*Rev 10/77*

# Itel Advanced Systems

## MANAGEMENT SUMMARY

When it introduced the Advanced System computers in October 1976, Itel became the second vendor to offer what are essentially "plug-compatible" replacements for IBM central processing units. The Advanced System family consists of six models built around two central processing units, and all are described by Itel as "100 percent functionally compatible with the IBM System/360's and 370's."

Manufactured by National Semiconductor Corporation (through its Exsysco subsidiary), the two central processing units are designated the AS/4 and AS/5 and are offered as alternatives to the IBM System/370 Models 148 and 158, respectively. There are three uniprocessor models designated the AS/4, AS/5-1, and AS/5-3, and three multiprocessor models designated the AS/4 MP, AS/5-1 MP, and AS/5-3 MP. All of the AS systems are field-upgradable without exchanging CPU's.

Itel claims that the AS/4 has 1.4 times the performance capability of an IBM 148, and that the AS/5-1 and AS/5-3 are equal in performance to the IBM 158-1 and 158-3, respectively. The AS/5-1 MP is rated equal in performance to a 158-1 MP, and the AS/5-3 MP equal to a 158-3 MP. The AS/4 MP offers slightly better performance than the AS/5-3 and the IBM 158-3, according to Itel.

Purchase prices for the CPU's with the minimum one megabyte of memory are $800,000 for the AS/4, $1.3 million for the AS/5-1, and $1.5 million for the AS/5-3. The multiprocessor versions are priced at twice as much as the corresponding uniprocessor models, plus $250,000 for a coupler for tightly coupled MP configurations. Memory increments are available in one-megabyte modules, and these are priced at $95,000 across the board. Itel plans to market the AS systems on a variety of leasing plans, none of which will involve Itel as the owner of the systems. The only lease price figures ▷

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The Itel Advanced System computers are designed to compete directly against the IBM System/370 Models 148, 158-1, and 158-3. Itel claims that its processors provide increased performance and/or cost savings while maintaining complete functional compatibility with the IBM software and peripheral equipment.

## CHARACTERISTICS

SUPPLIER: Itel Corporation, Data Products Group, One Embarcadero Center, San Francisco, California 94111. Telephone (415) 983-0000.

MANUFACTURER: National Semiconductor Corporation, 2900 Semiconductor Drive, Santa Clara, California 95051. Telephone (408) 737-5000.

MODELS: AS/4, AS/4 MP, AS/5-1, AS/5-1 MP, AS/5-3, and AS/5-3 MP.

### DATA FORMATS

All data formats, instruction formats, and other architectural features completely follow the IBM System/370 architecture.

BASIC UNIT: 8-bit byte. Each byte can represent 1 alphanumeric character, 2 BCD digits, or 8 binary bits. Two consecutive bytes form a "halfword" of 16 bits, while 4 consecutive bytes form a 32-bit "word."

FIXED POINT OPERANDS: Can range from 1 to 16 bytes (1 to 31 digits plus sign) in decimal mode; 1 halfword (16 bits) or 1 word (32 bits) in binary mode.

FLOATING-POINT OPERANDS: 1 word, consisting of 24-bit fraction and 7-bit hexadecimal exponent, in "short" format; 2 words, consisting of 56-bit fraction and 7-bit hexadecimal exponent, in "long" format; or 4 words in "extended precision" format.

