BASF 7/6X Series

MANAGEMENT SUMMARY

UPDATE: *The BASF 7/6X Series remains essentially unchanged, except for price reductions throughout the series. However, the series can now support a new laser printer, the BASF 6890 Printing Subsystem, that was announced at CeBit '86. In addition, BASF has recently released the 6485 disk storage unit which features a capacity of 5 gigabytes and is compatible with the IBM 3380-E, as well as the 6378 tape system which is compatible with the IBM 3420. This report also covers the BASF 6580 High-Speed Storage System.*

BASF Data Technology is a leading PCM manufacturer. The company reported a very successful year in 1985. Company worldwide sales increased by 24 percent to reach DM 1.5 billion. Three quarters of the sales were in Europe, and one quarter were overseas. BASF has installed approximately 400 mainframe computers and over 23,000 peripherals worldwide. The firm employs 3,200 people. Its business strategy for 1986 calls for additional expansion of the plug-compatible mainframe business and the establishment of a production facility for the BASF 4800 chromium dioxide computer tape cassette. Expenditures for research and development, as well as for additional personnel, are expected to increase by approximately 20 percent.

The 7/6X Series offers complete compatibility with IBM's 4300 and 370 Series at lower cost, in less space, and with lower power consumption and consists of several models, the 7/63, 7/65, 7/68, and 7/69. The BASF machines are based on the Hitachi M240H, which uses highly integrated circuits and 64K-bit chips. BASF claims excellent reliability for the machines because all systems are tested at temperature and shock ranges that are well in excess of those ever likely to be met.

BASF announced the 7/6X Series in three stages. In Spring 1982, the 7/65 and 7/68 were launched; in Spring 1983, a new entry-level system, the 7/63, was introduced; and in ➢

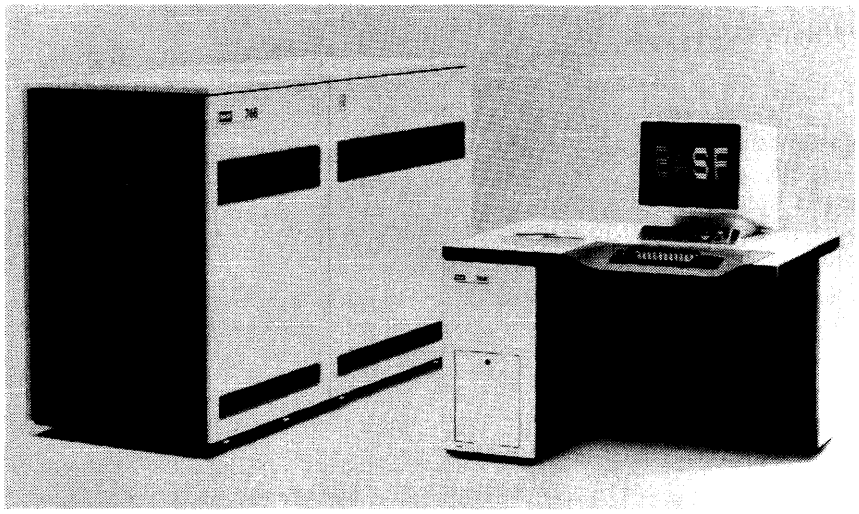
The BASF 7/6X Series contains four-field upgradable models that are compatible with the IBM 4300 and 370 Series at the hardware and software levels. The BASF machines are Hitachi-based and can use all IBM's peripherals as well as those from plug-compatible manufacturers.

MODELS: BASF 7/63, 7/65, 7/68, and 7/69.
CONFIGURATIONS: 1 CPU, from 4MB to 16MB main memory, 1 or 2 byte multiplexer channels, 4 to 10 block multiplexer channels.
COMPETITION: IBM 4300 Series, and other comparable Hitachi-based systems such as those from NAS Advanced Systems.
PRICE: Purchase prices range from approximately 430.000 DM for an entry level 7/63 to approximately 930.000 DM for the top-of-the-line 7/69.

CHARACTERISTICS

VENDOR: BASF AG, D6700 Ludwigshafen, West Germany. Telephone (0621) 601. Telex 464738 basf.

COMPANY LOCATIONS: *Argentina*: BASF Argentina SA, Av. Corrientes 327, 1000 Buenos Aires. Telephone (01) 312 94916; *Austria*: BASF Osterreich GmbH, Hietzinger Hauptstr. 119, A-1131 Vienna. Telephone (0222) 82 94310; *Belgium*: BASF Chimie SA, Avenue Hamoir-Iaan 14, B-1180 Brussels. Telephone (02) 375 2400; *Brazil:* BASF Brasileira SA, Industrias Quimicas, Avenida São Luiz 86, 01046 São Paulo SP. Telephone (011) 257 0011; *Finland*: O.Y. Mercantile AB, Viljatie 2, SF-00701 Helsinki. Telephone (0) 354122; *France*: Compagnie Française BASF SA, 140 rue Jules Guesde, 92303 Levallois. Telephone (01) 730 5500; *Netherlands*: BASF Nederland, b.v., Kadestraat 1, 6811 Arnhem. Telephone (085) 717171; *Spain*: BASF Espanola SA, Paseo de Gracia 99, E-08008 Barcelona. Tele- ➢



The BASF 7/68, a plug-compatible substitute for the IBM 4341-2, is based on the Hitachi M240H and can support both IBM and BASF peripherals. BASF reports that tests show that the 7/68 operates about twice as fast as the 4341-2 while taking up less space and generating less heat.

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Autumn 1984, the top-end 7/69 was announced. The 7/63 is competitive with the IBM 4341 Model Group 12, while the more powerful models compete with the IBM 4341-2, which is no longer manufactured.

All four models can be equipped with up to 16MB of main memory, ranging from 4MB on the 7/63, 7/65, and 7/68, and from 8MB on the 7/69. Each system also contains 64KB of buffer memory, from which most instructions are accessed. Corresponding IBM 4300 machines also have a maximum of 16M bytes of main memory. The BASF 7/6X machines can have two byte multiplexer channels, one being standard. The basic configuration of the four models includes four block multiplexer channels, optionally increasing to five on the /63, six on the /65, eight on the /68, and ten on the most powerful /69.

Software is an area in which most potential buyers are not fully convinced by the claims of plug-compatible manufacturers regarding full functionality of the target manufacturer's software on the plug-compatible machine. So it is worth looking at this area in detail.

On any BASF-Hitachi type machine, microcode is the key to success. Any operating system is going to run better if it is either directly microcoded or can use a set of microcoded instructions. In the 7/6X machines, optimal performance is achieved with certain operating systems. BASF recommends DOS/VSE, VM/SP, MVS/SP, and OS/VSI. Frequently used supervisor functions are executed directly in microcode, rather than at the operating system level. Application programs are also claimed to benefit from the resulting decrease in overhead. The overall result is that not only will the IBM 4341 software run on the BASF 7/6X, but, in most cases, it will run more effectively than on the original machine.

Throughput using the same software is the only real measure of performance, and BASF quotes extensive test figures using this criterion. The keys to throughput are processor power, channel capabilities, and the performance of the peripherals. In processor performance, the 7/65 is between 30 and 50 percent faster than the 4341-2; the 7/68 is up to twice as fast; actual speed depends on any options selected. Channel capabilities favor the BASF products.

COMPETITIVE POSITION

Through the 7/6X Series, BASF is a competitor to the IBM 4300 Series. In particular, the 7/63 competes against the 4341 Model Group 12; the 7/65, 7/68, and 7/69 compete against the IBM 4341-2. BASF also competes with other plug-compatible manufacturers, such as NAS with its Hitachi-based systems, Amdahl, Burroughs, and Prime.

ADVANTAGES AND RESTRICTIONS

The principal advantages of any PCM over IBM is offering compatible hardware and software at a reduced price. The BASF 7/6X systems require less space and power than the IBM 4300 Series and produce a lower heat output.

phone (03) 215 1354; *Sweden*: BASF Svenska AB, Vretenvaegen 10, S-17154 Solna. Telephone (08) 980840; *Switzerland*: BASF (Schweiz) AG, Appital, CH-8820 Wädenswil/Au. Telephone (017) 839111; *United Kingdom*: BASF United Kingdom Ltd., 4/5 Fitzroy Square, London W1P 6ER. Telephone (01) 388 4200.

MANUFACTURER: Hitachi, Japan.

MODELS: BASF 7/63, 7/65, 7/68, and 7/69.

DATE ANNOUNCED: 7/63—Spring 1983; 7/65, 7/68—Spring 1982; 7/69—September 1984.

DATE OF FIRST DELIVERY: 7/63—June 1983; 7/65—June 1982; 7/68—July 1982; 7/69—December 1984.

NUMBER INSTALLED TO DATE: Approximately 200.

DATA FORMATS

BASIC UNIT: 8-bit byte, representing one alphanumeric character, 2 BCD digits, or 8 bits. Two consecutive bytes form a half-word of 16 bits, and 4 consecutive bytes produce a word of 32 bits.

