Amdahl 580 Systems

MANAGEMENT SUMMARY

The most recent addition to the Amdahl line of IBM compatible devices is the Amdahl 5840. Introduced in June of 1983, the Model 5840 is an entry-level system in the 580 Series of large-scale processors. In addition to the entry-level 5840, Amdahl's 580 product line includes the 5850 and 5860, the company's most powerful uniprocessors, and the dual-processor 5870 and 5880, which consist essentially of two tightly-coupled 5860 CPU Complexes. Like the 470 family of processors, the 580 systems are fully compatible with the IBM System/370 instruction set. The 580 will provide 31-bit real and virtual addressing in support of IBM's System/370 Extended Architecture (XA). The entry-level 5840 is field upgradable to the 5850. The 5850 is to be field upgradable to the 5860. The Model 5860 can be field upgraded to either the 5870 or the 5880, and the 5870 can be field upgraded to the 5880.

COMPETITIVE POSITION

Amdahl 580 Systems compete for business with IBM's large scale 3081 systems and NAS AS/9000 Series. The entry level 5840 in the series is geared toward users who do not require the higher performance of the Amdahl 5850. The Model 5840 fills the performance gap between the Amdahl 470V/8 and the Amdahl 5850. The new system's performance in most commercial environments is about 1.1 to 1.3 times greater than that of the Amdahl 470V/8.

The Model 5860 has twice the performance of Amdahl's former top-end system, the 470V/8, giving it an execution speed of approximately 13 MIPS (million instructions per second). The attached-processor 5870 has about 1.7 times ➢

Amdahl Corporation's top of the line is their 580 Series of high-performance, plug-compatible mainframes. Consisting of five models, the 580 Series is comprised of one-processor and two-processor systems. All five are fully compatible with comparable IBM hardware and software, and aim to offer improved price/performance over their IBM counterparts.

MODELS: 5840, 5850, 5860, 5870, and 5880.
CONFIGURATION: One (5840, 5850 and 5860) or two CPUs (5870 and 5880), 16 to 64 megabytes of memory, and 16 to 32 channels.
COMPETITION: IBM 3081, NAS AS/9000 Series.
PRICE: Base purchase prices are $2,350,000 (5840), $2,750,000 (5850), $3,150,000 (5860), $5,200,000 (5870), and $6,190,000 (5880).

CHARACTERISTICS

MANUFACTURER: Amdahl Corporation, 1250 East Arques Avenue, Sunnyvale, California 94086. Telephone (408)746-6000. In Canada: One First Canadian Place, Suite 3940, P.O. Box 123, Toronto, Ontario, Canada M5X 184. Telephone (416) 862-7479. ➤

The Amdahl Model 5860 is the most powerful uniprocessor that Amdahl has ever produced. This member of the Amdahl 580 family represents an evolutionary extension to the product line and offers a compatible growth path for Amdahl 470 users. The 5860 has twice the processing power of Amdahl's 470V/8. Standard features on the 5860 include 16 I/O channels, 16 MB of main storage, two 32K high-speed buffers, power distribution unit, system console and air cooling.

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the 5860's power, or 22 MIPS, and the dual-processor Model 5880 is rated at about 23 MIPS, or about 3.5 times as powerful as the 470V/8. IBM's 3081 Model Groups G and K, both dyadic-processor systems, are rated at about 10.5 and 13.5 MIPS, respectively. All 580 systems have 16 megabytes of main memory, expandable to 32 megabytes in 8-megabyte increments. In addition, the 5860, 5870, and 5880 are expandable to 64 megabytes in 16 megabyte increments after 32 megabytes. Each 580 uniprocessor (5840, 5850, 5860) and attached processor (5870) is equipped with 16 channels per processor (made up of either 14 block/2 byte or 15 block/1 byte multiplexers) with an option for an additional 8 or 16 block multiplexer channels per processor. The 5880 channels can be configured three ways: 28 block/4 byte, 29 block/3 byte, or 30 block/2 byte, not to exceed a total of 32 channels.

A basic 5860 with 16 megabytes of memory and 16 channels costs $3,150,000. A similarly equipped 3081K, which is rated slightly more powerful in the batch mode than the 5860, costs $3,860,000.

PROCESSORS AND PERIPHERALS

The performance increases of the 580 are made possible through improvements in system design, technology, and packaging, according to Amdahl. The processor incorporates a five-phase pipeline design which reduces the number of machine cycles per instruction. This technique produces a maximum execution rate of one instruction per cycle. The 470 systems, for comparison, execute one instruction per two cycles. The processor cycle time in the 580 is 23¼ nanoseconds. The memory cycle time is 280 nanoseconds. Data paths are eight bytes wide, compared to four bytes in the 470, and the 580 uses a dual-bus structure to interconnect all functional units. Two 32K high-speed buffers (HSB), using the 470 "nonstore-through" technique, permit data to be modified in the buffer rather than in main storage. One HSB is used for rapid access to instructions and the other HSB is for fast access to data—a method Amdahl says reduces the interference between the instruction fetching and execution activities.

The system's block multiplexer channels all support the data streaming feature, and can transmit data at up to six megabytes per second. The initial Input/Output Processor (IOP), with 14 or 15 block multiplexer channels, has a maximum aggregate data rate of 50 megabytes per second. Higher data rates can be obtained by adding a second IOP. Up to 256 subchannels are available on every channel, and subchannel queuing is provided as a standard feature. One or two byte multiplexer channels are implemented in the 580 Console Complex, and have a 200K-bytes-per-second data rate each.