INSTRUCTIONS: 2, 4, or 6 bytes in length, which usually specify 0, 1, or 2 memory addresses, respectively. ▶
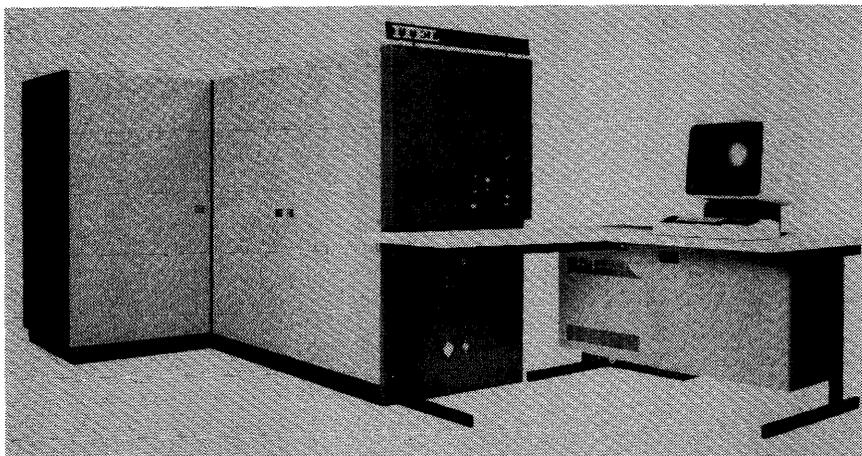


*The Itel Advanced Systems are fully compatible with the IBM System/370 processors but are said to require only about one-half the components of an IBM 370/158, use only 40 percent of the power, and run about 9 degrees cooler. Not shown in this photo is the standard 180-cps console matrix printer which augments the standard CRT console.*

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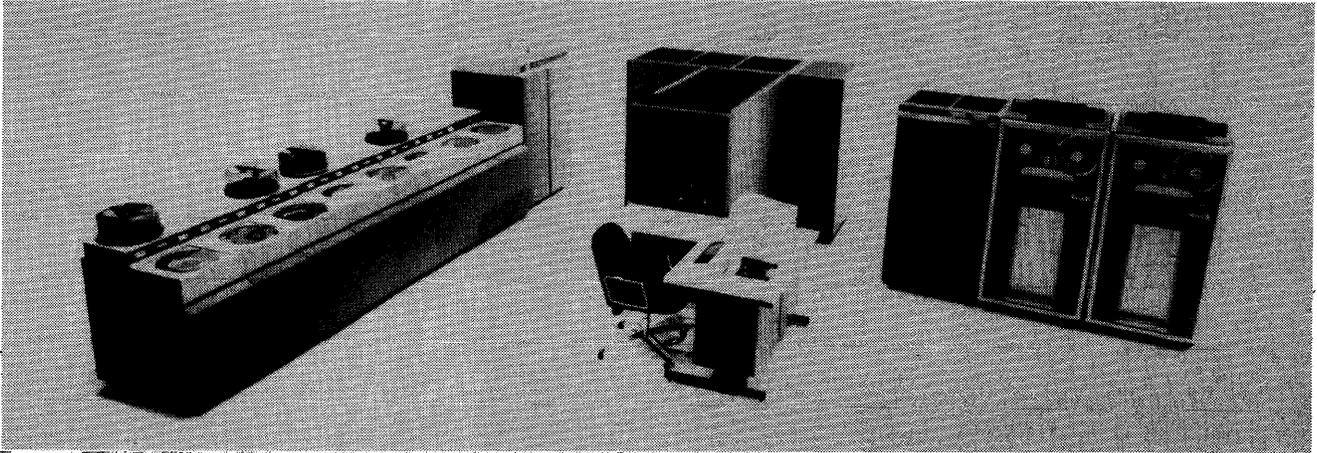


*Here the Advanced System mainframe is flanked by Itel disk and tape subsystems. Itel Corporation is a major third-party lessor of IBM computer equipment and claims to be the leading independent supplier of 3330-style disk drives and monolithic add-on main memory.*

▷ the company has released to date show an AS/5-1 system for $42,707 per month under a 4-year conditional sale agreement and $30,435 per month under a 7-year conditional sale agreement, both financed at 11 percent interest.

Initial customer deliveries of the AS systems are scheduled for the second quarter of 1977.