FIXED-POINT OPERANDS: Operands can range from 1 to 16 bytes (1 to 31 digits plus sign) in decimal mode and one half-word (16 bits) or one word (32 bits) in binary mode.

FLOATING-POINT OPERANDS: In short format, an operand consists of one word with 24-bit fractional part and 7-bit hexadecimal exponent. For extended precision format, 2 words are used, comprising a 56-bit fraction and 7-bit hexadecimal exponent.

INSTRUCTIONS: Instructions are 2, 4, or 6 bytes in length, specifying 0, 1, or 2 memory addresses, respectively.

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

MAIN MEMORY

TYPE: NMOS LSI 64K-bit chips formed into packages, each consisting of 10 layers of glass epoxy, 22 by 42 cm. Sheets preprinted with copper conductors.

The packages are, in turn, inserted in platters, which contain gold-coated pin contacts to receive the packages. The basic machine has two platters, each of which measures 46 by 42 cm. Extensive testing is carried out at temperatures far in excess of the recommended environmental limits. The platters are also subjected to shock testing. The result is extremely high reliability, according to BASF.

CYCLE TIME: Access time to main memory is 150 nanoseconds. Access time to bipolar cache memory, from which most instructions are fetched, is 18 nanoseconds.

CAPACITY: 7/63, 7/65, 7/68—4MB to 16MB; 7/69—8MB to 16MB.

CHECKING: There are three mechanisms for error detection. These are:

- **Parity checking on all data paths within the central processor and on all the channels.**
- **A Hamming-code check on all operations in main storage. This check automatically ensures that all single-bit errors are corrected and that all multiple errors are detected.**
- **A combined check sum and parity check to detect and correct errors in control storage.**

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Another important factor is reliability. BASF claims an average customer figure of 48 months as the mean-time-between-failure. To back up this claim, BASF refers to actual customer installations of machines, saying that these have achieved a 36-month MTBF figure. Strengthening BASF's claim, seven respondents in Datapro's survey of British users who evaluated the BASF 7/6X and 7/7X in a combined rating gave a perfect score of 4.00 for *reliability of mainframe.*

BASF also claims that its installation and upgrade times are significantly lower than IBM's.

In addition to the 7/6X machines, BASF also markets the 7/7X and 7/8X Series of Hitachi-based PCM systems which compete against the IBM 303X and 3081. This full line of BASF machines provides a wide performance range that offers users the possibility of retaining peripherals and some software when purchasing a more powerful system.

In the area of peripherals, users will benefit from the recent releases of the BASF 6485 disk drive and the BASF 6890 printing subsystem. The BASF 6485 disk storage system, offering a 5-gigabyte capacity, is compatible with the IBM 3380-E models. The cost-per-megabyte of storage capacity is now more than 20 percent cheaper than conventional 80-type disks. In addition to attractive selling prices, BASF also offers rental agreements to allow users to adjust their storage capacities on a flexible, as needed basis.

The BASF 6890 printing subsystems offer users the opportunity of migrating to a laser system through the existing 3203-5 interface, that is already provided for the connection of conventional printers. BASF chose to price the 6890 below the level of the IBM 3800 subsystem, but with less capacity. However, BASF provides the option of setting up two 6890 systems when increased capacity is needed. This method increases redundancy and offers the user a great margin of flexibility.

An additional benefit to users is the BASF 6580 High-Speed Storage System which is directed to installations running central processors of the top performance range. It offers considerably faster input/output operations than magnetic disk systems. Data throughput can be greatly increased and CPU performance can be improved. The system can store time-sensitive data that must be consulted very frequently. A maximum storage capacity of two gigabytes can be attained for each string. According to BASF, some users have reported throughput improvements of up to 50 percent.

USER REACTION

The 1986 Datapro Survey of British Users of Computer Systems brought responses from seven BASF 7/6X and 7/7X users grouped together in one set of ratings. The average life of the systems was approximately 29 months. Major applications areas included accounting, order processing/inventory control, purchasing, education, sales/distribution, and decision support.

STORAGE PROTECTION: Protection is facilitated by the use of 2K pages or multiples thereof. There is also separate protection for the lowest address space in memory. These features prevent unauthorized access to programs and data.

CENTRAL PROCESSORS

The 7/63 operates at 1.5 million instructions per second (MIPS), the 7/65 at 1.0 MIPS, the 7/68 at 2.2 MIPS without the optional High Speed Arithmetic (HSA) feature and at 2.5 MIPS with HSA, and the 7/69 performs at 2.5 MIPS without HSA and at 2.8 MIPS with HSA. Central processor cycle times are 60 nanoseconds on the 7/63 and 7/65, 50 nanoseconds on the 7/68, and 43 nanoseconds on the 7/69.

All models are IBM 4341-compatible at both hardware and software levels and are heavily microprogrammed. Microprogram storage requires 144KB divided into 72-bit words. Loading of the microprogram is from two double-sided diskette drives integrated into the CPU.

The functions of the central processor are:

- **Executing both central and I/O instructions.**
- **Controlling and monitoring channel operations and main storage accesses.**
- **Communicating with the service processor when required.**
- **Facilitating access by the service processor if there is a hardware malfunction.**

All central processors contain all the requisite hardware and microcode to support the unique address structure of the IBM 4300 virtual storage architecture and, in addition, all IBM 370 mode functions.

SERVICE PROCESSOR: The service processor integrated into the CPU on all models, has the following functions:

- **Continuous monitoring of all attached environmental sensors (power, cooling, and humidity).**
- **Monitoring communication between console and CPU.**
- **Error analysis, gathering and recording data on hardware malfunction, and initiating recovery procedures.**
- **Controlling the execution of diagnostic programs.**
- **Initiating and controlling remote (telephone) system support functions.**

CONTROL STORAGE: Consists of 144KB, divided into 16K 72-bit words. Four kilobit bipolar chips are used with an access time of 18 nanoseconds.

BUFFER STORAGE: The high-speed buffer serving as cache memory also uses 4K-bit bipolar chips with an access time of 18 nanoseconds. Capacity is 64KB which, BASF claims, will ensure that most instructions will be found in this buffer, rather than in main memory.

ADDRESSING: There are three forms of addressing used on the BASF 7/6X systems: real, absolute, and logical. In the ECPS/VSE mode, operations take place as if the machine were an IBM 4300 and there is a single-level form of address translation. In the System/370 mode, a 2-level table lookup feature is applied.

Direct addressing of virtual program segments can take place, eliminating any requirement to operate in VSE mode.

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The seven users were as a whole well satisfied with their BASF machines, for they all replied affirmatively to the question, "Did the system do what you expected it to do?"

Users were asked to evaluate the different aspects of their systems under the headings Excellent, Good, Fair, and Poor. The weighted average obtained is based on a scale of 4.0 for Excellent to 1.0 for Poor. Users gave the highest rating of 4.00 for reliability of mainframe and extremely high marks for maintenance responsiveness and maintenance effectiveness. The system ratings are summarized in the following table:

Ease of operation	3.17
Reliability of mainframe	4.00
Reliability of peripherals	3.17
Maintenance service:	
Responsiveness	3.67
Effectiveness	3.67
Technical support:	
Troubleshooting	3.00
Education	2.33
Documentation	2.50
Manufacturer's software:	
Operating system	3.00
Compilers & assemblers	2.80
Applications programs	2.40
Ease of programming	2.40
Ease of conversion	2.20
Overall satisfaction	2.80

Weighted averages on a scale of 4 for Excellent, 3 for Good, 2 for Fair, and 1 for Poor. □

There is also a dual-address space facility whereby two locations can be addressed simultaneously.

DYNAMIC ADDRESS TRANSLATION: Address translation is effected in System/370 mode only. There is no need for it in 4300 mode (strictly speaking, ECPS/VSE mode) because of the direct addressing of virtual program segments.

In 370 mode, the translation between virtual and real addresses is made via a 2-level table lookup. This process is aided by the provision of a Translation Look-Aside Buffer (TLB) which provides 512 address pairs.

INSTRUCTION REPERTOIRE: There are two operating modes, the ECPS: VSE (Extended Control Program Support) mode for 4300 operations, and the System/370 mode. In the 4300 mode, there are 187 instructions available and in the 370 mode, 183 instructions. The Universal 370 instruction set is included.

The instruction set includes complete arithmetic facilities for processing variable-length decimal and fixed-point binary operands, as well as instructions which handle loading, storing, comparing, branching, shifting, editing, radix conversion, code translation, logical operations, packing, and unpacking. In addition, a group of "privileged instructions," usable only by the operating system, handles input/output and various hardware control functions.

Also standard are some instructions that were optional on some models of the System/370. These include the dynamic address translation instructions of the Load Read Address, Reset Reference Bit, Purge Translation Look-Aside Buffer, Store Then AND System Mask, and Store Then OR System Mask; the VTAM support instruction of Compare and Swap and Compare Double and Swap; the OS/VS support instructions of Insert PSW Key, Set PSW Key from Address, and Clear I/O; the extended precision floating-point instructions; and multiply/add.