Extensive use of LSI technology and component packaging contributes to the system's overall performance. The 580 systems, like the 470, are all air cooled. The LSI chips used in the 580 have a higher density than those in the 470, but generate less heat. High-speed 4K RAM modules are used for microcode control stores, registers, and HSBs. These RAMs, plus the LSI chips, are intermixed on 14-layer

MODELS: Amdahl 5840 (single processor), 5850 (single processor), 5860 (single processor), 5870 (dual processor), 5880 (dual processor).

DATE ANNOUNCED: November 1980 (5860 and 5880); October 1981 (5870); September 1982 (5850); June 1983 (5840).

DATE OF FIRST DELIVERY: Model 5860, 3rd quarter, 1982; Model 5870, 4th quarter 1983; Model 5880, 4th quarter 1983; Model 5850, 3rd quarter 1983; Model 5840, 4th quarter 1983.

DATA FORMATS

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

BASIC UNIT: 8-bit bytes. 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.

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

SYSTEM CONFIGURATION

The Amdahl 580 is built from several interrelated components. Each element is implemented in a Multiple Chip Carrier (MCC), which contains all logic and circuitry required, in a compact package. All functions are housed within the 580 mainframe, and include the following:

- **Instruction Unit (I-Unit), which processes instructions and controls the CPU**
- **Execution Unit (E-Unit), which performs the required computations**
- **Storage Unit (S-Unit), which manages the system's operand storage and retrieval activities**
- **Instruction Buffer (I-Buffer), that provides high-speed buffer storage for instruction streams**
- **Operand Buffer (O-Buffer), that provides similar storage capabilities for operand data**

These components make up the Central Processor (CPU). Additional 580 elements include:

- **Input/Output Processor (IOP), which manages I/O requests and provides 14 or 15 block multiplexer channels, each of which can transfer data at up to 6 megabytes per second**

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	5840	5850	5860	5870	5880
SYSTEM CHARACTERISTICS					
Relative performance to 470V/8	1.2	1.75	2.0	3.4	3.5
Date announced	6/83	5/83	11/80	10/81	11/80
Date of first delivery	4th qtr. 1983	3rd qtr. 1983	3rd qtr. 1982	4th qtr. 1983	4th qtr. 1983
Production status	Active	Active	Active	Active	Active
Number of processors	1	1	1	2	2
Principal operating systems	MVS/SP, VM/SP, ACP	MVS/SP, VM/SP, ACP	MVS/SP, VM/SP, ACP	MVS/SP, VM/SP, ACP	MVS/SP, VM/SP, ACP
Field upgradeable to	5850	5860	5870,5880	5880	—
Basic system price (16MB)	$2,350,000	$2,750,000	$3,150,000	$5,200,000	$6,190,000 (32MB)
PROCESSOR					
Cycle time, nanoseconds	23¼	23¼	23¼	23¼	23¼
BUFFER STORAGE					
Type	Bipolar RAM	Bipolar RAM	Bipolar RAM	Bipolar RAM	Bipolar RAM
Cycle time, nanoseconds	N/A	N/A	N/A	N/A	N/A
Bytes, fetched per cycle	8	8	8	8	8
Capacity, bytes	2 x 32K	2 x 32K	2 x 32K	4 x 32K	4 x 32K
MAIN STORAGE					
Type	Dynamic NMOS	Dynamic NMOS	Dynamic NMOS	Dynamic NMOS	Dynamic NMOS
Cycle time, nanoseconds	280	280	280	280	280
Parity checking	yes	yes	yes	yes	yes
Error checking and correction	yes	yes	yes	yes	yes
Bytes fetched per cycle	8	8	8	8	8
Minimum capacity, bytes	16M	16M	16M	16M	32M
Maximum capacity, bytes	32M	32M	64M	64M	64M
Memory increment size, bytes	8M	8M	8M	8M	8M
I/O CHANNELS					
Block multiplexer only, std.*	14 or 15	14 or 15	14 or 15	14 or 15	28 to 30
Byte multiplexer, standard*	1 or 2	1 or 2	1 or 2	1 or 2	2 to 4
Maximum channel data rates					
Block multiplexer, bytes per second	6M	6M	6M	6M	6M
Byte multiplexer, bytes per second	200K	200K	200K	200K	200K
Aggregate data rate, bytes per second	50-80M	50-80M	50-80M	50-80M	50-80M
Channel-to-channel adapter	yes	yes	yes	yes	yes
Data Streaming	yes	yes	yes	yes	yes

*Channels should total 16 in 5840, 5850, 5860 and 5870; 32 in 5880.

Multiple Chip Carriers (MCC) that can implement an entire system function. Up to 121 LSI chips and RAM modules can be mounted on each MCC. Only eight MCCs are needed for a basic 580, including five for the CPU, and one each for the IOP, System Service Processor (SSP), and Memory Bus Controller (MBC). A ninth MCC is required when increasing the block multiplexer channels from 16 to the maximum 32. Up to 13 MCCs can be accommodated in the LSI "stack," a 5.6 cubic foot enclosure with its two side walls made up of printed circuit boards for interconnecting the MCCs. The 580 employs a dual-bus design with eight-byte data paths. The A-Bus carries data from the SSP, IOP, and CPU to the MBC, which manages the system's memory activities. The B-Bus returns data to these three components from the MBC.

