

# Honeywell Series 60, Model 6/06

## MANAGEMENT SUMMARY

Introduced along with the Level 6 Models 6/34 and 6/36 in January 1976, the 6/06 is a functional copy of the Honeywell 716 CPU, which formed the basis for the earlier Honeywell System 700 family of minicomputer systems.

All of the Level 6 processors use the same basic or (in the case of the 6/43) enhanced microprocessor-based CPU and employ packaging and construction techniques that reduce production costs. All system elements are constructed on 4-level multi-layer PC boards, enabling the CPU to be mounted on one 15-by-16-inch board.

The semiconductor main memory for the Model 6/06 processor is built from 4K NMOS dynamic RAM's and has a cycle time of 650 nanoseconds. The NMOS memory is available with either parity or error correction and is packaged in 8,192-word memory modules, sometimes called Memory-Pacs. These modules are mounted in piggyback fashion on memory controller boards to form 8K, 16K, 24K and 32K-word memories. The memories are noninterleaved and capable of a single-word fetch. Maximum memory capacity of the basic CPU is 32,768 words, but this limit can be extended to 65,536 words through the addition of the CPF9201 extended memory feature.

The Model 6/06 computer consists of three elements: the CPU; the memory; and the System 700 interface, a specially designed PC board that connects the Level 6 Megabus, a high-speed synchronous bus, to the System 700 peripheral controllers. Only the three units mentioned connect to the Megabus in the 6/06. All peripheral con-

Although it is a Level 6 processor in name and general architecture, the 6/06 serves solely as a functional replacement for the earlier Honeywell 716 CPU, operating at 60 to 70 percent of that machine's performance level. The 6/06 can be configured with almost the entire range of Honeywell System 700 peripherals and operates exclusively with software designed for the 700 series.

## CHARACTERISTICS

**MANUFACTURER:** Honeywell Information Systems, Inc., 200 Smith Street, Waltham, Massachusetts 02154. Telephone (617) 891-8400.

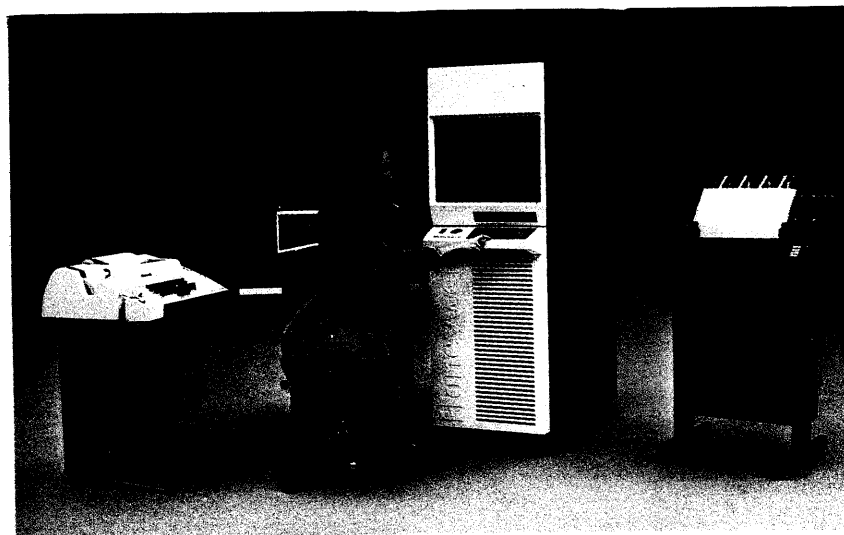
Honeywell Information Systems is a division of Honeywell, Incorporated, an international corporation whose products include industrial and residential control systems, sophisticated test instruments for both medical and industrial applications, aircraft guidance systems and instrumentation, photographic equipment, satellite support subsystems, and electronic data processing products. The parent company is also a leader in solar energy research. Honeywell's computer operations were enhanced by the 1970 merger with General Electric's computer systems division. Honeywell has subsidiary companies in virtually every western country and in some eastern-bloc countries. The company currently employs about 100,000 persons worldwide.

**MODELS:** Series 60, Level 6, Model 6/06.

**DATE ANNOUNCED:** January 1976.

**DATE OF FIRST DELIVERY:** January 1976.

**NUMBER INSTALLED TO DATE:** NA.



*This Honeywell Model 6/06 system in a typical remote terminal configuration includes the processor with 32K words of parity core memory, dual cassette tape drives, a cartridge disk drive, a 165-cps serial printer, and a synchronous communications controller. Even though the 6/06 looks like other members of the Level 6 line, its distinctive firmware emulation of the Honeywell 716 sets it apart.*

*REFERENCE EDITION. This is a mature product line, and no significant further developments are anticipated. Because of its importance, coverage is being continued, but no further update is planned.*

## Honeywell Series 60, Model 6/06

➤ trollers, communications controllers, and other system elements connect to the System 700 bus, created by the System 700 interface.

Despite an identical instruction set and the functional copying of the 716 CPU, the 6/06 has some differences that are significant. The most noteworthy difference is the 6/06's internal performance, which is rated at only 60 to 70 percent of the 716's performance level. Another difference is the elimination of the DMC channel that permitted users to connect a 716 CPU to existing Honeywell 316 or 516 peripheral systems through a DMC adapter. This feature is not present in the 6/06, and peripheral subsystems compatible with the earlier 316 and 516 CPU's are no longer offered by Honeywell.

Peripherals offered with the Model 6/06 include nearly all those available for the 716 CPU. Two magnetic tape subsystems, the Model 4180 and 4190 Series, require DMC facilities and cannot be used with the 6/06. The complement of peripherals compatible with both the 6/06 and 716 CPU's is still extensive, consisting of several types of fixed-head disk drives, disk cartridge and pack drives, magnetic tape drives, line printers, teletypewriter terminals, card and paper tape equipment, and both synchronous and asynchronous communications controllers. An extensive line of process control interfaces, digital-to-analog, and analog-to-digital equipment is also available.