The only instructions which are not supported in 370 mode are the multiprocessor instructions.

INSTRUCTION TIMES: BASF has carried out extensive benchmark and other tests on the 7/6X machines, which have involved carefully chosen mixes of instructions for system, commercial, and scientific applications. In each mix, the weight given to each instruction, and whether a branch is taken, is specified. Details of these mixes can be obtained from BASF.

INTERRUPTS: Classes of interrupts include I/O, external, program, supervisor call, machine check, and restart. Classes of interrupts are distinguished by the storage locations in which the old program status word (PSW) is stored and from which the new PSW is fetched.

BASF states that as a result of buffering on all channels, there are fewer interrupts than on the IBM systems.

SYSTEM CONSOLE: The console consists of a 14-inch, 4-color CRT display with separate keyboard. A hard copy printer is optional. The keyboard has 87 keys which include 12 program function keys. The CRT display is a standard 80-character by 25-line display with an extra line for showing systems status. It can be connected up to 33 m from the central processor.

CONFIGURATION RULES

MODEL 7/63: The basic configuration includes a central processor with 4MB of main memory, one BYMUX and four BLMUXs, each with 256 subchannels, and a system console unit, comprising a VDU and separate keyboard. Integrated in the central processor are two double-sided diskette drives for microcode loading and a service processor. Main memory can be expanded to 16MB in increments of 2MB and 4MB. One additional BYMUX and one additional BLMUX can be supported.

MODEL 7/65: The standard configuration comprises a central processor, 4MB of main memory, one BYMUX, four BLMUXs, a system console, and two double-sided diskette drives. Options for the 7/65 include an expansion of main memory in 2MB and 4MB steps up to a maximum capacity of 16MB, a second BYMUX, and two additional BLMUXs.

MODEL 7/68: The standard configuration consists of a central processor, 4MB of main memory, one BYMUX, four BLMUXs, and twin double-sided diskette drives. There is a VDU console with keyboard. Main memory can be increased in 4MB steps to 16MB. The number of BYMUXs can be increased to 2, and the number of BLMUXs to 6.

MODEL 7/69: This model contains a central processor with 8MB of main memory, one BYMUX, four BLMUXs, a system console, and two double-sided diskette drives. Expansion possibilities include increasing main memory to 16MB in increments of 4MB and 8MB and adding a second BYMUX and 6 extra BLMUXs.

Other options for all models are:

- A console printer.
- The so-called direct control feature, which interfaces directly with another compatible central processor or peripheral to enable data exchange to take place with the minimum delay.

- A channel-to-channel adapter which facilitates the exchange of data between CPUs via byte or block multiplexer channels.
- Additional channel control units.
- High-Speed Arithmetic (HSA) which accelerates execution of floating-point and fixed-point arithmetic instructions with a performance improvement of up to 15 percent (available on all 7/6X models).
- An I/O diskette drive with IBM 3540-compatible data recording format (manual diskette feed).

INPUT/OUTPUT CONTROL

I/O CHANNELS: All models include as standard one byte multiplexer channel (BYMUX) and four block multiplexer channels (BLMUX), and can support one additional BYMUX. The 7/63 can optionally support five BLMUXs; the maximum is six on the 7/65, the 7/68 supports up to eight BLMUXs, and the 7/69 optionally includes a total of 10.

The BYMUXs have a data transfer rate of 80KB per second on the 7/63 and 7/65, and 100KB per second on the 7/68 and 7/69. BLMUXs on all models operate at 3MB per second. A datastreaming facility is standard on all BLMUXs. The average data transfer rate is 12MB per second on the 7/63, 13MB per second on the 7/65, 16MB per second on the 7/68, and 22MB per second on the 7/69.

Each of the byte and block multiplexer channels has 256 subchannels. Each channel also has a 1024-byte buffer. Data transfer between channel and main storage is accomplished in blocks of 32 or 64 bytes. The method of attaching controllers and thus peripheral devices is exactly the same as that on the IBM 360 and 370 series. Each channel can support up to 8 controllers, and they can be cluster controllers. Each of the 256 subchannels can be, in effect, a specific device. Any IBM or IBM-compatible peripherals can be used, the latter including the wide range of peripherals offered by BASF.

MASS STORAGE

BASF 6580 HIGH-SPEED STORAGE SYSTEM: The 6580 is intended primarily for computing centers with central processors of the top performance range. It offers considerably faster input/output operations than magentic disk systems. In the storage hierarchy, this system is situated between the main memory of the central processor and the magnetic disk periphery. It can store time-critical data which must be consulted frequently. Each string can support a maximum storage capacity of 2 gigabytes.

Implementing the 6580 does not require alterations to existing software. The 6580 can run under the same XA and /370 operating systems as the current multidrive disk storage systems. When the system is switched on, it writes data from the integrated Winchester disk into the memory. When the system is switched off, this process occurs in reverse. The additional battery unit of the BASF 6581 prevents accidental destruction of data. The maximum 2-gigabyte configuration of the 6580 is approximately 1.80 m high and requires a floor space of 80 cm by 455 cm.

BASF DISK DRIVES:

BASF 6240, 6240F, 6242: Compatible respectively with the IBM 3340A2, the 3340A2F, and 3340B2, these drives can be connected via either the IBM DASD adaptor to the 4331 or via the IBM 3830; or BASF 6038 or 3880 Model 1 storage control to the 4341; or with the IBM 3830 or BASF 6038 to the BASF 7 Series. Cacacity of the 6240, 6240F, and 6242 is 70MB per spindle with one or two spindles. Average access time for all three models is 20 ms, average rotational delay is 10 ms, and the transfer rate is 885KB per second.

BASF 6244: Compatible with the IBM 3344, this drive can be connected via either the IBM DASD adapter to the 4331 or via the IBM 3830, BASF 6038, or IBM 3880 Model 1 storage control to the IBM 4341; or via the BASF 6038 or IBM 3830 to the BASF series machines. Capacity is 280MB per spindle with either one or two spindles. Average access time is 20 ms, rotational delay is 10 ms, and the transfer rate is 885KB per second.

BASF 6250, 6250F, 6252, 6252F, 6253, 6253F: These six drives are compatible, respectively, with the IBM 3350A2, 3350A2F, 3350B2, 3350B2F, 3350C2, and 3350C2F. The main drive is either the 6250 or the 6253. The BASF 6250, a two-drive unit with a capacity of 317.5MB per drive, also provides the logic and power for the attachment of either three 6252s/6252Fs or up to two 6252s/6252Fs, and/or one 6253/6253F. The 6253 also is a twin-drive unit with a capacity of 317.5MB per drive, but it can function as either a 6250 or a 6252 through setting a manual switch. The 6253F is the same as the 6253 except it has a fixed head which offers immediate access (zero access time) to up to 1,144,140 bytes of data. The 6252, of which either two or three can be connected to a 6250, has a capacity of 317.5MB per drive. The 6252F is exactly the same as the 6252, apart from the availability of 1,144,140 bytes of immediate access storage. The average access time of all these drives is 20 ms, the rotational delay averages 8.4 ms, and the transfer rate is 1198KB per second. The controller is either the IBM 3830 Model 2 storage control or the IBM 3880 Model 1 storage control when connected to the 4341 or 4331, and the BASF 6038 or the IBM 3830 Model 2 for connection to the BASF 7 Series computers.

BASF 6470/6472: Compatible with the IBM 3370, the 6470 and 6472 units can be attached to BASF 7/6X Series, and IBM 4341, 4361, and 4381 systems using the IBM 3880 Models 1, 2, or 4. Connection to the IBM 4331 and 4361 is also possible through the DASD adapter. The disk unit has one spindle with a capacity of 570MB. The average access time is 20 ms, and the transfer rate is 1859KB per second. The two units are specifically compatible with the IBM 3370 A01 (BASF 6470) and IBM 3370 B01 (BASF 6472).

BASF 6470-2/6472-2/6473-2: Compatible with IBM 3370-2. Connection to BASF and IBM systems is as for BASF 6470/6472. The disk unit has one spindle with a capacity of 730MB. The average access time is 19 ms, and the transfer rate is 1859KB per second. The units are specifically compatible with IBM 3370 A02 (BASF 6470-2) and IBM 3370 B02 (BASF 6472-2). The BASF 6473-2 has no IBM equivalent and allows, as the last unit in a string, increased performance by using the "Cross Call" feature.

BASF 6475/6476/6477: Compatible with the IBM 3375, the units can be attached to BASF 7/6X Series, and IBM 4341, 4361, and 4381 systems using the BASF 6085-1 or IBM 3880 Models 1, 2, or 4 disk controllers. The disk unit has one spindle with a capacity of 820MB. The average access time is 19 ms, and the transfer rate is 1859KB per second. The units are specifically compatible with the IBM 3375 A01 (6475), IBM 3375 B01 (6476), and IBM 3375 D01 (6477).