System compatibility is a key element of the Amdahl 580. To provide increased flexibility in this important area, the 580 uses Distributed Microcode on its Instruction Unit (I-Unit), Execution Unit (E-Unit), IOP, MBC, and the SSP. Amdahl claims this approach results in shorter control paths and reduced contention. The microcode control store, typically centralized, is now distributed to the same MCC as the functional unit it controls. The performance of

• Console Processor, which monitors CPU functions, provides maintenance and diagnostic routines via the system support Processor (SSP), and includes up to two byte multiplexer channels

• Memory Bus Controller (MBC), which controls data accesses to the Main Storage Unit (MSU), data bus transfers, and provides overall system coordination and timing facilities

A second IOP can be configured giving the 580 a maximum of 31 block multiplexer channels per CPU.

The 580 comes in the 5840, 5850 and 5860, which are uniprocessors, the 5870, a dual-processor arrangement that couples a 5860 CPU complex with a second 580 CPU, and the 5880, a dual-CPU complex that Amdahl states is based on two tightly-coupled 5860 complexes. The 5860, 5870, and 5880 have a maximum of 64 megabytes of memory. The 5840 is upgradeable to the 5850, the 5850 is upgradeable to the 5860, the 5860 is field-upgradeable to either the 5870 or the 5880 and the 5870 can be upgraded to the 5880. Memory and channels are shared by the two processors in the 5870 and the 5880. The 5840 is rated at 1.2 times the performance of the Amdahl 470V/8, the 5850 is 1.5 times the 470V/8, the 5860 is rated at twice the performance of the 470V/8, the 5870 has 70 percent more power than the 5860, and the 5880 is rated at 3.5 times the 470V/8.

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each functional unit can then be customized for optimum performance. Another factor, I/O protocol compatibility, is reduced to a single PCB, the Channel Interface Handler. Modifications to accommodate protocol changes are made simply by updating the Channel Interface Handler. A new hardware/firmware product called Macrocode will support the machine check and channel check capabilities of the 580. Amdahl indicated that Macrocode will play an important role in implementing future system compatibility techniques. Macrocode, along with hardware and microcode, will be used on the Amdahl 580 to implement System/370 Extended Architecture.

System reliability, availability, and serviceability are performed via several methods: 1) advanced error-checking and correction (ECC) circuitry, such as main memory ECC, buffer ECC, bus parity checking, E-Unit parity and residue checking, and instruction retry; 2) history RAMs which record bus and microcode transactions on an audit trail; 3) diagnostic circuitry integral with each MCC, and 4) improved component packaging, particularly in the MCC.

SOFTWARE AND SUPPORT

The 580 systems are completely compatible with IBM System/370 operating systems; in particular MVS/SP Releases 1 and 2, VM/SP Releases 1 and 2, and ACP, as well as all available Amdahl software products. Amdahl's Universal Timesharing System (UTS), based on the UNIX operating system developed by Bell Laboratories, is now available.

Amdahl has announced it will support IBM's MVS/SP Version 2 and related data management facilities, also known as the System/370 Extended Architecture, or MVS/XA. In particular, the company said it will support the 31-bit addressing required in the new Extended Architecture mode, not only in its 580 Series, but also in its 470V/7 Series and 470V/8 product lines. Releases 1 and 2 of IBM's VM/SP, and VM/SP High Performance Option program products will also be supported. Amdahl supports the new 3880 Storage Control Models 11 and 13.

Centralized system maintenance and troubleshooting are provided by the 580 Console Complex. Console maintenance features include 1) Scan-In/Scan-Out to record and recreate a particular condition; 2) isolation of faulty components at the console; 3) execution of diagnostic routines by the console; 4) error logging; 5) access to Hardware History Tables to assist in fault analysis; 6) Dynamic Error Analysis to analyze the error logs; and 7) dynamic monitoring of selected I/O channels. The 580 can access the Amdahl Diagnostic Assistance Center (AMDAC) the same as 470 users.

ADVANTAGES AND RESTRICTIONS

One major advantage of the Amdahl 580 Series is that the systems are completely compatible with the IBM 370 operating systems as well as all available Amdahl software products. In addition, the 580 is a system which makes extensive use of LSI technology and component packaging affording users improved performance.

TECHNOLOGY

As in the 470 series of processors, the 580 makes extensive use of large-scale integration (LSI) chips using high-performance emitter-coupled logic (ECL) circuitry. Up to 400 of these circuits can be contained on a single LSI chip, compared to only 100 circuits per chip on the 470. In spite of its obviously increased packing density, a 580 chip generates only slightly more heat than a 470 chip. The 580, like the 470, is air cooled.

A new high-speed 4K RAM module was developed by Amdahl to handle such functions as Distributed Microcode control storage, high-speed buffer (HSB) storage, and system registers.

Amdahl combines up to 121 RAM and logic chips on a Multiple Chip Carrier (MCC). This increased packing density, with almost three times the number of chips per MCC as the 470, permits the implementation of an entire system function on a single MCC. Each system MCC is arranged in a small (only about 5.6 cubic feet) stack with a maximum of 13 MCCs possible. Each of the two stack side walls incorporates a 12-layer printed circuit board for MCC-to-MCC interconnections. A minimum of 8 MCCs is required for a basic 580 system. Compared to the 470, with as many as 59 MCCs required, the 580 provides more internal data paths and increased reliability.

Tying all functional units together are two data buses, the A-Bus and B-Bus. Each bus moves unidirectionally, and has a 72-bits-wide data path. The two buses are integral parts of the stack side walls, and provide shorter data paths, simplified physical connections, and a reduction in the number of connections required among functional units. The A-Bus transports data from the Console, I/O Processor (IOP), and CPU to the Memory Bus Controller (MBC). The B-Bus returns data to these units from the MBC.