All existing software that is usable in the System 700 is executable on the Model 6/06, although its performance is reduced, and no new packages appear to be forthcoming. Operating systems include OP-16, for small dedicated systems; the BOS batch operating system; and the OS/700 real-time multiprogramming operating system. Program development can be performed with BOS or OS/700. Language processors supported by BOS and OS/700 include the DAP-16 assembler and DAP-700 macro-assemblers, FORTRAN IV and FORTRAN/700 compilers, and a BASIC interpreter. In addition, utilities such as linkage editors, linking loaders, and editors are available. The Model 6/06 software is bundled, in contrast to the newer, separately priced software that is used with the other Level 6 models.

The future of the Model 6/06 computer is uncertain. It was devised as a lower-cost replacement for the 716, but its lower performance level appears to preclude total replacement of the older computer.

Although the 6/06 is still an active product at this writing, Honeywell is directing its principal small-system efforts toward the other Level 6 models, the 6/34, 6/36, and 6/43 (Report M11-480-301). These Level 6 computers are in no way compatible with Honeywell's earlier 316, 516, or 716 minicomputers, having different instruction sets, entirely new I/O controllers, and new operating software. It appears that the sole mission of the 6/06 is to provide a transition system for current users of the Honeywell 316, 516, and System 700 equipment until such time as these users can begin converting to the "true" Level 6 line.

## ➤ DATA FORMATS

**BASIC UNIT:** 16-bit word.

**FIXED-POINT OPERANDS:** Signed 15-bit single-precision or signed 30-bit double-precision operands. Byte and bit operands are also possible. In both single- and double-precision operands, the high-order bit of the first word is the sign bit. In double precision, the high-order bit of the second word is always zero. Signed data is always in two's complement notation. Ranges for signed double words, signed words, signed bytes, unsigned words, and unsigned bytes are, respectively, + about 2 billion, -32,768 to 32,767, -128 to 127, 0 to 65,535, and 0 to 255.

**FLOATING-POINT OPERANDS:** In the 6/06, these are available only through software routines. A single-precision signed floating-point number is represented by an 8-bit exponent and a 23-bit fraction plus the sign of the fraction. A double-precision floating-point number has the same format but adds another 16-bit word to the fraction for a total of 39 bits. In the first word of the floating-point format, the sign is in the most significant bit position, followed by the 8-bit exponent in excess-128 notation, followed by the most significant 7 bits of the fraction.

**INSTRUCTIONS:** The 6/06 utilizes a Honeywell System 700-compatible instruction set that is distinctly different from the instruction set used in the other Level 6 Models. There are four classes of instructions, all of which are one-word types: Memory Reference (MR), Input/Output (I/O), Shift (SH), and Generic (G). MR instructions have a 1-bit indirect tag, a 1-bit index tag, a 4-bit operation code, a sector bit (base or "0" sector, or current sector), and a 9-bit address field (memory is divided into 512-word sectors). I/O instructions have a 6-bit operation code, a 4-bit function code, and a 6-bit device address. SH instructions have a 10-bit operation code and a 6-bit field that specifies the number of places to be shifted (allows shift of up to 64 places). G instructions have a full 16-bit operation code without any modifying bits.

**INTERNAL CODE:** ASCII.

## MAIN STORAGE

**TYPE:** 4K-chip MOS RAM; the chip employs N-channel, silicon-gate technology.

**CYCLE TIME:** 650 nanoseconds per word, with an access time of 440 nanoseconds.

**CAPACITY:** Memory for the Level 6 computers consists of 8192-word memory modules which mount piggyback on a memory controller board. Up to four memory modules are accommodated by one controller board for a total of 32,768 words per board. The 6/06 can have two memory controller boards, or up to 65,536 words, if the CPF 9201 Extended Memory Option is added.

**CHECKING:** One parity bit per byte is standard, and 22-bit EDAC (error detecting and correcting) memories are available as an option. The EDAC memories employ a 6-bit Hamming code to detect and correct all internally caused single-bit errors and detect all double-bit errors.

With both EDAC and parity memory, address parity accompanies the most significant eight bits on the address bus. When memory detects an error on these bits, it does not respond; the result is a bus timeout. Each device controller/communications processor on the Megabus checks parity on information received from the Megabus and indicates an error by setting a parity error status bit.

## Honeywell Series 60, Model 6/06

### PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION & SPEED	MANUFACTURER
<b>MAGNETIC TAPE EQUIPMENT</b>		
700-4041/700-4042	Industry-compatible, 7-track, 26 ips, 200/556/800 bpi, magnetic tape subsystem with DMA interface; up to three add-on 700-4042 drives per system; 5.2/14.5/20.8 KBS	Honeywell
700-4051/700-4052	Industry-compatible, 9-track, 26 ips, 800 bpi, magnetic tape subsystem with DMA interface; up to three add-on 700-4052 drives per system; 20.8 KBS	Honeywell
700-5400/700-5401	Cassette subsystem; 600K-byte capacity (both sides), 7 ips, 2-track, per inch; 700 bytes per second	Honeywell
<b>PRINTERS</b>		
700-5541	Serial printer; 5 x 7 dot matrix, 64 ASCII character set, 12-channel VFU optional, 10 characters per inch, 4 to 14.8-inch paper, 132 positions, 6 lines per inch, DMA interface; 165 cps	Centronics
700-5542	Same as 700-5541 but 96 ASCII character set	Centronics
700-5551	Line printer; drum, 136 positions, 96 ASCII character set, 10 characters per inch, 4 to 16-inch paper, 6 or 8 lines per inch, DMA interface; 240 lpm	Dataproducts 2230
700-5552	Same as 700-5551 but 64 ASCII character set; 300 lpm	Dataproducts 2230
700-5565	Line printer; 132 positions, 64 ASCII characters, DMA interface; 300 lpm	Honeywell
700-5576	Line printer; 132 positions, 64 ASCII characters, DMA interface; 450 lpm	Honeywell
700-5577	Line printer; 132 positions, 64 ASCII characters, DMA interface; 650 lpm	Honeywell
700-5568	Line printer; 132 positions, 64 ASCII characters, DMA interface; 950 lpm	Honeywell
700-5569	Line printer; 132 positions, 64 ASCII characters, DMA interface; 1100 lpm	Honeywell
<b>PUNCHED CARD EQUIPMENT</b>		
700-5151	Reader; 80-column, DMA interface, table-top mounting; 300 cpm; 51-column option available	Peripheral Dynamics
700-5152	Reader; 40 or 80-column mark sense, DMA interface, table-top mounting; 300 cpm; 51-column option available	Peripheral Dynamics
700-5162	Reader; 80-column, DMA interface; 600 cpm	Honeywell
700-5163	Reader; 80-column, DMA interface; 800 cpm	Honeywell
700-5164	Reader; 80-column, DMA interface; 1050 cpm	Honeywell
700-5172	Reader/Punch; 80-column, DMA interface; 400/100-400 cpm	Honeywell
700-5176	Punch; 80-column, DMA interface; 100-400 cpm	Honeywell
<b>PUNCHED TAPE EQUIPMENT</b>		
700-5010	Reader; 300 cps	Okidata
700-5210	Punch; 110 cps	Teletype
<b>TERMINALS</b>		
700-5307	ASR-33 teletypewriter; 10 cps	Teletype
700-5310	KSR-33 teletypewriter; 10 cps	Teletype
700-5507	ASR-35 teletypewriter; 10 cps	Teletype