BASF 6480/6481: Compatible with the IBM 3380, this model attaches to BASF 7/6X, 7/7X, and 7/8X, and IBM 4341, 4361, 4381, 303X, or 308X systems via the BASF 6085-7 control unit. The 6480/6481 has two drives per unit, each with a capacity of 1260MB. Average access time is 25 ms. The transfer rate is 3MB per second.

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BASF SERIES 7/6X CHARACTERISTICS

	BASF 7/63	BASF 7/65	BASF 7/68	BASF 7/69
SYSTEM CHARACTERISTICS				
Date of introduction	Spring 1983	Spring 1982	Spring 1982	September 1984
Date of first delivery	June 1983	June 1982	July 1982	December 1984
Number of CPUs per system	1	1	1	1
Principal operating systems	DOS/VSE or VM/SP or MVS/SP or OS/VS1	DOS/VSE or VM/SP or MVS/SP or OS/VS1	DOS/VSE or VM/SP or MVS/SP or OS/VS1	DOS/VSE or VM/SP or MVS/SP or OS/VS1
MAIN STORAGE				
Storage type	NMOS	NMOS	NMOS	NMOS
Read cycle time, nanoseconds	600 approx.	600 approx.	600 approx.	600 approx.
Bytes fetched per cycle	8	8	8	8
Minimum capacity, MB	4	4	4	8
Maximum capacity, MB	16	16	16	16
Increment size, MB	2, 4	2, 4	4	4, 8
Error correcting memory	Standard	Standard	Standard	Standard
BUFFER STORAGE				
Capacity, KB	64	64	64	64
Cycle time, nanoseconds	18	18	18	18
CENTRAL PROCESSOR				
Performance, MIPS	1.5	1.8	2.2-2.5	2.5-2.8
Operating modes	ECPS System/370	ECPS System/370	ECPS System/370	ECPS System/370
Instruction set	S/370 universal except for multi-processor	S/370 universal except for multi-processor	S/370 universal except for multi-processor	S/370 universal except for multi-processor
Reloadable control storage	Standard	Standard	Standard	Standard
I/O CHANNELS AND ADAPTERS				
No. of BYMUXs	1-2	1-2	1-2	1-2
No. of BLMUXs	4-5	4-6	4-8	4-10
Total maximum no. of channels	7	8	10	12
Maximum channel data rates				
byte multiplexer, KB/sec.	80	80	100	100
block multiplexer, MB/sec.	3	3	3	3
Channel-to-channel adapter	Optional	Optional	Optional	Optional
All other adapters from IBM or PCMs	Can be fitted	Can be fitted	Can be fitted	Can be fitted

BYMUX—Byte multiplexer channel.
BLMUX—Block multiplexer channel.

BASF 6485: Compatible with the IBM 3380-E, the 6485 offers a capacity of 5 gigabytes. A maximum of 20 gigabytes can be attained per string. Like the 3380-E models, the BASF 6485 systems have data transmission rates of 3MB per second, as well as average access times of 17 ms. The BASF 6085 control unit can support 2.5-gigabyte and 5-gigabyte disk units. The use of the buffered control unit BASF 6085-23, which is equivalent to the IBM 3880-23, increases data throughput rate when frequently needed data are written in the memory with a maximum of 64KB.

INPUT/OUTPUT UNITS

Most of the IBM Systems 360, 370, 4300 and 303X Series peripherals can be linked to the 7/6X Series, together with PCM devices.

The BASF peripheral units that can be linked to the 7/63, 7/65, 7/68, and 7/69 include the following tape units and printers:

BASF 6060/636X COMPACT MAGNETIC TAPE SUB-SYSTEM: The 6060 is the controller and the 636X the magnetic tape drive. The drive is compatible with IBM's 3420 Models 4 and 6. The 6060 control unit can have switching capabilities to enable it to access up to 16 tape drives. When the unit is to be linked to two channels, automatic threading is standard. The 636X tape drive is either the 6364 or the 6366 unit. The recording density in each case is either 6250 bpi in Group Coded Recording (GCR) or 1600 bpi in PE. Data transfer rates are 500KB per second for the 6364 at 6250 bpi and 128KB per second at 1600 bpi; 780KB per second for the 6366 at 6250 bpi and 200KB per second at 1600 bpi.

BASF 6050/6358 MAGNETIC TAPE SUBSYSTEM: The 6050 is the controller and the 6358 the magnetic tape drive. The drive is compatible with IBM's 3420-8. The recording density is either 6250 bpi in GCR or 1600 bpi in PE. Data transfer rates are 1250KB per second at 6250 bpi and 320KB per second at 1600 bpi.

Other peripherals offered for the 7/6X by BASF are the 6603 and 6606 line printers.

BASF 6070/6378: A reel tape system, the BASF 6378 offers performance improvements through data compression. Compatible with the IBM 3420, the 6070/6378 has a data transmission rate nominally up to 3MB per second, thus corresponding to the IBM 3480 system. Data protection on the BASF 6378 without compression is 6 minutes and 39 seconds; with compression it is 4 minutes and 24 seconds.

BASF 6603 LINE PRINTER: This has its own integrated controller. The printer is compatible with the IBM 3203-5 and operates at 1250 lines per minute with a 48-character set. The unit uses a print band which is mounted as a separate device to facilitate changing. Among the advan-

BASF 7/6X Series

tages of this printer are microprogrammed self-diagnostics; microprocessor management of the printing process, paper feed, ribbon feed buffer, and transfer of data between channel and printer; and paper feed under program control. Paper particles and dust are removed continuously during printing by a vacuum system. A major advantage claimed is that the printer is silent because of a cover that encloses the printer and the powered stacker. Using an OCR print band, the printout is OCR-readable.

BASF 6606 LINE PRINTER: Compatible with the IBM 3203-5. It prints 2000 lines per minute using a 48-character set, 1640 lpm with a 64-character set, 1200 lpm with a 96-character set, and 950 lpm with a 128-character set. Its features are the same as for the 6603, including OCR capability. The 6606 uses the same print bands and print ribbons as the 6603.

BASF 6890 PRINTING SUBSYSTEM: A laser system, the 6890 has a printout rate of 88 pages (DIN A4) per minute and can be connected to all current BASF and compatible CPUs. To achieve the connection, the same 3203-5 interface is used that is already operational for conventional impact printers. The printer is 1.4 m high and requires a floor space of 178 cm by 84 cm.

A Winchester disk is a standard feature of the basic version to store form designs and graphic symbols electronically. If the user wishes, the orientation of the printed output can be turned by 90 degrees, depending on the format of the document being printed, to achieve considerable increases in document output.

The 3203-5 interface, developed by BASF, was created in cooperation with OEM suppliers. The connection to the 3203-5 interface facilitates the user's migration to laser technology. In addition, software support is provided from the BASF Software Support Group. Training programs are also offered for the operating personnel.

BASF expects the service life of the most sensitive part of a laser system, the drum, to be a least 1.2 million pages. In early practical tests, lifetime cycles of 5 million pages were recorded. The system works with single-part continuous fanfold paper which is tractor fed. Both the input and the output capacities are 3,000 sheets. The toner is fixed in an environmentally acceptable heat and pressure process. Several character sets are offered in the standard configuration, and others can be added as the user requires.

COMMUNICATIONS

All communications adapters from IBM for the 4300 Series and comparable devices from PCMs can be fitted to the BASF 7 Series. BASF itself does not offer any devices in this area.

SOFTWARE

COMPATIBILITY: Two operating modes are available:

- ECPS:VSE (Extended Control Program Support/Virtual Storage Extended) mode which permits the usage of DOS/VSE in native mode.
- System/370 mode which allows the use of DOS/VSE, VM/370, MVS/SP-JES2, and MVS/SP-JES3.

All IBM program products, as well as compatible programs from other suppliers, can be used.

OPERATING SYSTEMS: Any operating system that complies with IBM 370 or 4300 principles can be run, but for optimum functioning of the 7/6X, BASF recommends one of the following, since these systems use functions that are either directly microcoded in the BASF products or use instructions which are closest to the way the machines are microcoded:

- DOS/VSE
- VM/SP
- MVS/SP
- OS/VS 1

DOS/VSE: This extended disk-resident operating system provides enhancements over the older DOS/VS in the specific areas of processor support, hardware features, device support, usability improvements, and serviceability. It operates with virtual storage, considered a single entity, of up to 16MB.

DOS/VSE supports the System/370 and ECPS/VSE operating modes. When functioning in the ECPS/VSE mode, there is an improvement in efficiency by about 10 percent over other modes. This improvement is achieved by the efficiency of the storage management functions, in which a single-level address translation is incorporated compared with a two-level table lookup in 370 mode.

VM/SP: The Virtual Machine/System Product can be regarded as a superoperating system under which DOS/VSE and MVS/SP can run. The overall effect of having such a superoperating system is to increase the operating efficiency of the suboperating systems by as much as 80 percent. For example, supervisor calls which would normally take place in DOS/VSE are handled by microcoded functions within VM/SP. In other words, a firmware solution is offered for a software overhead problem. This solution is not without cost, since it has been estimated that VM/SP will use about 15 percent of a system's resources.