CENTRAL PROCESSOR

Within the Amdahl 580 CPU, two instruction functions are continuously performed in parallel: instruction fetch (I-Fetch) and instruction execution.

Each processor cycle the I-Fetch component provides a double word of instruction flow and holds it in the Instruction Word Buffer (IWB) in the I-Unit until needed for execution. With each cycle instructions are moved in and out of the IWB at the rate of one, two, or three half words of instruction data.

INSTRUCTION UNIT (I-Unit): The I-Unit controls instruction execution and processes system interrupts. Specific functions of the I-Unit include:

- **Instruction fetching, decoding, and buffering**
- **Determining effective operand addresses**
- **Provide register access for operands**
- **Maintain overlapped pipeline processing technique via control of Storage Unit (S-Unit), Execution Unit (E-Unit), and I/O Processors (IOPs)**

After an instruction is fetched, a five-phase pipeline operation takes over. The pipeline concept, also used in the Amdahl 470, permits the I-Unit to have several instructions in various phases of execution simultaneously. With each processor cycle another instruction enters the pipeline from the IWB. The instruction preceding it moves into the next

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Other advantages noted are Amdahl's design of the hardware to provide system reliability, availability, and serviceability, all in demand by today's users.

Currently as announced by Amdahl, the 580 System has a restriction of less memory and channel capability than is available with the IBM 3084. Amdahl offers 64 megabytes of main storage while 96 megabytes is available with the IBM system. Amdahl offers up to 32 channels while the IBM system has a limit of 48 channels.

USER REACTION

Amdahl was one of three vendors in Datapro's 1983 survey of general purpose computer users that received one of the highest overall percentages of user recommendations. All respondents to this survey were users of Amdahl's 470 family. First deliveries of Amdahl's 5860 system did not begin until fourth quarter 1982. The remaining systems, the 5840, 5850, 5870, and 5880 are not scheduled for delivery until third and fourth quarter 1983. □

phase of execution. By the fifth processor cycle, at maximum execution rate, five instructions are in the pipeline simultaneously, in different execution phases. Since instruction flow involves five basic steps, at the maximum execution rate the result is an effective rate of one instruction per machine cycle. For comparison, the 470 executes at a maximum rate of one instruction per *two* cycles. This increased execution rate permits the 580 to execute twice as fast as Amdahl's previous top-end system, the 470V/8.

Extensive parity checking is performed throughout the I-Unit. All incoming instructions are checked for parity, and the results are checked again after completion of execution. All control registers and the program status word are checked each time they are used. In addition, parity is checked for the timer and the address generation function, and parity is also maintained for all program-referable data.

The 580 I-Unit is compatible with the IBM System/370 Principles of Operation opcodes. These elements are implemented within the CPU by a mixture of hardware, microcode, and a new class of firmware called Macrocode. Critical system functions are implemented in hardware for fastest execution, while other less critical functions can be implemented in microcode resident on the MCC used by the I-Unit. Macrocode is planned for future system enhancements, most likely to permit Amdahl to respond faster to IBM enhancements which are implemented in microcode.

STORAGE UNIT (S-Unit): All I-Unit data requests are processed by the S-Unit. Virtual-to-absolute address translations are performed in the S-Unit, which includes a Translation Lookaside Buffer (TLB) to facilitate rapid virtual-to-absolute translations. Data traffic between the CPU data buffers and main memory is controlled by the S-Unit. It also provides the bus interface between the CPU and the rest of the 580.

A double word of data is accessed each cycle by the S-Unit from its high-speed buffers (HSB). The four storage arrays in the S-Unit, the data array, the data select array, the tag array, and the TLB array, are accessed simultaneously during this activity. The data array has 512 32-byte lines organized within its primary and alternate partitions, and contains the actual data lines. The tag array mirrors the data array in organization, and contains TLB pointers that indicate the pages to which the data lines belong. The data select array facilitates the virtual address selection process. The TLB array contains the virtual-to-absolute address translations.

Since the 580 processes I-Fetch and execution functions separately, two high-speed buffers (HSB) for instructions and operands are provided. Both the Instruction Buffer (I-Buffer) and the Operand Buffer (O-Buffer) have 32K bytes of storage, are two-way, set-associative, and are organized into primary and alternate partitions of 512 32-byte lines. If a line of requested data is not present within a HSB, the S-Unit sends a message to main memory requesting the desired line.

The high-speed TLB has 512 entries organized into primary and alternate partitions of 256 translations to speed virtual-to-absolute address translations. Within each TLB entry is Segment Table Origin (STO) information which eliminates the need for a separate STO stack, as in the 470. Address translations conform to the System/370 structure.

EXECUTION UNIT (E-Unit): The E-Unit executes the arithmetic and logical instructions contained in the 580's instruction set. Operands and opcodes are received from/returned to either the O-Buffer or the I-Unit Register Facility as required by the specific instruction. Performance is enhanced within the instruction pipeline via concurrent activity on two separate instructions by the E-Unit Logic Unit and Checker (LUCK) and the various execution cycle processes (multiply, add, shift, pack, and decimal correct). LUCK and execution phase operations require one processor cycle. In addition, the 580 uses an eight-byte-wide data path, compared to a four-byte path in the 470. Amdahl has optimized certain logic algorithms used with frequently-executed instructions to improve execution speeds.

ADDITIONAL PROCESSOR FEATURES: Other features of the System/370 found in the Amdahl 580 processors include control registers, direct addressing, double word buffer, machine check handling, multiple bus architecture, channel command retry, channel indirect addressing, byte-oriented operand feature, console audible alarm, remote console, remote data link, console file, extended control mode, and program event recording.