➤ All Model 6/06 system elements, except memories and the general-purpose interface, contain independent self-test features that are initiated automatically each time the system is powered up or at any time by command. Memories are tested by the CPU after it performs its own self-check. Each module in the system has an LED failure indicator that is normally extinguished by the test routine. Users can isolate failed modules by observing the indicators, and thereby reduce maintenance costs. Further, Honeywell has established a factory service plan whereby users can easily return failed modules including 6/06 System 700 interface, for repair or replacement without the need for a customer engineer. A free phone consultation service has also been set up to aid customers in performing such service themselves. Honeywell provides both contract and non-contract maintenance and ➤

➤ **STORAGE PROTECTION:** The CPU 9201 Extended Memory Option also has a memory lockout feature, by means of which 512-word blocks can be write-protected.

**RESERVED STORAGE:** At present, 127 of the first 162 locations in sector 0 or another dedicated sector are reserved for A, B, S, push, pop, and X register storage, bootstrap loaders, and interrupt vectors.

### CENTRAL PROCESSORS

The Model 6/06 is a microcomputer programmed to emulate the Honeywell 716 CPU. Standard features of the 6/06 include base sector relocation, high-speed arithmetic, real-time clock, power fail/auto restart, and hardware bootstrap loaders, as well as optional memory lockout and up to 64K-word addressing. The 6/06 uses the same internal Megabus as the Level 6, Models 6/34 and 6/36, but the 6/06 uses this bus only to connect the CPU, memory, and the System 700 bus interface. ➤

## Honeywell Series 60, Model 6/06

➤ field support through its own network of more than 400 support locations and thousands of field support personnel worldwide.

Training courses in programming and maintenance are offered at Honeywell's training centers in Wellesley, Massachusetts and Phoenix, Arizona.

Level 6 systems may be purchased or leased on terms of one, three, or five years. After expiration of the lease term, users can either terminate upon 90 days' notice, continue usage at the same monthly charge, or purchase the equipment at its fair market value. System additions and upgrades can be purchased, leased under a separate lease arrangement, or included in a renegotiated lease package.

### USER REACTION

Honeywell was unwilling to provide the names of any Model 6/06 users at this time, and no Model 6/06 users responded to Datapro's 1977 minicomputer user survey. Please refer to Report M11-480-301 for user reaction to other models in the Level 6 line. □

➤ The memory save and auto restart unit that is standard on the 6/06 ensures data retention for two memory controller boards (up to 64K words of memory) for a two-hour period. Support circuit power runs are separated to minimize standby power drain. Electronics within the optional unit maintains the battery charge, retains memory contents when the system is manually powered down, regulates outputs, and indicates holdup failures. Power failures generate an interrupt with the auto restart feature. Following power failures, operations are automatically resumed, starting at memory location zero. Up to 1.5 microseconds are allowed for the user program interrupt handler.

**CONTROL STORAGE:** The read-only memory in the 6/06 consists of 768 48-bit words with an access time of 250 nanoseconds.

**REGISTERS:** Physically, the 6/06 has 18 programmable hardware registers. However, the 716 processor has only seven programmable registers, and only these seven are accessible to a 6/06 user. These include two 16-bit arithmetic registers (A and B), the 15-bit program counter (P), two 16-bit address modification registers (X and S), the 8-bit base relocation register (J), and the 16-bit keys register (K), which is used for internal status and control purposes. The S Register is a push/pop (last-in/first-out) register used to form message or priority queues.

**ADDRESSING:** The Model 6/06 has two operating modes which govern the formation of effective addresses. These two modes, designated as with and without base sector relocation capabilities, are determined by whether or not the high-speed arithmetic option has been implemented in the CPU. Under each operating mode, there are two additional modes, normal and extended, which are established by execution of the EXA instruction or by the occurrence of an interrupt. In all operating modes, the following addressing schemes are available: direct, page-relative (512 words), indexed, indirect, page-relative-indexed, page-relative-indirect, page-relative-indirect-indexed (post indexing), and indirect-indexed (post indexing). Up to 1,024 word locations can be directly addressed (512 words in sector "0" and 512 words in the sector in which the "current" instruction is located). Address range under all operating modes is 32K words, or 64K words if the extended memory option is implemented. Indirect addressing is multi-level.

The base sector relocation feature is part of the high-speed arithmetic option and permits additional addressing flexibility. The feature adds an additional 5-bit page register that is alterable under program control and permits full range addressing throughout a 16K-word address space rather than the standard 512-word page space.