It is also advisable to run under the VSE/AF package, since without the AF (Advanced Functions), VSE itself is inefficient. The Advanced Functions package makes sure that certain operations, which are unique to 4300 storage management, (and thus also to the BASF machine management) are given to VM/SP to be performed.

MVS/SP: Supporting the ECPS:MVS and System/370 modes, MVS/SP includes the "Cross Memory Service" function which allows simultaneous operation of two addressing areas.

OS/VS 1: The OS/VS 1 operating system supports the System/370 mode.

PRICING AND SUPPORT

PRICING: The following prices apply in Germany only and are not necessarily indicative of prices outside Germany.

EQUIPMENT PRICES

	Purchase Price (DM)
Model 7/63 with 4MB main memory, 1 byte multiplexer channel, 4 block multiplexer channels	430.000
Model 7/65 with 4MB main memory, 1 byte multiplexer channel, 4 block multiplexer channels	520.000
Model 7/68 with 8MB main memory, 1 byte multiplexer channel, 4 block multiplexer channels	730.000
Model 7/69 with 8MB main memory, 1 byte multiplexer channel, 4 block multiplexer channels	930.000
Model 6580 High-Speed Storage System, 128MB	1.000.000
Model 6890 Printing Subsystem (available fourth quarter 1986)	325.000 ■

BASF 7/6X Series

MANAGEMENT SUMMARY

The chief attraction of the BASF 7/6X Series—comprised of the 7/63, 7/65, 7/68, and 7/69—is virtually complete compatibility with IBM's 4300 and 370 series at lower cost, in less space, and with lower power consumption. The BASF machines are based on the Hitachi M240H, using very highly integrated circuits with 64K-bit chips. Excellent reliability is claimed, as all systems are tested at temperature and shock ranges well in excess of those likely to be met in practice.

The organizations most likely to be interested in these BASF products are those looking for an upgrade or replacement for existing IBM 370 or 4300 range systems. The main question in all cases is—is it worth it? Do the cost savings, which can be considerable, especially if non-IBM peripherals are also used, really warrant the risks in dealing with a smaller company with little experience in maintaining mainframes? On a statistical basis, the probability is that the more highly integrated the circuits, the less the likelihood of faults. It is also true that peripherals give more problems than processors, and that those of the electromechanical type (printers and readers, for example) give more trouble than the units with fewer moving parts, and BASF has considerable experience in maintaining peripherals. On this basis, the risks are lower with BASF than with IBM. As far as the software is concerned, there is no doubt about total compatibility.

BASF announced the 7/6X Series in three stages. In Spring 1982, the 7/65 and 7/68 were launched; a new entry-level system, the 7/63, was introduced in Spring 1983; and in Autumn 1984 the top-end 7/69 was announced. The 7/63 is competitive with the IBM 4341 model group 12, while the more powerful models compete with the 4341-2, which is no longer manufactured.

Throughput using the same software and same program is the only real measure of performance, and BASF quotes

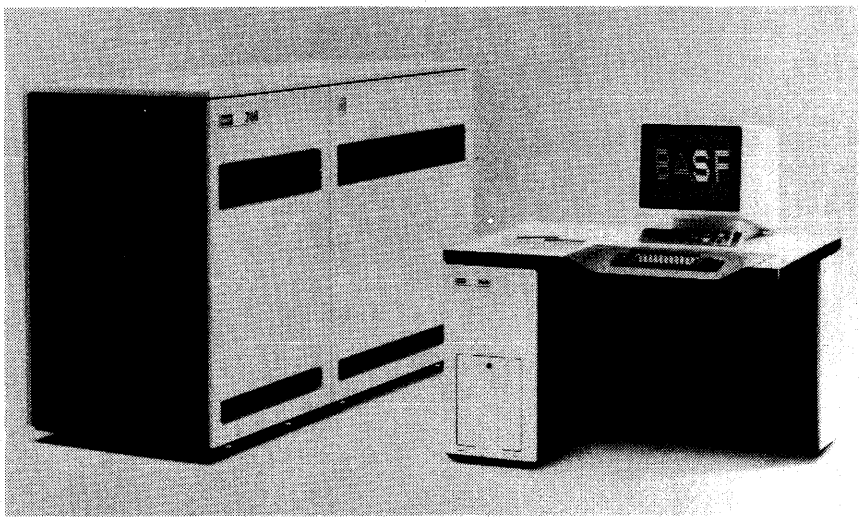
The BASF 7/6X Series contains four-field upgradable models that are compatible with the IBM 4300 and 370 Series at both hardware and software levels. BASF aims to provide improved price/performance over the IBM systems. The BASF machines are Hitachi-based and can use all IBM's peripherals as well as those from plug-compatible manufacturers such as BASF.

MODELS: BASF 7/63, 7/65, 7/68, and 7/69.
CONFIGURATIONS: 1 CPU, from 4MB to 16MB main memory, 1 or 2 byte multiplexer channels, 4 to 10 block multiplexer channels.
COMPETITION: IBM 4300 Series, and other comparable Hitachi-based systems such as NAS Advanced Systems.
PRICE: Purchase prices range from approximately 500.000 DM for an entry level 7/63 to approximately 1,000.000 DM for the top end 7/69.

CHARACTERISTICS

VENDOR; BASF AG, D6700 Ludwigshafen, West Germany. Telephone (621) 601.

COMPANY LOCATIONS: *Argentina*: BASF Argentina SA, Av. Corrientes 327, 1000 Buenos Aires. Telephone (01) 312 94916; *Austria*: BASF Osterreich GmbH, Hietzinger Hauptstr. 119, A-1131 Vienna. Telephone (0222) 82 94310; *Belgium*: BASF Chimie SA, Avenue Hamoir-Iaan 14, B-1180 Brussels. Telephone (02) 375 2400; *Brazil:* BASF Brasileira SA, Industrias Quimicas, Avenida São Luiz 86, 01046 São Paulo SP. Telephone (011) 257 0011; *Finland*: O.Y. Mercantile AB, Viljatie 2, SF-00701 Helsinki. Telephone (0) 354122; *France*: Compagnie Française BASF SA, 140 rue Jules Guesde, 92303 Levallois. Telephone (01) 730 5500; *Netherlands*: BASF Nederland, b.v., Kadestraat 1,



The BASF 7/68, a plug-compatible substitute for the IBM 4341-2, is based on the Hitachi M240H and can support both IBM and BASF peripherals. BASF reports that tests show the 7/68 about twice as fast as the 4341-2 while taking up less space and generating less heat.

BASF 7/6X Series

BASF SERIES 7/6X CHARACTERISTICS

	BASF 7/63	BASF 7/65	BASF 7/68	BASF 7/69
SYSTEM CHARACTERISTICS				
Date of introduction	Spring 1983	Spring 1982	Spring 1982	September 1984
Date of first delivery	June 1983	June 1982	July 1982	December 1984
Number of CPUs per system	1	1	1	1
Principal operating systems	DOS/VSE or VM/SP or MVS/SP or OS/VS1	DOS/VSE or VM/SP or MVS/SP or OS/VS1	DOS/VSE or VM/SP or MVS/SP or OS/VS1	DOS/VSE or VM/SP or MVS/SP or OS/VS1
MAIN STORAGE				
Storage type	NMOS	NMOS	NMOS	NMOS
Read cycle time, nanoseconds	600 approx	600 approx	600 approx	600 approx
Bytes fetched per cycle	8	8	8	8
Minimum capacity, MB	4	4	4	8
Maximum capacity, MB	16	16	16	16
Increment size, MB	2, 4	2, 4	4	4, 8
Error correcting memory	Standard	Standard	Standard	Standard
BUFFER STORAGE				
Capacity, KB	64	64	64	64
Cycle time, nanoseconds	18	18	18	18
CENTRAL PROCESSOR				
Performance, MIPS	1.5	1.8	2.2-2.5	2.5-2.8
Operating Modes	ECPS System/370	ECPS System/370	ECPS System/370	ECPS System/370
Instruction Set	S/370 universal except for multi-processor	S/370 universal except for multi-processor	S/370 universal except for multi-processor	S/370 universal except for multi-processor
Reloadable control storage	Standard	Standard	Standard	Standard
I/O CHANNELS AND ADAPTORS				
No. of BYMUXs	1-2	1-2	1-2	1-2
No. of BLMUXs	4-5	4-6	4-8	4-10
Total maximum no. of channels	7	8	10	12
Maximum channel data rates				
byte multiplexer, KB/sec.	80	80	100	100
block multiplexer, MB/sec.	3	3	3	3
Channel-to-channel adapter	Optional	Optional	Optional	Optional
All other adapters from IBM or PCMs	Can be fitted	Can be fitted	Can be fitted	Can be fitted

BYMUX—byte multiplexer channel
BLMUX—bock multiplexer channel

extensive test figures using this criterion. However, many people are faintly suspicious of such tests. Results are often difficult to interpret and rows of figures don't make interesting reading. The keys to throughput are processor power, channel capabilities, and the performance of the peripherals. In processor performance, the 7/65 is between 30 and 50 percent faster than the 4341-2, and the 7/68 is up to twice as fast, the actual speed depending on what options are added. The channel capabilities favor the BASF products.

