capabilities

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MICROCONTROLLER APPLICATIONS

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USING THE INTEL MCS®-51 BOOLEAN PROCESSING CAPABILITIES

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1.0 INTRODUCTION

The Intel microcontroller family now has three new members: the Intel 8031, 8051, and 8751 single-chip microcomputers. These devices, shown in Figure 1, will allow whole new classes of products to benefit from recent advances in Integrated Electronics. Thanks to Intel's new HMOS technology, they provide larger program and data memory spaces, more flexible I/O and peripheral capabilities, greater speed, and lower system cost than any previous-generation single-chip microcomputer.

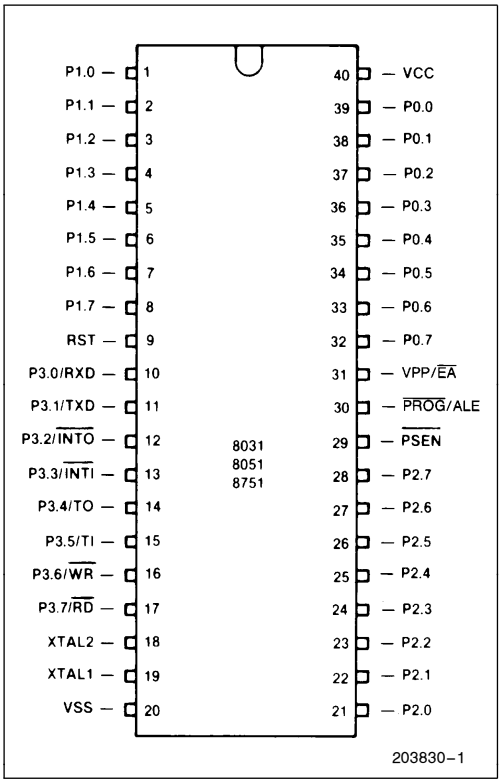

Figure 1. 8051 Family Pinout Diagram

Table 1 summarizes the quantitative differences between the members of the MCS®-48 and 8051 families. The 8751 contains 4K bytes of EPROM program memory fabricated on-chip, while the 8051 replaces the EPROM with 4K bytes of lower-cost mask-programmed ROM. The 8031 has no program memory on-chip; instead, it accesses up to 64K bytes of program memory from external memory. Otherwise, the three new family members are identical. Throughout this Note, the term "8051" will represent all members of the 8051 Family, unless specifically stated otherwise.

The CPU in each microcomputer is one of the industry's fastest and most efficient for numerical calculations on byte operands. But controllers often deal with bits, not bytes: in the real world, switch contacts can only be open or closed, indicators should be either lit or dark, motors are either turned on or off, and so forth. For such control situations the most significant aspect of the MCS®-51 architecture is its complete hardware support for one-bit, or *Boolean* variables (named in honor of Mathematician George Boole) as a separate data type.

The 8051 incorporates a number of special features which support the direct manipulation and testing of individual bits and allow the use of single-bit variables in performing logical operations. Taken together, these features are referred to as the MCS-51 *Boolean Processor*. While the bit-processing capabilities alone would be adequate to solve many control applications, their true power comes when they are used in conjunction with the microcomputer's byte-processing and numerical capabilities.

Many concepts embodied by the Boolean Processor will certainly be new even to experienced microcomputer system designers. The purpose of this Application Note is to explain these concepts and show how they are used.

For detailed information on these parts refer to the **Intel Microcontroller Handbook,** order number 210918. The instruction set, assembly language, and use of the 8051 assembler (ASM51) are further described in the **MCS®-51 Macro Assembler User's Guide for DOS Systems,** order number 122753.

Table 1. Features of Intel's Single-Chip Microcomputers

EPROM Program Memory	ROM Program Memory	External Program Memory	Program Memory (Int/Max)	Data Memory (Bytes)	Instr. Cycle Time	Input/ Output Pins	Interrupt Sources	Reg. Banks
8748	8048	8035	1K 4K	64	2.5 μs	27	2	2
—	8049	8039	2K 4K	128	1.36 μs	27	2	2
8751	8051	8031	4K 64K	128	1.0 μs	32	5	4

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