**INSTRUCTION REPERTOIRE:** The Model 6/06 incorporates the Honeywell Series 16 set of 72 instructions plus 6 additional instructions and addressing techniques: 9 load/store instructions, 5 arithmetic instructions, 7 logical instructions, 13 shift/rotate instructions, 5 byte-oriented (half word) instructions, 25 program control instructions, 7 processor control instructions, and 9 I/O instructions.

**INSTRUCTION TIMINGS:** All times are for full-word fixed-operands in *microseconds*.

Load/Store:	2.0/2.25
Add/Subtract:	2.0/2.0
Multiply/Divide:	8.8/10.0
Compare and Branch:	2.75

**INTERRUPTS:** The 6/06 has 63 levels of priority interrupt. Nine are dedicated or privileged interrupts for processor features and options or for internal conditions such as the watch-dog timer, register stack, power failure, etc. The remaining interrupts are for use by I/O devices to notify the CPU of I/O completion, communications activity, etc.

**PHYSICAL SPECIFICATIONS:** The 6/06 processor is housed in a chassis 5.25 inches high, 19 inches wide, and 29.7 inches deep. A 60-inch cabinet with CPU and memory weighs 358 pounds. Electrical requirements for the 6/06 are 3-phase, 208 VAC, 60Hz. Power consumption for the 6/06 computer is 905 watts, and heat dissipation is 3084 BTU's per hour. A fully loaded cabinet requires 2.9 KVA and generates 8000 BTU's per hour.

System 700 expansion chassis are 10.5 inches high, 19 inches wide, and 22 inches deep. System 700 power supplies used with the peripheral controllers, require 115 or 230 VAC, 47 to 63 Hz.

Operating environment for the 6/06 system is 40 to 110 degrees F., with relative humidity between 20 and 80 percent, noncondensing.

### INPUT/OUTPUT CONTROL

**I/O CHANNELS:** The Megabus, a high-speed I/O bus, is implemented as a printed-circuit backplane for interfacing both memory modules and the System 700 interface. Up to 64 I/O controllers can be supported by the system.

Two types of I/O operations are supported on the I/O Bus: programmed I/O (PIO) via instructions and direct memory access (DMA). The maximum data transfer rate is 500K words per second.

The multi-channel DMA capability is provided to handle block data transfers for magnetic tape, fixed-head disks, and high-speed communications controllers on a cycle-stealing basis concurrently with central processor operations. The priority of DMA data transfers is determined by a priority network according to the respective device interrupt link positions in reserved memory.

The PIO interface is provided for slower-speed devices such as the teleprinter, paper tape reader, or cassette subsystem on a character, byte, or 16-bit word parallel basis.

The Model 3010 Data Multiplex Control (DMC) adapter, which is used to interface Honeywell 316 and/or 516 peripheral controllers to the 716 CPU, is not available with the 6/06 CPU. ➤

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## ► INPUT/OUTPUT CONTROL

**SIMULTANEOUS OPERATIONS:** The central processor can accept interrupts from other units between the read request and the read response bus cycles to/from memory. The memory does not initiate the read response cycle until after it has accessed the data. This is done during a 650-nanosecond memory cycle which partially overlaps the two bus cycles. During this time the bus is free to accept requests from other units, interleaving bus cycles and effectively overlapping operations.

## CONFIGURATION RULES

All 6/06 systems are automatically configured by Honeywell with as many cabinets, chassis, and power supplies as are necessary. The user does not need to order these items separately.

The 6/06 computer chassis contains five slots, one for the CPU, two for memory controller boards, one for the System 700 interface board, and one spare slot. The power supply is mounted separately. All peripheral controllers are mounted in System 700 expansion drawers which have 18 slot positions.

## MASS STORAGE

**700-4500 FIXED-HEAD DISK SUBSYSTEMS:** Designed for the 6/06 only, these units provide data storage capacities of 64K, 128K, 256K, and 512K 16-bit words in Model 700-4510, -4511, -4512, and -4513, respectively. Each of the models includes its own controller and requires one chassis slot position. An add-on 512K-word Model 700-4514 drive can also be attached to the 700-4513 subsystem. These head-per-track units have an average rotational delay of 12.5 milliseconds and an average data transfer rate of 82,000 words per second over the DMA interface.

**700-4760 DMA CARTRIDGE DISK DRIVES:** These drives use the 700-4760 disk control unit, which can control up to four disk drives. Four models are offered for the 6/06 only: the 700-4763, with a capacity of 1.25 million words; the 700-4764 2.5-million-word drive; the 700-4767 2.5-million-word drive; and the 700-4768 5.0-million-word drive. The 700-4763 and 4767 record data on a single removable cartridge, whereas Models 700-4764 and -4768 each have one fixed and one removable cartridge.

All four models store 3600 words per track, formatted with 64-, 128-, 256-, or 512-word sectors, selectable by the user. The single-density 700-4763 and -4764 have 204 tracks per surface, and the double-density 700-4767 and -4768 use 408 data tracks per surface. Disk drives of the same track density can be intermixed on the same 700-4760 controller. All 700-4760 subsystems interface the 6/06 CPU through the DMA channel.

The drives rotate at 2400 rpm with an average rotational delay of 12.5 milliseconds. Average head positioning time is 35 milliseconds for the single-density drives and 40 milliseconds for the double-density models. Track-to-track head movement times are 9 and 10 milliseconds, respectively, for the single- and double-density models, while times for head movement across all tracks are 60 and 70 milliseconds. Data transfer rate for the controller is 156K words/second. The 700-4760 disk drives are manufactured by EM&M (Caelus).

**700-4780 DMA DISK DRIVE SUBSYSTEMS:** These disk pack drives are offered for the 6/06 only as either a one-drive, 3.7-million-word subsystem (the Model 700-4780) or a multi-drive subsystem for up to four drives. The Model 700-4781 is a basic 7.5-million-word subsystem that can be expanded to a total capacity of 30 million words by adding

up to three 700-4785 add-on drives. The 700-4780 uses an IBM 1316-type 10-surface disk pack, while the 700-4781 and 700-4785 use IBM 2316-type 20-surface packs. The 700-4780 series controller interfaces the 6/06 CPU through the DMA channel. All models record data at 1800 words per track, formatted with 64-, 128-, 256-, or 512-word sectors, selectable by the user. Average rotational delay is 12.5 milliseconds, and average head positioning time is 55 milliseconds. The data transfer rate is 78K words/second. The 4780 disk drives are manufactured by Magnetic Peripherals Inc., the CDC-Honeywell joint-venture company.