All 4 models can be equipped with up to 16M bytes of main memory, ranging from 4M bytes on the 7/63, 7/65, and 7/68, and from 8M bytes on the 7/69. Each system also contains 64K bytes of buffer memory, from which most instructions are accessed. Corresponding IBM 4300 machines also have a maximum of 16M bytes of main memory.

The BASF 7/6X machines can have two byte multiplexer channels, one being standard. The basic configuration of the four models includes four block multiplexer channels,

6811 Arnhem. Telephone (085) 717171; *Spain*: BASF Espanola SA, Paseo de Gracia 99, E-08008 Barcelona. Telephone (03) 215 1354; *Sweden*: BASF Svenska AB, Vretenvaegen 10, S-17154 Solna. Telephone (08) 980840; *Switzerland*: BASF (Schweiz) AG, Appital, CH-8820 Wädenswil/Au. Telephone (017) 839111; *United Kingdom*: BASF United Kingdom Ltd., 4/5 Fitzroy Square, London W1P 6ER. Telephone (01) 388 4200.

MANUFACTURER: Hitachi, Japan.

MODELS: BASF 7/63, 7/65, 7/68, and 7/69.

DATE ANNOUNCED: 7/63: Spring 1983; 7/65, 7/68: Spring 1982; 7/69: September 1984.

DATE OF FIRST DELIVERY: 7/63: June 1983; 7/65: June 1982; 7/68: July 1982; 7/69: December 1984.

NUMBER INSTALLED TO DATE: Approximately 200.

DATA FORMATS

BASIC UNIT: 8-bit byte, representing one alphanumeric character, 2 BCD digits, or 8 bits. Two consecutive bytes

BASF 7/6X Series

optionally increasing to five on the /63, 6 on the /65, 8 on the /68, and 10 on the most powerful /69.

SOFTWARE

Software is rapidly assuming a prime position in most management thinking about computers, hardly surprising when the cost ratio has moved so firmly into the software court and away from hardware. It is also an area where most people don't totally believe plug-compatible manufacturers' claims regarding full functionality of the target manufacturer's software on the plug-compatible machine. So it is worth looking at this area in detail.

On any BASF-Hitachi type machine, microcode is the key to success. Any operating system is going to run better if it is either directly microcoded or can use a set of microcoded instructions. With the 7/6X machines, optimal performance is achieved with certain operating systems. BASF recommends DOS/VSE, VM/SP, MVS/SP, and OS/VSI. Frequently used supervisor functions are executed directly in microcode, rather than at the operating system level. Application programs are also claimed to gain from the resulting decrease in overhead. The overall result is that not only will the IBM 4341 software run, but it will run, in most cases, more effectively than on the original machine.

COMPETITION: With the 7/6X Series, BASF is a competitor to the IBM 4300 Series, in particular the 4341 model group 12 with the 7/63, and the 4341-2 with the 7/65, 7/68, and 7/69. BASF also competes with other plug-compatible manufacturers, such as NAS with its Hitachi-based systems, Amdahl, Burroughs, and Prime.

ADVANTAGES AND RESTRICTIONS

The main advantages of any PCM over IBM is hardware and software compatibility with the relevant IBM machine, in this case the 4300 Series, at reduced price. The BASF 7/6X systems require less space and power and produce a lower heat output than the IBM 4300.

Another important factor is reliability. BASF claims a likely customer figure of 48 months as the mean time between faults. To backup this claim, BASF refers to actual customer installations of machines, saying that these have achieved a 36-month MTBF figure. As a final advantage, BASF says that its installation and upgrade times are significantly less than IBM's.

BASF also markets the 7/7X and 7/8X Series of Hitachi-based PCM systems which cover the IBM 303X and 3081. The full line of BASF machines therefore provides a wide performance range that offers users the possibility of retaining peripherals and some software when purchasing a more powerful system.

USER REACTION

The 1983 Datapro Survey of German Users of Computer Systems brought responses from 6 BASF 7/XX users covering eight systems. Information on 7/6X, 7/7X, and 7/8X

form a half-word of 16 bits and 4 consecutive bytes produce a word of 32 bits.

FIXED-POINT OPERANDS: Operands can range from 1 to 16 bytes (1 to 31 digits plus sign) in decimal mode and one half-word (16 bits) or one word (32 bits) in binary mode.

FLOATING-POINT OPERANDS: In short format, an operand consists of one word with 24-bit fractional part and 7-bit hexadecimal exponent. For extended precision format, 2 words are used, comprising a 56-bit fraction and 7-bit hexadecimal exponent.

INSTRUCTIONS: Instructions are 2, 4, or 6 bytes in length, specifying 0, 1, or 2 memory addresses, respectively.

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

MAIN STORAGE

TYPE: NMOS LSI 64K-bit chips formed into packages, each consisting of 10 layers of glass epoxy, 22 by 42 cm. Sheets preprinted with copper conductors.

The packages are, in turn, inserted in platters, which contain gold coated pin contacts to receive the packages. The basic machine has 2 platters, each of which measures 46 by 42 cm. Extensive testing is carried out at temperatures far in excess of the recommended environmental limits. The platters are also subjected to shock testing. The result is extremely high reliability, according to BASF.

CYCLE TIME: Access time to main memory is 150 nanoseconds. Access time to bipolar cache memory, from which most instructions are fetched, is 18 nanoseconds.

CAPACITY: 7/63, 7/65, 7/68: 4MB to 16MB; 7/69: 8MB to 16MB.

CHECKING: There are 3 mechanisms for error detection. These are:

- **Parity checking on all data paths within the central processor and on all the channels.**
- **A Hamming-code check on all operations in main storage. This automatically ensures that all single-bit errors are corrected and that all multiple errors are detected.**
- **A combined check sum and parity check to detect and correct errors in control storage.**

STORAGE PROTECTION: Protection is facilitated by the use of 2K pages or multiples thereof. There is also separate protection for the lowest address space in memory. These features prevent unauthorized access to programs and data.

CENTRAL PROCESSOR: The 7/63 operates at 1.5 million instructions per second (MIPS), the 7/65 at 1.0 MIPS, the 7/68 at 2.2 MIPS without the optional High Speed Arithmetic (HSA) feature and at 2.5 MIPS with HSA, and the 7/69 performs at 2.5 MIPS without HSA and at 2.8 MIPS with HSA. Central processor cycle times are 60 nanoseconds on the 7/63 and 7/65, 50 nanoseconds on the 7/68, and 43 nanoseconds on the 7/69.

All models are IBM 4341-compatible at both hardware and software levels and are heavily microprogrammed. Microprogram storage requires 144KB divided into 72-bit words. Loading of the microprogram is from 2 double-sided floppy disk drives integrated into the CPU.

machines is included in one table. The average life of the systems was approximately 16 months. Major applications areas included accounting/billing, order processing/inventory control, payroll/personnel, manufacturing, purchasing, and sales distribution.

A database management system was installed on five machines, a communications monitor ran on seven systems, and three systems supported integrated word processing functions.

Significant advantages cited by users included compatibility of software and peripherals carried over from the other systems, as promised by BASF; a good response time; and easy expansion and reconfiguration of the system. The only problem—late delivery of equipment—was noted by one user.

The six users were obviously well satisfied with the BASF machines, for all replied "Yes" to both of the following questions: "Did the system do what you expected it to do?", and "Would you recommend the system to another user?".

Users were asked to evaluate the different aspects of their systems under the headings Excellent, Good, Fair, and Poor. The weighted average obtained is based on a scale of 4.0 for Excellent. The system ratings are summarized in the following table:

Ease of operation	3.17
Reliability of mainframe	3.83
Reliability of peripherals	3.17
Maintenance service:	
Responsiveness	3.50
Effectiveness	3.50
Technical support:	
Troubleshooting	2.83
Education	2.80
Documentation	2.67
Manufacturer's software:	
Operating system	2.75
Compilers & assemblers	3.00
Applications programs	2.33
Ease of programming	2.33
Ease of conversion	2.33
Overall satisfaction	2.30

Weighted averages on a scale of 4 for Excellent, 3 for Good, 2 for Fair, and 1 for Poor. □

The functions of the central processor are:

- **Executing both central and I/O instructions.**
- **Controlling and monitoring channel operations and main storage accesses.**
- **Communicating with the service processor when required.**
- **Facilitating access by the service processor if there is a hardware malfunction.**

All central processors contain all the requisite hardware and microcode to support the unique address structure of the IBM 4300 virtual storage architecture and, in addition, all IBM 370 mode functions.