Machine check handling analyzes errors and attempts recovery by retrying the failed instruction if possible. If retry is unsuccessful, it attempts to correct the malfunction or to isolate the affected task. Channels have the capability to perform channel command retry, a channel and control-unit procedure that causes a command to be retried without requiring an I/O interruption. Channel Indirect Addressing (CIA) is a companion feature to dynamic address translation, providing data addresses for I/O operations. CIA permits a single channel command word to control the transmission of data that crosses noncontiguous pages in real main storage. If CIA is not indicated, then channel one-level (direct) addressing is employed. The byte-oriented operand feature permits storage operands of most non-privileged operations to appear on any byte boundary. Instructions must appear on even byte addresses. The console audible alarm is a device activated when predetermined events occur that require operator attention or intervention for system operation. Remote consoles are available in addition to the standard console. The remote data link allows establishment of communications with a technical data center to remotely diagnose system malfunctions. The console file is the basic microprogram loading device for the system, containing a read-only file device. The media read by this device contains all the microcode for field engineering device diagnostics, basic system features, and any optional system features. The extended control mode (EC) is a mode in which all features of the System/370 computing system, including dynamic address translation, are opera-

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tional. Program event recording is a hardware feature used to assist in debugging programs by detecting and recording program events.

The optional Channel-to-Channel Adapter permits direct communication between an Amdahl 580 and an IBM System/370, 303X, or 3081 via a standard I/O channel. It can be attached to a block multiplexer channel and uses one control unit position on either channel. In an interconnection between an Amdahl 580 and an IBM processor, either system can be equipped with the Channel-to-Channel Adapter, and it is required on only one of the interconnected channels. Up to two CCAs can be implemented in a system.

The Two-Byte Interface, with up to four available per IOP, doubles the bandwidth of the data path between the channel and the control units which support this option.

OPERATIONAL MODE: Amdahl 580 operates in the Extended Control (EC) mode. 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 new system control functions; therefore, virtual-storage-oriented operating systems must be used.

The 580 can also operate in the Extended Architecture (XA) mode. This capability supports 31-bit addressing, with real and virtual address sizes of two billion bytes. Normal EC mode supports 24-bit addressing with a maximum of 16 million bytes of real and virtual address space per user program. The 580 will support bimodal operation, in which user programs with 24- and 31-bit addresses can execute concurrently, and a dynamic channel subsystem. Implementation of this capability will be available during the second quarter 1984.

REGISTERS: Sixteen 32-bit general registers are used for indexing, base addressing, and as accumulators. Other program-visible registers are the same as in the System/370. Machine-dependent registers contained in the 580 processors are not visible to the user and may differ from the System/370.

INSTRUCTION REPERTOIRE: The Amdahl 580 instruction set consists of the complete System/370 Universal Instruction Set, including the five System/370 instructions for Dynamic Address Translation.

PHYSICAL SPECIFICATIONS: Environmental conditions for 580 processors are included in the following table.

Temperature Range	60° to 90° F (16° to 32° C)
Underfloor Temperature	50° to 66° F (10° to 19° C)
Relative Humidity Range (noncondensing)	35% to 55%
Maximum Wet Bulb Temperature	78° F (26° C)
Heat Output (BTUs/hr)	51,500
Power Consumption	22 to 27 KVA
Power Required	208V, 415 Hz 208V, 60 Hz 230V, 50 Hz 380V, 50 Hz 415V, 50 Hz Both 4-wire and three-phase
Mainframe dimensions (L x W x H)	123" x 36" x 70" (312 cm x 91 cm x 178 cm)
Mainframe weight	3600 lbs (1630 kg)
Minimum configuration room dimensions (L x W)	256" x 128" (650 cm x 325 cm)

MAIN STORAGE

STORAGE TYPE: Dynamic NMOS; 16K chips

CYCLE TIME: 280 nanoseconds

CAPACITY: 16 to 64 megabytes, in 8-megabyte increments

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.

STORAGE PROTECTION: Storage protection facilities are comparable to those implemented in the IBM System/370.

RESERVED STORAGE: The 580 processors reserve an area in lower memory for such purposes as interrupt handling routines, CPU ID, channel ID, and machine check logouts.

The Amdahl 580 Main Storage Unit (MSU) uses four-way line interleaving and four-way quarterline (each quarterline is eight bytes in length) multiplexing to provide up to 64 megabytes of storage. The data bus paths are 72 bits (double word) wide, and transfer eight-byte messages, plus parity, between the MSU and the Memory Bus Controller (MBC) every cycle. The most common data bus transactions are MSU data fetches, and the 580's bus system has been optimized to support this activity.

MEMORY BUS CONTROLLER (MBC): The primary data traffic manager within the 580 is the MBC. A key element in the instruction execution process of the 580, the MBC receives requests from the CPU, I/O Processor, or console over the A-Bus. The MBC includes the following components:

- Data Integrity Unit, which assures that copies of a currently-accessed data line which also exist in other system elements, such as the MSU and the two HSBs, contain the same data.
- Interrupt Router, which directs external system interrupts to the CPU.
- Timer Complex, which provides System/370 timing facilities such as the time-of-day clock, clock comparator, CPU timer, and interval timer.
- I/O Router, which translates logical channel addresses to real addresses, formats them for IOP or console action, and facilitates channel reconfiguration.
- Main Storage Controller (MSC), which provides the correct control signals for MSU memory requests, and generates error checking and correction (ECC) codes.