Each AS CPU has a processor cycle time of 115 nanoseconds, seven I/O channels (one of which is a spare that can be used as either a byte or block multiplexer channel), and a minimum of one megabyte of main memory. Maximum memory capacity and number of I/O channels double in MP configurations. With the standard increments of one megabyte, memory capacity can be expanded to a maximum of four megabytes in the AS/4 and to eight megabytes in the AS/5-1 and AS/5-3. MP versions can be doubled to a maximum of 8 and 16 megabytes of memory for the AS/4 and AS/5 systems, respectively. Like their IBM counterparts, the AS/5 machines use bipolar buffer (or cache) memories, the AS/5-1 with 8K bytes and the AS/5-3 with 16K bytes. Standard features for all AS models include a CRT with light pen and a 180-cps hard-copy printer.

According to Itel, IBM operating systems and program products, as well as all user-written programs that operate on an IBM 370/158 (except for those containing time-dependent code), will run on all the AS models. The IBM operating systems run in native mode, and any IBM or Itel plug-compatible peripheral device that is designed to attach to an IBM 370/158 can be used with all AS models. Principal operating systems for the three uniprocessor models are IBM's DOS/VS, OS/VS1, OS/VS2, and MVS, while MVS is the main operating system for the MP versions.

Itel claims that the AS processing units have only about one-half the number of components found on an IBM 370/158, thus enabling them to utilize about 40 percent ▷

► **INTERNAL CODE: EBCDIC (Extended Binary-Coded Decimal Interchange Code).**

## MAIN STORAGE

**STORAGE TYPE: Metal oxide semiconductor (MOS).**

**CAPACITY: From 1 to 16 million bytes, in 1-million-byte increments, housed in a single cabinet. (See table for capacities of the individual models.)**

**CYCLE TIME: See table.**

**CHECKING: Error checking and correction (ECC) circuitry in main memory performs automatic correction of all single-bit errors and detection of all double-bit and most other multiple-bit memory errors.**

A reconfiguration capability is standard with all AS models. In the event of an unrecoverable error, or any other problem with a memory module, the operaor can "dial out" the problem module (one-half million or one million bytes) and reconfigure the remaining memory for continuous operation.

**STORAGE PROTECTION: The Store and Fetch Protection features, which guard against inadvertent overwriting and/or unauthorized reading of data in specified 2048-byte blocks of storage, are standard in all models.**

## CENTRAL PROCESSOR

**INDEX REGISTERS: Sixteen 32-bit general registers, used for indexing, base addressing, and as accumulators, plus four 64-bit floating-point registers per processor.**

**INSTRUCTION REPERTOIRE: The AS instruction set consists of the complete System/370 Universal Instruction Set, including the five S/370 instructions for Dynamic Address Translation.**

**INSTRUCTION TIMES: Itel states that individual instruction times are not currently available, but that average execution times for the AS systems will equal or exceed the performance of the comparable System/370 processors (see Management Summary).**

**OPERATIONAL MODES: Like the System/370, the Itel AS computers can operate in either the Basic Control (BC) mode or Extended Control (EC) mode. The BC mode maintains general upward compatibility with the** ►