SERVICE PROCESSOR: The service processor integrated into the CPU on all models, has the following functions:

- **Continuous monitoring of all attached environmental sensors (power, cooling, and humidity).**
- **Monitoring communication between console and CPU.**
- **Error analysis, gathering and recording data on hardware malfunction, and initiating recovery procedures.**
- **Controlling the execution of diagnostic programs.**
- **Initiating and controlling remote (telephone) system support functions.**

CONTROL STORAGE: Consists of 144KB, divided into 16K 72-bit words. Four kilobit bipolar chips are used with an access time of 18 nanoseconds.

BUFFER STORAGE: The high-speed buffer serving as cache memory also uses 4K-bit bipolar chips with an access time of 18 ns. Capacity is 64KB which, BASF claims, will ensure that most instructions will be found in this buffer, rather than main memory.

ADDRESSING: There are 3 forms of addressing used on the BASF 7/6X systems: real, absolute, and logical. In the ECPS/VSE mode, operations take place as if the machine were an IBM 4300 and there is a single-level form of address translation. In the System/370 mode, a 2-level table lookup feature is applied.

Direct addressing of virtual program segments can take place, eliminating any requirement to operate in VSE mode. There is also a dual-address space facility whereby 2 locations can be addressed simultaneously.

DYNAMIC ADDRESS TRANSLATION: Address translation is effected in System/370 mode only. There is no need for it in 4300 mode (strictly speaking, ECPS/VSE mode) because of the direct addressing of virtual program segments.

In 370 mode, the translation between virtual and real addresses is made via a 2-level table lookup. This process is aided by the provision of a Translation Look-Aside Buffer (TLB) which provides 512 address pairs.

INSTRUCTION REPERTOIRE: There are 2 operating modes, the ECPS: VSE (Extended Control Program Support) mode for 4300 operations, and the System/370 mode. In the 4300 mode there are 187 instructions available and in the 370 mode, 183 instructions. The Universal 370 instruction set is included.

The instruction set includes complete arithmetic facilities for processing variable-length decimal and fixed-point binary operands, as well as instructions which handle loading, storing, comparing, branching, shifting, editing, radix conversion, code translation, logical operations, packing and unpacking. In addition, a group of "privileged instructions" usable only by the operating system, handles input/output and various hardware control functions.

Also standard are some instructions that were optional on some models of the System/370. These include the dynamic address translation instructions of the Load Read Address, Reset Reference Bit, Purge Translation Look-Aside Buffer, Store Then AND System Mask, and Store Then OR System Mask; the VTAM support instruction of Compare and Swap and Compare Double and Swap; the OS/VS support instructions of Insert PSW Key, Set PSW Key from Address, and Clear I/O; the extended precision floating point instructions; and multiply/add.

BASF 7/6X Series

The only instructions which are not supported in 370 mode are the multiprocessor instructions.

INSTRUCTION TIMES: BASF has carried out extensive benchmark and other tests on the 7/6X machines. These have involved carefully chosen mixes of instructions for system, commercial and scientific applications. In each mix, the weight given to each instruction, and whether a branch is taken, is specified. Details of these mixes can be obtained from BASF.

INTERRUPTS: Classes of interrupts include I/O, external, program, supervisor call, machine check, and restart. Classes of interrupts are distinguished by the storage locations at which the old program status word (PSW) is stored and from which the new PSW is fetched.

BASF says that because of buffering on all channels, there are fewer interrupts than on the IBM systems.

SYSTEM CONSOLE: The console consists of a 14-inch, 4-color CRT display with separate keyboard. An option is a hard-copy printer. The keyboard has 87 keys which include 12 program function keys. The CRT display is a standard 80-character by 25-line display with an extra line for showing systems status. It can be connected up to 33 meters from the central processor.

PHYSICAL SPECIFICATIONS

The 7/63 and 7/65 central cabinets each measure 1.3 by 1.2 by 0.8 m^3 (height x width x depth) and weigh 550 kg.

The central cabinet of the 7/68 and 7/69 have the following dimensions: 1.3 by 2.0 by 0.8 m^3; and weigh 782 kg.

Operating temperatures for all models should be between 10 and 32 degrees Celsius.

INPUT/OUTPUT CONTROL

I/O CHANNELS: All models include as standard one byte multiplexer channel (BYMUX) and 4 block multiplexer channels (BLMUX), and can support one additional BYMUX. The 7/63 can optionally support 5 BLMUXs, the maximum is 6 on the 7/65, the 7/68 supports up to 8 BLMUXs, and the 7/69 optionally includes a total of 10.

The BYMUXs have a data transfer rate of 80KB per second on the 7/63 and 7/65, and 100KB per second on the 7/68 and 7/69. BLMUXs on all models operate at 3MB per second. A datastreaming facility is standard on all BLMUXs. The average data transfer rate is 12MB per second on the 7/63, 13MB per second on the 7/65, 16MB per second on the 7/68, and 22MB per second on the 7/69.

Each of the byte and block multiplexer channels has 256 subchannels. Each channel also has a 1024-byte buffer. Data transfer between channel and main storage is accomplished in blocks of 32 or 64 bytes. The method of attaching controllers and thus peripheral devices is exactly the same as on the IBM 360 and 370 series. Each channel can support up to 8 controllers which can be cluster controllers. Each of the 256 subchannels can be, in effect, a specific device. Any IBM or IBM-compatible peripherals may be used, the latter including the wide range of peripherals offered by BASF.

CONFIGURATION RULES

MODEL 7/63: The basic configuration includes a central processor with 4MB of main memory, 1 BYMUX and 4 BLMUXs, each with 256 subchannels, and a system console unit, comprising a VDU and separate keyboard. Integrated in the central processor are 2 double-sided floppy disk drives for microcode loading, and a service processor. Main memory can be expanded to 16MB in increments of 2MB and 4MB. One further BYMUX and one additional BLMUX can be supported.

MODEL 7/65: The standard configuration comprises a central processor, 4MB of main memory, 1 BYMUX, 4 BLMUXs, a system console, and 2 double-sided floppy disk drives. Options for the 7/65 include an expansion of main memory in 2MB and 4MB steps up to a maximum capacity of 16MB, a second BYMUX, and 2 additional BLMUXs.

MODEL 7/68: The standard configuration consists of a central processor, 4MB of main memory, 1 BYMUX, 4 BLMUXs, and twin double-sided floppy disk drives. There is a VDU console with keyboard. Main memory can be increased in 4MB steps to 16MB. The number of BYMUXs can be increased to 2, and the number of BLMUXs to 6.

MODEL 7/69: This model contains a central processor with 8MB of main memory, 1 BYMUX, 4 BLMUXs, a system console, and 2 double-sided floppy disk drives. Expansion possibilities include increasing main memory to 16MB in increments of 4MB and 8MB, and the addition of a second BYMUX and 6 extra BLMUXs.

Other options for all models are:

- A console printer.
- The so-called direct control feature, which interfaces directly with another compatible central processor or peripheral to enable data exchange to take place with the minimum delay.
- A channel-to-channel adapter which facilitates the exchange of data between CPUs via byte or block multiplexer channels.
- Additional channel control units.
- High-Speed Arithmetic (HSA) which accelerates execution of floating point and fixed point arithmetic instructions with a performance improvement of up to 15 percent (available on all 7/6X models).
- An I/O diskette drive with IBM 3540-compatible data recording format (manual diskette feed).

MASS STORAGE

All IBM mass storage devices for the 360, 370, and 4300 Series can be fitted to the BASF 7/6X Series. Comparable peripherals from PCMs, including BASF, may be used. The BASF disk drives are:

BASF 6240, 6240F, 6242: Compatible respectively with the IBM 3340A2, the 3340A2F, and 3340B2, these drives can be connected via either the IBM DASD adaptor to the 4331 or via the IBM 3830; or BASF 6038 or 3880 Model 1 storage control to the 4341; or with the IBM 3830 or BASF 6038 to the BASF 7 Series. Cacacity of the 6240, 6240F, and 6242 is 70MB per spindle with one or two spindles. Average access time for all three models is 20 ms, average rotational delay is 10 ms, and the transfer rate is 885KB/second.

BASF 6244: Compatible with the IBM 3344, this drive can be connected via either the IBM DASD adapter to the 4331 or via the IBM 3830, BASF 6038 or IBM 3880 Model 1 storage control to the IBM 4341; or via the BASF 6038 or IBM 3830 to the BASF series machines. Capacity is 280MB per spindle with either one or two spindles. Average access time is 20 ms, rotational delay is 10 ms, and the transfer rate 885KB/second.