Once a request has entered the MSU from the MBC, the MSU accesses four quarterlines from one of the four interleaves present and latches them within the Main Storage Data-Out Register. The quarterlines (actually a 32-bit data line) are then routed over the B-Bus (move-in data path) to the appropriate component, such as the S-Unit, IOP, or console.

INPUT/OUTPUT CONTROL

The Amdahl 580 handles I/O activities with an Input/Output Processor (IOP) and 14 or 15 block multiplexer channels as standard. A second IOP is optional per CPU,

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and can provide an additional 16 block multiplexer channels in increments of eight channels. Each channel has 256 subchannels and can accommodate data transfer speeds up to 6.0 megabytes per second. The maximum aggregate data rate for the initial IOP with 16 channels is approximately 50 megabytes per second. Utilizing the second IOP increases the aggregate rate to approximately 80 megabytes per second.

The IOP is based on three components: 1) the I/O Controller (IOC), 2) the Bus Handler, and 3) the 16 Interface Handlers associated with the channels. An IOP, which includes the IOC and Bus Handler, is implemented on a single MCC. The IOC and Bus Handler are shared by the 16 channels.

Data flowing in and out of the IOP moves over the 580's two buses. The Bus Handler is the interface to the A-Bus and B-Bus for the IOP, and provides data buffering when needed. The IOC provides the processing capabilities of the IOP, and manages the Bus Handler and the 16 Interface Handlers. Normal data transfer activities, including channel bus and tag manipulation, and data buffering, are done by the Interface Handlers.

Data and commands are fetched directly from the Main Storage Unit, rather than from a shared HSB. This reduces contention between the I/O subsystem and the CPU.

Subchannel Queuing, a new 580 feature, holds I/O activities that have been denied access to the system, typically a result of a busy device or channel. The held request is then released for processing once the desired device or channel frees up. The feature helps to reduce the CPU load.

CONSOLE INPUT/OUTPUT

The command center of the 580 is the Console Complex, which provides an operator's console interface, and is the primary means of conducting both local and remote system diagnostics. The Console Complex and its associated components are implemented in microcode and contained in a single MCC.

The Console Complex includes the following:

- Microcoded System Support Processor with two megabytes of memory, capable of executing a subset of the Amdahl 580 instruction set
- An I/O channel, associated with one hard disk and two floppy disks
- Up to two local and two remote CRT/keyboard units, comparable to IBM 3277
- A system scanning facility
- Modem control facilities for access to Amdahl Diagnostic Assistance Center (AMDAC)
- A Bus Handler for attachment to the system's A-Bus and B-Bus
- One or two byte multiplexer channels (two, three, or four provided in the 5880), each with an associated Interface Handler, which support data rates up to 200K bytes per second

PERIPHERAL EQUIPMENT

The Amdahl 580 systems can utilize all IBM System/370, 303X, and 3081 input/output and mass storage devices, as well as their plug-compatible counterparts from independent vendors. Detailed coverage of many of these peripherals can be found in Volume 2 of DATAPRO 70.

COMMUNICATIONS CONTROL

Amdahl has two Communications Processors, the 4705 and the 4705E. The 4705 was announced in October 1980, and the 4705E in April 1983. Both models are program compatible with the IBM 3705–II. The 4705 has approximately 1.8 times the power of the 3705–II and has 64K to 512K bytes of memory, in 64K-byte increments. The 4705E has approximately 2.4 times the power of the 3705–II and has 256K to 1M-byte of memory, in 256K-byte increments. Up to 352 communications lines can be connected, and the start/stop, BSC, and SDLC protocols are supported. The 4705 and 4705E models are compatible with IBM 3705 communications software and access methods.

SYSTEM RELIABILITY

To ensure consistently high levels of reliability, availability, and serviceability in the 580, Amdahl has incorporated a wide range of features utilizing the 580's design, technology, and packaging.

- Sophisticated ECC circuitry, including Main Storage ECC, buffer ECC, parity checking in the buses and E-Unit, and instruction retry.
- History RAMs that provide an audit trail of system activities.
- Diagnostic circuitry contained within each MCC.
- Improved fault isolation from denser LSI design, which can implement an entire system function on a single MCC.
- Improved reliability through fewer overall connections in the LSI and MCC packaging.
- RAMs and LSI circuitry packaged on the same MCC.

SERVICE AND SUPPORT

Amdahl's commitment to the efficient maintenance of the 580 is reflected both in the 580 itself and Amdahl's field support organization.

The Console Complex is the hub of all diagnostic operations in the 580. Diagnostic functions in the System Support Processor are implemented in microcode for greater reliability, and include:

- Re-creation of a failed system condition through scan-in/scan-out records
- Isolation of defective Field Replaceable Units (FRUs) with an internal console-generated program
- An enhanced Maintenance Analysis Language to permit scanning the system trouble log and execute diagnostic routines as needed
- Access to history logs to aid in error diagnosis

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- History logs analyzed by the Dynamic Error Analysis program

- Selective channel monitoring via the Integrated Channel Analyzer

AMDAHL DIAGNOSTIC ASSISTANCE CENTER (AMDAC): Located at Amdahl headquarters in Sunnyvale, the East Coast center in Columbia, MD, Toronto, and London, AMDAC is maintained 24 hours per day and 7 days a week by technical support specialists to solve difficult problems that cannot be resolved by field engineering on site. Via the modem in the Console Complex, an on-line telephone hookup can be established between AMDAC and the customer system. AMDAC maintains a variety of system consoles, any of which can perform standard diagnostic tests on the user's system. Program Temporary Fixes (PTFs) can also be implemented on a 580 via the Console Complex.