## INPUT/OUTPUT UNITS

See Peripherals/Terminals table.

## COMMUNICATIONS CONTROL

**700-6312 SYNCHRONOUS SINGLE-LINE CONTROLLER (SSLC):** The SSLC provides an interface for one half- or full-duplex synchronous line through a Bell 201/203 modem (or equivalent) to the I/O bus (PIO) at up to 10,800 bps. A 700-6313 code convention option provides hardware CRC/LRC, and a 700-6314 Block Transfer Feature provides a Bell 303 interface for data rates of up to 230.4K bps to the DMA, achieved by packing two characters per word.

**700-6321 LOW-SPEED MULTI-LINE CONTROLLER (LSMLC):** The LSMLC provides asynchronous character-oriented interfaces for 4 to 128 narrow-band half- or full-duplex lines (45 to 300 bps) with an aggregate data transfer rate of up to 11K characters/second. Model 700-6351 four-line modules for interfacing Bell System 103 A/F modems (or equivalent) must be used.

**700-6333 MEDIUM-SPEED MULTI-LINE CONTROLLER (MSMLC):** The MSMLC provides asynchronous or synchronous interfaces for up to 16 lines through use of the 700-6362 two-line asynchronous adapter or the 700-6363 synchronous adapter. The 700-6362 handles speeds up to 2400 bps, and the 700-6363 handles line speeds up to 9600 bps. Up to eight adapters of either type can be attached to the MSMLC.

**700-6324 UNIVERSAL MULTI-LINE CONTROLLER (UMLC):** Both models of the UMLC provide a character-oriented interface for up to 64 half- or full-duplex synchronous or asynchronous lines in two-line increments through the 700-6352 asynchronous module (compatible with Bell System 103/202 modems at 45 to 2400 bps), or the 700-6353 synchronous module (compatible with Bell System 201/203 modems at up to 10,800 bps), in any mix up to an aggregate data transfer rate of 57,600 characters/second. Data transfers are performed on a full block of data without relinquishing control of memory.

**700-6901/6902 PROGRAMMABLE AUTO-CALL INTERFACE (ACI):** The 700-6901 ACI controls two Bell System 801 ACU's (auto-call units), and the 700-6902 ACI controls up to four 801 ACU's via programmed I/O.

**700-3100 INTERCOMPUTER COMMUNICATIONS UNIT (ICU):** The ICU connects to the I/O bus (one per CPU), providing communications between systems at data rates up to 100K words per second through direct memory access.

## SOFTWARE

**OPERATING SYSTEMS:** Honeywell offers three operating systems for the Model 6/06: Batch Operating System (BOS), OP-16, and OS/700. ►

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► **Batch Operating System (BOS)** is a disk-based operating system that controls assembly, compiling, loading, and execution of user programs on the Honeywell 316, 516, 716, and 6/06 computers. Users direct BOS through control commands that describe the job to the operating system. BOS functions only between jobs, exercising no control once a program begins execution. The operating system can regain control only through a user program transfer or through operator intervention.

BOS requires either a fixed- or moving-head disk for use as a "backing store," a temporary storage facility for program segments swapped out by the operating system. Files swapped out of memory are allocated automatically by BOS and written in fixed-length blocks. Blocks sizes are variable and are determined at system configuration time. BOS uses only the area assigned to it at system generation time. This area is divided into a system area and a user (scratch) area. All remaining disk space is available to the user.

BOS supports two file access methods, sequential and random, through FORTRAN statements. Compiled or assembled program segments can be stored in sequential files while awaiting execution. Up to three sequential files may be open simultaneously.

Random files are not compatible with BOS sequential files and may not be stored with the former. Random files are accessed through file directories which, in themselves, are files. Program overlays can also be random files. Up to 75 files can be defined in any one program or overlay, although only the five most recently used files are retained in memory.

Programming languages supported by BOS are FORTRAN IV and the DAP-16 Assembler. Of note is a 14-key sort utility for variable-length records up to 120 characters long. The minimum hardware configuration for BOS is 12K words of memory, and fixed- or moving-head disk with a minimum capacity of 256K words, an ASR 33 console teletypewriter, and one or more of the following I/O devices: magnetic tape transport (up to four), card reader, line printer, or high-speed paper tape reader/punch.

**OP-16** is a small, modular, multiprogramming operating system that was originally written for the Honeywell 316 and 516 computer systems for use in real-time data acquisition and control applications. OP-16 features priority task scheduling, centralized I/O control and interrupt processing, communication between user programs, and a complete set of utility and support programs, debugging aids, and on-line peripheral test routines.

One version of OP-16 is core-only, while a second version supports either a fixed-head or moving-head disk. In either system, active programs must be totally contained in memory.

OP-16 includes the RTX-16 real-time executive, which assigns priorities to programs and schedules them for execution, performs device and memory allocation, handles external interrupts, and handles all communications between user programs and the operating system and between the operator and the operating system. RTX-16 also processes all system and program errors and performs all functions required to support multiprogramming within the system.

RTX-16 is subdivided into four parts: the basic executive, a configuration module, the FIFO communication queuing subroutine, and the error print program.

The minimum hardware configuration required for the core-only version of OP-16 is any Model 6/06 or System 700 CPU with 8K words of memory, a real-time clock, and an ASR-33, ASR-35, or equivalent console device. This configuration will not permit system generation. Less restricted operation is possible on larger systems.

OP-16 is not intended for program development and does not directly support any language processors. Program development should be performed on larger systems using the BOS or OS/700 operating system.