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## CHARACTERISTICS OF THE ADVANCED SYSTEM PROCESSOR MODELS

| | Model AS/4 | Model AS/4MP | Model AS/5-1 | Model AS/5-1 MP | Model AS/5-3 | Model AS/5-3 MP |
|---|---|---|---|---|---|---|
| **SYSTEM CHARACTERISTICS** | | | | | | |
| Date of introduction | Oct. 1976 | Oct. 1976 | Oct. 1976 | Oct. 1976 | Oct. 1976 | Oct. 1976 |
| Virtual storage capability | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of central processors | 1 | 2 | 1 | 2 | 1 | 2 |
| Principal operating systems | DOS/VS, OS/VS1, OS/VS2, MVS | MVS | DOS/VS, OS/VS1, OS/VS2, MVS | MVS | DOS/VS, OS/VS1, OS/VS2, MVS | MVS |
| **MAIN STORAGE** | | | | | | |
| Storage type | Semiconductor (MOS) | Semiconductor (MOS) | Semiconductor (MOS) | Semiconductor (MOS) | Semiconductor (MOS) | Semiconductor (MOS) |
| Read cycle time, nanoseconds | 1035 | 1035 | 1035 | 1035 | 920 | 920 |
| Write cycle time, nanoseconds | 690 | 690 | 690 | 690 | 690 | 690 |
| Bytes fetched per cycle | 16 | 16 | 16 | 16 | 16 | 16 |
| Minimum capacity, bytes per system | 1,048,576 | 2,097,252 | 1,048,576 | 2,097,252 | 1,048,576 | 2,097,252 |
| Maximum capacity, bytes per system | 4,194,304 | 8,388,608 | 8,388,608 | 16,777,216 | 8,388,608 | 16,777,216 |
| Increment size, bytes | 1,048,576 | 1,048,576 | 1,048,576 | 1,048,576 | 1,048,576 | 1,048,576 |
| **BUFFER STORAGE** | | | | | | |
| Cycle time, nanoseconds | — | — | 115 | 115 | 115 | 115 |
| Bytes fetched per cycle | — | — | 4 | 4 | 4 | 4 |
| Minimum capacity, bytes | None | None | 8,192 | 16,384 | 16,384 | 32,768 |
| Maximum capacity, bytes | None | None | 8,192 | 16,384 | 16,384 | 32,768 |
| **PROCESSING UNIT** | | | | | | |
| Machine cycle time, nanoseconds | 115 | 115 | 115 | 115 | 115 | 115 |
| Processing unit features: | | | | | | |
| Clock Comparator & CPU Timer | Standard | Standard | Standard | Standard | Standard | Standard |
| Direct Control | Standard | Standard | Standard | Standard | Standard | Standard |
| Dynamic Address Translation | Standard | Standard | Standard | Standard | Standard | Standard |
| Floating Point | Standard | Standard | Standard | Standard | Standard | Standard |
| Extended Precision Floating Point | Standard | Standard | Standard | Standard | Standard | Standard |
| High-Speed Multiply | Standard | Standard | Stand·rd | Standard | Standard | Standard |
| Compatibility features: | | | | | | |
| IBM 1401/1440/1460 Compatibility | Standard | Standard | Standard | Standard | Standard | Standard |
| IBM 1410/7010 Compatibility | Standard | Standard | Standard | Standard | Standard | Standard |
| IBM 7070/7074 Compatibility | Standard | Standard | Standard | Standard | Standard | Standard |
| OS/DOS Compatibility | Standard | Standard | Standard | Standard | Standard | Standard |
| **CHANNELS** | | | | | | |
| No. of Selector Channels per system | None | None | None | None | None | None |
| No. of Block Multiplexer Channels | 5 or 6 | 10 or 12 | 5 or 6 | 10 or 12 | 5 or 6 | 10 or 12 |
| No. of Byte Multiplexer Channels | 1 or 2 | 2 or 4 | 1 or 2 | 2 or 4 | 1 or 2 | 2 or 4 |

▷ of the power required and be considerably smaller. The company also stated that an AS system runs about 9 degrees cooler than a 370/158, thereby increasing reliability.

Incorporated in 1967, Itel Corporation is a specialized business and financial services organization. Its operating groups arrange capital equipment lease transactions, lease Itel-owned equipment, and process business data. The company states that it has approximately $700 million worth of IBM 370 systems and Itel-supplied peripherals on finance leases written over the last five years, and that it is the originator of tax-oriented partnerships, which now have $50 million in System/370 operating lease portfolios. Itel also claims to be the largest independent supplier of 3330-type disk drives and monolithic main memories, and is the sole-source supplier of 3330-type disk drives for the U.S. Government.

At the time of the announcement, Itel said that it had firm orders from six customers for a total of seven systems. The company sees its market for the AS systems as being four-tiered:  ▷

▶ System/360 architecture and programming. In the EC mode, the Program Status Word (PSW) and the layout of the permanently assigned lower main storage area are altered to support Dynamic Address Translation and other system control functions; therefore, the virtual-storage-oriented operating systems must be used.