Field Support Centers (FSC), located worldwide, help insure a smooth transition at installation time. In addition, FSCs are chartered to analyze and correct problems in supported operating systems.

SOFTWARE

Amdahl offers complete functional compatibility with IBM 360/370/303X/308X software. Operating systems supported include OS/VS1 SVS, MVS, MVS/SP, MVT, VM/370, VM/SP, and ACP. Support is included for such major IBM subsystems as HASP, ASP, TSO, TCAM, JES2, JES3, VTAM, TSCS, CMS, and IPCS.

VM/EXTENDED CHANNEL SUPPORT (VM/ECS): Used in conjunction with Amdahl's 580/Entended Channels hardware, this program product provides support for up to 32 channels operating in a VM environment. The software also supports Amdahl's MVS/ECS program product.

MVS/EXTENDED CHANNEL SUPPORT (MVS/ECS): Similar to VM/ECS, MVS/ECS can support up to 32 channels on a 580 system. MVS/ECS does not, however, extend the maximum number of controllers, devices, or optional channel paths that can be configured under MVS.

Amdahl also offers several other software products for use on 580 and compatible processors. These software products are briefly described below.

VM/PERFORMANCE ENHANCEMENT (VM/PE): This product improved the performance and availability of an MVS system when running under VM/SP.

VM/SOFTWARE ASSIST (VM/SA): This product improves virtual machine performance under VM/SP by improving privileged instruction simulation.

MVS/SP ASSIST (MVS/SPA): This product is designed to improve the performance of an MVS/SP Version 1 Release 3 system when run on a CPU without the IBM System/370 Extended Facility (EF) feature.

MVS/SE ASSIST (MVS/SEA): This product allows the execution of MVS/SE and MVS/SP systems on uniprocessors without the IBM System 370 Extended Facility (EF) feature.

MVS/SE SUPPORT (MVS/SES): This product allows the execution of MVS/SE and MVS/SP systems on attached processors and multiprocessors without the IBM System/370 Extended Facility (EF) feature.

UNIVERSAL TIMESHARING SYSTEM (UTS): This product provides a UNIX-based time sharing system for use on System/370 architecture processors.

CMS/ACCELERATOR (CMS/XL): This product is designed to improve performance in a CMS-intensive environment by reducing system overhead and system disk contention.

PRICING

The Amdahl 580 systems are offered for purchase or for lease under two- or four-year operating lease plans. Leases can be renewed for 12-month periods. Lease payments must be made monthly in advance. Lease payments include the lessee charge, property taxes, and insurance, but not maintenance charges. The minimum lease term for a system upgrade is 12 months. Leases can be terminated after two years upon payment of 30 percent of the total remaining rental payments. A 90-day written notice is required for cancellation. For users wishing to purchase leased equipment, purchase credits of 55 percent of each monthly payment are allowed to a maximum aggregate credit of 50 percent of the purchase price. The purchase credit applies either to the original lessee or the current leasee.

Monthly maintenance charges are not included in lease charges. Maintenance is provided for 24 hours per day and 7 days per week.

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.*	2-Year Lease	4-Year Lease
PROCESSORS AND MAIN MEMORY					
5840	CPU Complex; includes two 32K-byte buffer storage units, one or two byte multiplexer channels, console with maintenance processor, power distribution unit; main memory and channels as listed below.				
	With 16,777,216 bytes of main memory and:				
	16 channels	$2,350,000	$8,200	$89,124	$71,298
	24 channels	2,500,000	8,400	94,377	75,500
	32 channels	2,650,000	8,600	99,630	79,702
	With 25,165,824 bytes of main memory and:				
	16 channels	2,510,000	8,600	95,668	76,533
	24 channels	2,660,000	8,800	100,921	80,735
	32 channels	2,810,000	9,000	106,174	84,937
	With 33,554,432 bytes of main memory and:				
	16 channels	2,670,000	9,000	102,212	81,768
	24 channels	2,820,000	9,200	107,465	85,970
	32 channels	2,970,000	9,400	112,718	90,172
5850	CPU Complex; includes two 32K-byte buffer storage units, one or two byte multiplexer channels, console with maintenance processor, power distribution unit; main memory and channels as listed below.				
	With 16,777,216 bytes of main memory and:				
	16 channels	2,750,000	8,500	101,244	80,995
	24 channels	2,900,000	8,700	106,497	85,197
	32 channels	3,050,000	8,900	111,750	89,399
	With 25,165,824 bytes of main memory and:				
	16 channels	2,910,000	8,900	107,788	86,233
	24 channels	3,060,000	9,100	113,041	90,432
	32 channels	3,210,000	9,300	118,294	96,634
	With 33,554,432 bytes of main memory and:				
	16 channels	3,070,000	9,300	125,676	91,465
	24 channels	3,220,000	9,500	130,929	95,667
	32 channels	3,370,000	9,700	136,182	99,869
5860	CPU Complex; includes two 32K-byte buffer storage units, two byte multiplexer channels, console with maintenance processor, power distribution unit; main memory and channels as listed below.				
	With 16,777,216 bytes of main memory and:				
	16 channels	3,150,000	9,850	125,676	100,541
	24 channels	3,300,000	10,050	130,929	104,743
	32 channels	3,450,000	10,250	136,182	108,945