**OS/700** is a multi-level, real-time, multiprogramming operating system that exists in disk-based and core-only versions. It is designed to support real-time communications and control applications, including data entry, inquiry, and updating of both local and remote data bases such as credit verification, reservations, order entry, and inventory control. The number of active programs is limited only by available memory and the peripheral complement of the particular system. Disk-based OS/700 systems are intended for stand-alone systems, while core-resident OS/700 systems are designed to operate in remote computing systems that are linked to larger host systems.

OS/700 provides various levels of system operation, including foreground/background operating modes, clock-initiated program execution, and system resource management. The OS/700 executive permits users to assign priority levels (up to 16) to each task and activity execution. It also queues program requests to execute system functions according to previously established priorities.

OS/700 modules fall into three categories: executive, dependent, and off-line functions. The executive modules monitor the total system, scheduling and allocating system resources to various jobs. All jobs are loaded and started through the executive, as are all physical I/O operations and all physical and logical communications functions.

The dependent operating system modules include program development subsystems, on-line utilities, and system libraries. All these activities are initiated by the executive.

Off-line utilities include the system disk builder, disk save, restore, and print routines. To aid in disk allocation, a core-image text generator is included. Also included in the off-line utility modules are link text loaders and loader generators, disk bootstraps and bootstrap generators, and the disk volume labeler.

OS/700 jobs are referred to as "activities" and are subdivided into tasks. An activity is started by transferring control to its first task. As tasks terminate, control is returned to the OS/700 executive, which, in turn, determines the next task for execution. Activities are either core-resident or disk-resident; the former must be designated at system generation time. Disk-resident activities are brought into memory only when their execution is required. Activities can be defined as disk-resident at any time during system operations.

A task can request scheduling of another task, another activity, or its own activity. Tasks can be temporarily suspended by external interrupts. Upon completion of the interrupt handler, control can be transferred back to the original task unless the external interrupt requested a higher-priority task.

OS/700 divides user memory area into 17 activity areas. A disk-resident activity is always loaded into the activity area for which it has been linked. Multiple activities can be assigned to a memory area, but all portions of that memory area must be free of activities being executed before another can be brought in. Memory areas designated for permanently resident activities can never be used for any other activity.

Users can create disk-resident private libraries and also create, read, update, and delete files residing within libraries.

Languages supported by OS/700 include the DAP-700 Macro Assembler, the FORTRAN/700 compiler, and the ►

## Honeywell Series 60, Model 6/06

► **BASIC** interpreter. Minimum system requirements for OS/700 are 8K words of memory, 196K words of fixed-head disk storage or one million words of removable disk storage, an ASR 33 console teletypewriter, a line printer, and an additional high-speed input device. To develop programs and generate systems, main memory must be increased to a minimum of 24K words.

OS/700 file management supports both sequential and direct access methods. Sequential access must be used with variable-length records and can also be used for fixed-length records. Only fixed-length records can be used in direct-access files.

An OS/700 file requires four individual data structures: a directory entry containing the three-word file name; a 16-word directory entry (file descriptor) that defines the file characteristics and the addresses of the disk segments it occupies; control segments that define the file data areas and control areas, including the control segments themselves; and the file data area.

A file can contain any number of data segments, limited only by hardware, and need not occupy consecutive disk segments. Chaining information in each segment forms the intra-file linkages. Each segment can contain up to 32,767 logical records. These records are blocked within disk segments and can cross segment boundaries. Logical records can be either fixed or variable-length, but not both.

Control segments define the data areas occupied by a file. These areas are allocated by the operating system as required. A string of control segments is used to record the first-segment address of each data area occupied by the file. These control segments, like data segments, can be chained. The addresses of the first and last control segments and the number of data areas allocated to a file are contained in the 16-word file descriptor. The control segments permit the operating system to calculate the addresses of specific records.

*Host-Resident Software System* (HRSS) permits users to develop 6/06 or System 700 programs on a larger host computer where greater memory and peripheral facilities are available. HRSS has been specifically designed to support remote computer systems and can transmit developed programs down-line to a remote system, keeping development and distribution costs at a minimum. The HRSS package is coded in ANSI standard FORTRAN IV and can be adapted to run on any system that supports this language. HRSS consists of the DAP/700 Macro Assembler, a linkage editor, a configurator, and a sub-operating system that provides centralized control and a standard interface between HRSS components and the host file systems and job control facilities.

The sub-operating system is not machine-independent and must be modified for each host system. Currently, Honeywell has versions that run on Honeywell Series 2000 and 6000 systems and on IBM 360/370 systems.

**LANGUAGES:** For the 6/06, Honeywell offers the DAP-700 Macro Assembler, the FORTRAN/700 compiler, and a BASIC language interpreter, as well as a linkage editor and source text editor, for program development purposes.

*DAP-700 Macro Assembler* is a two-pass assembler that generates relocatable object code for the OS/700 linkage editors and listings for diagnostic purposes. DAP/700 also supports the older DAP16 assembly language, used in the Honeywell 316 and 516 systems, and includes pseudo-operations that permit stack and register addressing, two indexing modes (X and S), and support for 64K-word main memories. The assembler also has a FORTRAN interface module that permits intermixing statements of both languages in one program stream. FORTRAN-compatible storage allocation are also possible.

DAP-700 consists of a core-resident nucleus and six disk-resident modules which are swapped in and out of memory as needed. The six disk-resident modules include the command processor, the second-pass processor, two pseudo-operation processor modules, the symbole table map processor, and the assembler directive processor.

*FORTRAN IV* is a one-pass compiler that produces a source output file in the DAP/700 assembly language. It is an extension of ANSI FORTRAN that features a less rigidly defined language format, a direct interface to the operating system, and user access to dynamic program areas.

FORTRAN IV performs all I/O functions through the OS/700 I/O supervisor, making use of the OS/700 system drivers, the run-time I/O library, and a mathematical sub-routine library.

Enhancements to the basic ANSI FORTRAN IV language include mixed-mode arithmetic, octal and hexadecimal constants, optional and conditional compilation statements, and memory-to-memory format conversion.