**PROCESSOR FEATURES:** The timing features of the System/370 achitecture are included in the AS central processors. These include a CPU timer and a Clock Comparator; the latter provides a means for causing an interrupt when the standard Time-of-Day Clock reaches a program-specified value. Additional instructions are provided to set and store the Time-of-Day Clock, Clock Comparator, and CPU Timer.

The Standard Direct Control feature provides six external interrupt lines which operate independently of the normal data channels, plus the Read Direct and Write Direct instructions which provide for single-byte data transfers between an external device and main storage.

The Floating-Point Arithmetic feature provides instructions to perform floating-point arithmetic operations on both short (1-word) and long (2-word) operands.

The Extended Precision Floating-Point feature provides seven instructions for performing floating-point arithmetic ▶

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▷ ● Current single-system IBM System/370 Model 135 and 145 users considering an upgrade to a System/370 Model 148.

● Current single-system IBM Model 50, 65, and 155 users considering an upgrade to a System/370 Model 158.

● Current single-system IBM System/370 Model 158 users who want to reduce hardware costs, while maintaining performance.

● Multiple-system users of two or three IBM computers who want to retain IBM support on their "prime" system, but who are willing to expose themselves on their "backup" systems to a non-IBM alternative.

For users concerned about the continued availability of IBM software and support, Itel offers some encouragement. The company has several letters from IBM, addressed jointly to Itel and National Semiconductor, which state that, for existing operating systems only, those systems are considered in the public domain and can be used by anyone on any system, whether of IBM or non-IBM manufacture. Documentation, tapes containing new releases, and systems engineering support are available to anyone for those current operating systems at fees commensurate with typical fees charged by IBM for similar services.

While there is no assurance that IBM will maintain this posture for new operating systems, Itel points to its own history of supporting DOS/VS on System/360's, enhancements to OS/VS, and general support of users having OS/VS problems as evidence that it has an in-house capability to support OS/VS in the event of future policy changes by IBM that limit the present support availability.□

▶ on 4-word (16-byte) operands that provide a precision of up to 28 hexadecimal or 34 decimal digits.

High-Speed Multiply reduces the time required for long-precision floating-point and fixed-point multiply instructions.

The Channel-to-Channel Adapter permits direct communication between an AS processor and a System/370 via a standard I/O channel. It can be attached to either a selector channel or a block multiplexer channel and uses one control unit position on either channel. Either system can be equipped with the Channel-to-Channel Adapter, and it is required on only one of the interconnected channels.

**MULTIPROCESSING CONFIGURATIONS: The AS/4 MP (Multiprocessing), AS/5-1 MP, and AS/5-3 MP systems** each consist of two identical uniprocessor models, coupled by means of an Itel 7058 Multisystem Unit. Memory sizes for the two CPU's need not be identical. Minimum main memory size for an MP system is 2 million bytes, while the maximum is 16 million bytes. Buffer storage capacity for the AS/5-1 MP is 16K bytes, and for the AS/5-3 MP, 32K bytes. The number of I/O channels available in every MP system is 14, including the spare channel in each CPU. The 7058 Multisystem Unit interconnects the two processing units and houses a configuration control panel which the operator can use to reconfigure the system.

## INPUT/OUTPUT CONTROL

The AS/4 and AS/5 Processing Units include one or two byte multiplexer channels and four or five block multiplexer channels, plus one spare channel which can substitute for a failing byte or block multiplexer channel. Each byte multiplexer channel provides 256 nonshared subchannels or 8 shared and 120 nonshared subchannels. Each block multiplexer channel provides 16 shared and 480 nonshared subchannels and can accommodate a data rate of 1.5 million bytes per second.

## PERIPHERAL EQUIPMENT

The Itel systems can utilize all IBM System/360 and System 370 input/output and mass storage devices, as well as their plug-compatible counterparts from independent vendors.

## SOFTWARE

The AS systems offer complete functional compatibility with IBM System/360 and System/370 software. Itel intends to support users of current IBM system software by providing new releases of the software and supplying software support services for its customers.

## PRICING

Detailed prices for the AS systems have not been released by Itel to date. See the Management Summary for the pricing information that is currently available.■