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.*	2-Year Lease	4-Year Lease
	With 25,165,824 bytes of main memory and:				
	16 channels	3,310,000	10,250	132,220	105,776
	24 channels	3,460,000	10,450	137,473	109,978
	32 channels	3,610,000	10,650	142,726	114,180
	With 33,554,432 bytes of main memory and:				
	16 channels	3,470,000	10,650	138,764	111,011
	24 channels	3,620,000	10,850	144,017	115,213
	32 channels	3,770,000	11,050	149,270	119,415
	With 50,331,648 bytes of main memory and:				
	16 channels	3,790,000	11,450	151,852	121,481
	24 channels	3,940,000	11,650	157,105	125,683
	32 channels	4,090,000	11,850	162,358	129,885
	With 67,108,864 bytes of main memory and:				
	16 channels	4,110,000	12,250	164,940	131,951
	24 channels	4,260,000	12,450	170,193	136,153
	32 channels	4,410,000	12,650	175,446	140,355
5870	Attached CPU Complex consists of a 580 CPU tightly-coupled to a 5860 CPU Complex; includes two 32K-byte buffer storage units per CPU, two byte multiplexer channels, console with maintenance processor and power distribution unit per CPU; main memory and channels as listed below.				
	With 16,777,216 bytes of main memory and:				
	16 channels	5,200,000	16,850	211,092	168,874
	24 channels	5,350,000	17,050	216,345	173,076
	32 channels	5,500,000	17,250	221,598	177,278
	With 25,165,824 bytes of main memory and:				
	16 channels	5,360,000	17,250	217,636	174,109
	24 channels	5,510,000	17,450	222,889	178,311
	32 channels	5,660,000	17,650	228,142	182,513
	With 33,554,432 bytes of main memory and:				
	16 channels	5,520,000	17,650	224,180	179,344
	24 channels	5,670,000	17,850	229,433	183,546
	32 channels	5,820,000	18,050	234,686	187,748
	With 50,331,648 bytes of main memory and:				
	16 channels	5,840,000	18,450	237,268	189,814
	24 channels	5,990,000	18,650	242,521	194,016
	32 channels	6,140,000	18,850	247,774	198,218
	With 67,108,864 bytes of main memory and:				
	16 channels	6,160,000	19,250	250,356	200,284
	24 channels	6,310,000	19,450	255,609	204,486
	32 channels	6,460,000	19,650	260,862	208,688

*Includes 24-hour/7-day service; applies to both purchased and leased systems

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.*	2-Year Lease	4-Year Lease
5880	Dual CPU Complex; includes two 32K-byte buffer storage units and two byte multiplexer channels per CPU, console with maintenance processor and power distribution unit for each CPU; main memory and channels as listed below:				
	With 33,554,432 bytes of main memory and: 32 channels	6,190,000	18,715	246,769	197,415
	With 50,331,648 bytes of main memory and: 32 channels	6,510,000	19,515	259,857	207,885
	With 67,108,864 bytes of main memory and: 32 channels	6,830,000	20,315	272,945	218,355
	8-Megabyte Memory Increment	180,000	400	6,544	5,235
	Two-byte Interface	1,400	NC	62	50
	Eight Channel Group	150,000	200	5,253	4,202
	Channel to Channel Adapter	15,000	NC	625	500
	Remote Operator's Console	10,000	50	400	325
Field Upgrade					
	5840 to 5850	400,000	300	12,120	9,697
	5850 to 5860	400,000	1,350	24,432	19,546
	5860 to 5870	2,050,000	7,000	85,416	68,333
	5870 to 5880	370,000	665	12,083	9,667
	5860 to 5880	2,420,000	7,665	97,499	78,000

*Includes 24-hour/7-day service; applies to both purchased and leased systems

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EQUIPMENT PRICES

		Purchase Price	Monthly 2-Year Lease	Monthly 4-Year Lease	Monthly 24-hour, 7-day Maint.
4705 COMMUNICATIONS PROCESSOR					
4705-5	Processor with 64K bytes of memory, up to 64 lines	$35,350	$ 810	$ 675	$312
4705-6	Processor with 64K bytes of memory, up to 160 lines	46,650	1,200	1,000	340
4705-7	Processor with 64K bytes of memory, up to 256 lines	57,950	1,600	1,330	370
4705-8	Processor with 64K bytes of memory, up to 352 lines	69,250	2,010	1,670	399
MEMORY					
	Additional 64K bytes	2,650	162	134	72
	Additional 128K bytes	5,300	324	268	145

SOFTWARE PRICES

	Monthly License Fee	Monthly DSLO[1]	Annual License Fee	Annual DSLO[1]
PROGRAM PRODUCTS				
MVS/SE Assist (MVS/SEA)				
MVS/SE Support (MVS/SES)	$ 300	$ 250	$3,150	$2,350
MVS/Extended Channel Support	1,750	1,300	18,500	13,850
VM/Extended Channel Support	500	375	5,250	3,900
[2]VM/Performance Enhancement (VM/PE)	1,000	750	10,500	7,850
VM/Software Assist (VM/SA)	1,750	1,300	18,500	13,850
Universal Timesharing System (UTS)	500	375	5,250	3,900
Academic License				
Non-Academic License	1,000	750	10,500	7,850
	1,500	1,125	15,750	11,800 ■

[1]The Amdahl Distributed System License Option (DSLO) allows the user to license additional, unsupported copies of an Amdahl licensed program product for a reduced fee.

[2]A VM/PE workshop is required before installation at all sites at a one-time cost of $1,750.

LOCAL PROGRAMMING SUPPORT IS AVAILABLE AT NO ADDITIONAL CHARGE.

*Includes 24-hour/7-day service; applies to both purchased and leased systems