The *BASIC* interpreter for the 6/06 provides an interactive environment that permits users to develop programs and execute them either in batch mode or interpretively, one at a time. It is an enhanced version of Dartmouth BASIC with the following additions: multiple statements per line, provisions for multidimensional arrays, unrestricted subscript expressions, and provisions for intermixing both FORTRAN and DAP/700 assembly language statements in the program stream. Up to 10 subroutines may be called.

Omission of line number signifies immediate execution of the statement. In this interpretive mode, the DATA, DIMENSION, and DEFINE statements cannot be executed.

Source text editing capabilities inherent in the Honeywell BASIC interpreter permit deletion of lines or individual characters. Currently, only the high-speed paper tape reader/punch is supported by the BASIC interpreter.

**UTILITIES:** Under OS/700, 6/06 user has a choice of both on-line and stand-alone utilities. On-line utilities include system control functions; debug functions such as dump or search memory; maintenance functions such as copy and verify files; and magnetic tape functions such as blocking and compression of tape files, generation of tape indexes, and printing of tape indexes. Stand-alone utilities include disk copy, disk save/restore, and disk dump; peripheral loaders and loader generators; and debug routines to dump, search, replace, or fill memory.

**APPLICATIONS:** A wide variety of applications program support is available from Honeywell for the 6/06 in the categories of hospital/health care, including hospital inventory, patient accounting, medical records, laboratory analyses, and patient monitoring; manufacturing operations, including material movement, labor reporting, factory data collection, scheduling techniques, inventory control, and process control; communications applications, such as remote message/line concentration; and sensor-based functions.

**TEST AND VERIFICATION PROGRAMS:** An integral part of the Honeywell maintenance strategy, these programs consists of automatically executed processor and memory test permanently resident in ROM and a family of free-standing programs. These programs consist of eight central subsystem tests for the central processor, memory, scientific instruction processor, power failure detection, and real-time clock/watchdog timer; seven I/O subsystem tests for the console, card reader, printer, diskette, general-purpose DMA interface, cartridge disk, and magnetic tape units; and three communications subsystem tests. ►

## Honeywell Series 60, Model 6/06

### PRICING

**POLICY:** Honeywell Information Systems offers the Level 6 computers for purchase or lease. Leases are of the full-payout type with terms of one, three, or five years. Three- and five-year lease prices are shown in the accompanying price list. System lease prices include maintenance. After expiration of the lease term, users can either terminate upon 90 days' notice, continue usage at the same monthly charge, or purchase the equipment at its fair market value. System additions and upgrades can be purchased or leased.

Honeywell provides maintenance and field support through its own network of more than 400 support locations and thousands of field support personnel worldwide. Systems engineering support is provided at \$23 per hour.

The warranty period for systems purchased under the OEM contract is 30 days from the date of shipment and includes return-to-factory repair service. End-user contract warranties extend 90 days from installation and provide on-call service, including parts and labor charges.

Users with OEM service contracts qualify for discounts of up to 36 percent, while end users receive discounts of up to 21 percent. In both instances, the maximum discount rate is achieved at 100 systems. In addition, the Basic contract provides two training credits per *agreement*, while the end-user contract allows two training credits per *system*, with a maximum of 20 credits.

Prices given in the Equipment Prices section of this report apply to both OEM and end-user service contracts.

Non-contract service is priced at \$40 per hour for standard business hours. Monday through Friday; \$45 per hour for

other weekday hours plus Saturday; and \$53 per hour on Sundays and holidays. The minimum charge is 3 hours, and mileage is charged at 15 cents per mile, portal to portal.

Factory repair service is available for Level 6 modules and is priced at \$70 or 25 percent of the module list price, whichever is greater. Users pay all shipping charges.

Also available for customers who choose to do their own maintenance are an initial spares provisioning service (ISPS), a spare parts service (SPS), and an emergency spares service (ESS). Discounts are available on ISPS and SPS, but not on ESS. Fees for ESS are the current list price plus \$25 per item (\$50 order minimum) for special handling and all shipping charges.

Training courses in programming and maintenance are offered at Honeywell's training centers in Wellesley, Massachusetts and Phoenix, Arizona. Typical charge for formal instruction is \$400 per man-week. In addition, limited training is conducted at Honeywell field locations. Consult the nearest field sales office for course schedules.

**EQUIPMENT:** The following typical system includes all necessary controllers and adapters.

**6/06 TERMINAL SYSTEM:** Consists of a Model 6/06 CPU with 24K words of parity memory, high-speed arithmetic, real-time clock, power failure/auto restart, bootstrap loader, memory save, System 700 interface, KSR-33 console, one synchronous communications controllers, one 5-million-byte cartridge disk drive, 300-lpm line printer (132 positions), and 300-cpm card reader, plus cabinets and power supplies. Purchase price for the total system is \$46,480, and monthly maintenance charge is \$590. ■

### EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Rental (3-year lease)*	Rental (5-year lease)*
<b>PROCESSORS</b>					
6/06 CPU with high-speed arithmetic/base sector relocation, real-time clock, auto restart, memory save for up to 64K words, System 700 bus interface, 5-slot chassis and power supply, power distribution unit, and appropriate System 700 expansion drawers and cabinets as required; does not include memory controller or Memory-Pacs.					
CPS9220	6/06 CPU in 60-inch cabinet	7,100	61	30	223
<b>PROCESSOR OPTIONS</b>					
GTS9002	Additional System 700 bus interface	900	13	44	34
CPF9201	Extended Memory and Memory Lockout Option; required for systems with greater than 32K words of memory	1,500	12	63	47
<b>MEMORY</b>					
CMC9001	Single-Word Fetch Memory Controller for up to four NMOS parity memory modules; includes one 8K-word NMOS parity memory module	2,100	24	95	72
CMC9002	With error detection and correction (EDAC) instead of parity	2,500	28	113	85
CMM9001	Add-on NMOS parity memory module for CMC9001	1,250	10	53	39
CMM9002	Add-on NMOS EDAC memory module for CMC 9002	1,450	12	61	45
<b>MASS STORAGE</b>					
700-4510	Fixed-Head Disk Subsystem; 64K words; includes DMA controller	10,510	48	335	317
700-4511	Fixed-Head Disk Subsystem; 128K words; includes DMA controller	14,830	65	473	448
700-4512	Fixed-Head Disk Subsystem; 256K words; includes DMA controller	18,600	89	599	567
700-4513	Fixed-Head Disk Subsystem; 512K words; includes DMA controller	27,780	131	893	845
700-4514	Disk Storage Unit; additional 512K words for 4513 subsystem	19,145	95	615	583
700-4760	Cartridge Disk Control Unit (for four drives; includes DMA controller)	4,200	59	150	140
700-4763	Disk Drive for 1.25 million words; one removable disk	5,700	59	180	170
700-4764	Disk Drive for 2.5 million words; one fixed, one removable disk	7,800	71	260	250
700-4767	Disk Drive for 2.5 million words; high density, one removable disk	7,400	71	245	235
700-4768	Disk Drive for 5.0 million words; high density, one fixed, one removable disk	9,800	95	325	310
700-4780	Disk Drive Subsystem (3.7 million words; includes DMA controller)	16,500	202	550	525
700-4781	Disk Drive Subsystem (7.5 million words; includes DMA controller)	18,000	214	700	665
700-4785	Disk Drive (7.5 million words); add-on for 4781	14,500	155	570	540



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## EQUIPMENT PRICES

		Purchase Price	Monthly Maint.	Rental (3-year lease)*	Rental (5-year lease)*
<b>MAGNETIC TAPE EQUIPMENT</b>					
700-5400	Cassette Tape Subsystem	4,000	41	148	141
700-5401	Additional Cassette Drive for 5400	2,000	12	39	36
700-4041	Magnetic Tape Subsystem; 7-track, 26 ips; includes control for up to four transports and one tape unit	10,000	113	325	310
700-4042	Magnetic Tape Unit; 7-track, 20.8 KBS; add-on for 4041	7,000	83	225	215
700-4051	Magnetic Tape Subsystem; 9-track, 26 ips; includes control for up to four transports and one tape unit	10,000	113	325	310
700-4052	Magnetic Tape Unit; 9-track, 26 ips, 20.8 KBS	7,000	83	225	215
700-4053	Read Error Correction Feature (for 700-4051 or 700-4052)	840	5	31	29
<b>PRINTERS</b>					
700-5541	Serial Printer Subsystem; 165 cps, 64-character set	7,000	71	240	230
700-5542	Serial Printer Subsystem; 165 cps, 96-character set	7,900	77	265	255
700-5559	12-Channel VFU feature for 5551 or 5552	225	—	14	12
700-5551	240-lpm Printer Subsystem; 136 columns, 96-character set	14,000	119	560	535
700-5552	300-lpm Printer Subsystem; 136 columns, 64-character set	13,000	119	530	505
700-5549	Stand for 5541 or 5542	1,000	12	32	30
700-5565	300-lpm Printer Subsystem; 132 positions	12,000	214	435	415
700-5568	950-lpm Printer Subsystem; 132 positions	29,500	226	950	905
700-5569	1100-lpm Printer Subsystem; 132 positions	33,000	238	1,050	1,000
700-5576	450-lpm Printer Subsystem; 132 positions	21,000	202	650	620
700-5577	650-lpm Printer Subsystem; 132 positions	25,000	262	800	760
<b>PUNCHED CARD EQUIPMENT</b>					
700-5151	Card Reader Subsystem; 300 cpm	5,000	59	155	150
700-5152	Card Reader Subsystem, punched and marked cards; 300 cpm	6,000	65	205	195
700-5153	51-Column option for 700-5151 or 700-5152 reader	600	5	20	19
700-5162	Card Reader Subsystem; 600 cpm	8,000	95	270	255
700-5163	Card Reader Subsystem; 800 cpm	9,000	101	300	285
700-5164	Card Reader Subsystem; 1050 cpm	10,000	107	330	315
700-5172	Card Reader/Punch Subsystem; 400/100-400 cpm	16,500	131	580	555
700-5176	Card Punch Subsystem; 100-400 cpm	15,150	119	485	460
<b>PUNCHED TAPE EQUIPMENT</b>					
700-5010	Reader with Control; 300 cps	4,200	26	108	101
700-5210	Punch with Control; 110 cps	4,200	24	118	104
<b>TERMINALS</b>					
700-5300	Teleprinter interface	899	12	21	20
700-5307	ASR-33 Teleprinter with Control	2,301	48	90	85
700-5310	KSR-33 Teleprinter with Control	1,980	41	62	59
700-5507	ASR-35 Teleprinter with Control	5,564	41	173	164
<b>COMMUNICATIONS</b>					
700-3100	Intercomputer Communications Unit	4,173	48	135	127
700-6312	Synchronous Single-Line Controller	1,800	17	52	50
700-6313	Code Convention Option	1,600	15	47	45
700-6314	Block Transfer Feature	2,100	16	52	50
700-6315	Synchronous Single-Line Controller for HDLC	4,050	40	150	143
700-6316	MIL 188-C interface	570	15	32	31
700-6321	Low-Speed Multi-line Controller	8,600	48	251	237
700-6350	Relay Line Module; four lines	1,500	12	52	50
700-6351	103 Line Module; four lines	900	5	29	28
700-6353	Synchronous Line Module	1,000	5	29	28
700-6352	Asynchronous Line Module	900	5	29	28
700-6324	Universal Multi-Line Controller with Block Mode	8,900	48	260	246
700-6362/ 6363	Asynchronous/Synchronous Line Adapter (two lines)	1,300	10	38	36
700-6333	Medium-Speed Multi-Line Controller	3,300	12	55	51
700-6901	Autodial—two lines	1,800	12	75	72
700-6902	Autodial—four lines	2,300	24	96	92
700-6925	Synchronous Modem Bypass	395	10	16	10
700-6926	Asynchronous Modem Bypass	395	10	16	10
700-6927	Universal Modem Bypass	395	10	16	10