BASF 7/6X Series

BASF 6250, 6250F, 6252, 6252F, 6253, 6253F: These 6 drives are compatible, respectively with the IBM 3350A2, 3350A2F, 3350B2, 3350B2F, 3350C2, and 3350C2F. The main drive is either the 6250 or the 6253. The BASF 6250, a two-drive unit with a capacity of 317.5MB per drive, also provides the logic and power for the attachment of either three 6252s/6252Fs or up to two 6252s/6252Fs, and/or one 6253/6253F. The 6253 also is a twin drive unit with a capacity of 317.5MB per drive, but it can function as either a 6250 or a 6252 through setting a manual switch. The 6253F is the same as the 6253 except it has a fixed head which offers immediate access (zero access time) to up to 1,144,140 bytes of data. The 6252, of which either two or three can be connected to a 6250, has a capacity of 317.5MB per drive. The 6252F is exactly the same as the 6252, apart from the availability of 1,144,140 bytes of immediate access storage. The average access time of all these drives is 20 ms, the rotational delay averages 8.4 ms and the transfer rate is 1198KB/second. The controller is either the IBM 3830 Model 2 storage control or the IBM 3880 Model 1 storage control when connected to the 4341 or 4331, and the BASF 6038 or the IBM 3830 Model 2 for connection to the BASF 7 Series computers.

BASF 6470/6472: Compatible with the IBM 3370, the 6470 and 6472 units can be attached to BASF 7/6X Series, and IBM 4341, 4361, and 4381 systems using the IBM 3880 Model 1, 2, or 4. Connection to the IBM 4331 and 4361 is also possible through the DASD adapter. The disk unit has one spindle with a capacity of 570MB. The average access time is 20 ms, and the transfer rate is 1859KB/second. The two units are specifically compatible with the IBM 3370 A01 (BASF 6470) and IBM 3370 B01 (BASF 6472).

BASF 6470-2/6472-2/6473-2: Compatible with IBM 3370-2. Connection to BASF and IBM systems is as for BASF 6470/6472. The disk unit has one spindle with a capacity of 730MB. The average access time is 19 ms, and the transfer rate is 1859KB/second. The units are specifically compatible with IBM 3370 A02 (BASF 6470-2), and IBM 3370 B02 (BASF 6472-2). The BASF 6473-2 has no IBM equivalent and allows, as the last unit in a string, increased performance by using the "Cross Call" feature.

BASF 6475/6476/6477: Compatible with the IBM 3375, the units can be attached to BASF 7/6X Series, and IBM 4341, 4361, and 4381 systems using the BASF 6085-1 or IBM 3880 Models 1, 2, or 4 disk controllers. The disk unit has 1 spindle with a capacity of 820MB. The average access time is 19 ms, and the transfer rate is 1859KB/second. The units are specifically compatible with the IBM 3375 A01 (6475), IBM 3375 B01 (6476), and IBM 3375 D01 (6477).

BASF 6480/6481: Compatible with the IBM 3380. This model attaches to BASF 7/6X, 7/7X, and 7/8X, and IBM 4341, 4361, 4381, 303X, or 308X systems via the BASF 6085-7 control unit. The 6480/6481 has 2 drives per unit, each with a capacity of 1260MB. Average access time is 25 ms. The transfer rate is 3MB/second.

INPUT/OUTPUT UNITS

Most of the IBM Systems 360, 370, 4300 and 303X Series peripherals can be linked to the 7/6X Series, together with devices from PCMs, such as BASF, which is already very well-established in the peripherals area.

The IBM devices which can be connected include those detailed in the Input/Output Devices section of the report on the IBM 4300 Series (70C-504MK-301).

The BASF peripheral units which can be linked to the 7/63, 7/65, 7/68, and 7/69 include the following tape units and printers:

BASF 6060/636X COMPACT MAGNETIC TAPE SUBSYSTEM: The 6060 is the controller and the 636X the magnetic tape drive. The drive is compatible with IBM's 3420 Models 4 and 6. The 6060 control unit can have switching to enable it to access up to 16 tape drives, and for the unit to be linked to two channels, automatic threading is standard. The 636X tape drive is either the 6364 or the 6366 unit. The recording density in each case is either 6250 bpi in Group Coded Recording (GCR) or 1600 bpi in PE. Data transfer rates are: 500KB/sec. for the 6364 at 6250 bpi and 128KB/sec. at 1600 bpi; 780 KB/sec. for the 6366 at 6250 bpi and 200KB/sec. at 1600 bpi.

BASF 6050/6358 MAGNETIC TAPE SUBSYSTEM: The 6050 is the controller and the 6358 the magnetic tape drive. The drive is compatible with IBM's 3420-8. The recording density is either 6250 bpi in GCR or 1600 bpi in PE. Data transfer rates are 1250KB/sec. at 6250 bpi and 320KB/s at 1600 bpi.

Other peripherals offered for the 7/6X by BASF are the 6603 and 6606 line printers.

BASF 6603 LINE PRINTER: This has its own integrated controller. The printer is compatible with the IBM 3203-5 and operates at 1250 lines per minute with a 48-character set. The unit uses a print band which is mounted as a separate device to facilitate changing. Among the advantages of this printer are: microprogrammed self-diagnostics; microprocessor management of the printing process, paper feed, ribbon feed buffer, and transfer of data between channel and printer; and paper feed under program control. Paper particles and dust are removed continuously during printing by a vacuum system. A major advantage claimed is that the printer is silent because of a cover that encloses the printer and the powered stacker. Using an OCR print band, the printout is OCR-readable.

BASF 6606 LINE PRINTER: Compatible with the IBM 3203-5. It prints 2000 lines per minute using a 48-character set, 1640 lpm with a 64-character set, 1200 lpm with a 96-character set, and 950 lpm with a 128-character set. Its features are the same as for the 6603, including OCR capability. The 6606 uses the same print bands and print ribbons as the 6603.

COMMUNICATIONS CONTROL

All communications adapters from IBM for the 4300 Series and comparable devices from PCMs may be fitted to the BASF 7 Series. BASF itself does not offer any devices in this area.

SOFTWARE

COMPATIBILITY: Two operating modes are available:

- ECPS:VSE (Extended Control Program Support/Virtual Storage Extended) mode which permits the usage of DOS/VSE in native mode.
- System/370 mode which allows the use of DOS/VSE, VM/370, MVS/SP-JES2, and MVS/SP-JES3.

All IBM program products as well as compatible programs from other suppliers may be used.

OPERATING SYSTEMS: Any operating system that complies with IBM 370 or 4300 principles can be run, but for optimum functioning of the 7/6X, BASF recommends one of the following, since these use functions that are either directly microcoded in the BASF products or use instructions which are closest to the way the machines are microcoded:

BASF 7/6X Series

- DOS/VSE
- VM/SP
- MVS/SP
- OS/VS 1

DOS/VSE: This extended disk resident operating system provides enhancements over the older DOS/VS in the specific areas of processor support, hardware features, device support, usability improvements and serviceability. It operates with virtual storage, considered a single entity, of up to 16MB.

DOS/VSE supports the System/370 and ECPS/VSE operating modes. When functioning in the ECPS/VSE mode, there is an improvement in efficiency by about 10 percent over other modes. This is effected by the efficacy of the storage management, where there is a single-level address translation compared with a two-level table lookup in 370 mode.

More detailed information on this and the following operating systems can be found in the Datapro IBM 4300 Series Report (70C-504MK-301).

VM/SP: The Virtual Machine/System Product can be regarded as a superoperating system under which DOS/VSE and MVS/SP can run. The overall effect of having such a superoperating system is to increase the operating efficiency of the suboperating systems by as much as 80 percent. For example, supervisor calls which would normally take place in DOS/VSE are handled by microcoded functions within VM/SP. In other words, a firmware solution to a software overhead problem. This is not without cost, since it has been estimated that VM/SP will use about 15 percent of a system's resources.

It is also advisable to run under the VSE/AF package, since without the AF (Advanced Functions), VSE itself is inefficient. The Advanced Functions package makes sure that certain operations, which are unique to 4300 storage management (and thus also to the BASF machine management) are given to VM/SP to be performed.

MVS/SP: This supports the ECPS:MVS and System/370 modes. MVS/SP includes the "Cross Memory Service" function which allows simultaneous operation of 2 addressing areas.

OS/VS 1: The OS/VS 1 operating system supports the System/370 mode.

PRICING: The following prices apply in Germany only and are not necessarily indicative of prices outside Germany.

EQUIPMENT PRICES

	Purchase Price (DM)
MODEL 7/63 with 4MB main memory, 1 byte multiplexer channel, 4 block multiplexer channels.	522.000
MODEL 7/65 with 4MB main memory, 1 byte multiplexer channel, 4 block multiplexer channels.	637.000
MODEL 7/68 with 8MB main memory, 1 byte multiplexer channel, 4 block multiplexer channels.	836.000
MODEL 7/69 with 8MB main memory, 1 byte multiplexer channel, 4 block multiplexer channels.	932.000 ■

BASF 7/6X Series

Product Enhancement

BASF have now rounded out the 7/6X series with the addition of the 7/63 to the 7/65 and 7/68. The 7/63 now represents the bottom end of this series and is competitive with the IBM 4341 model group 12. It can be regarded as a scaled-down 7/65 with somewhat less processor performance (1.5 million instructions/sec. mips against the 7/65's 1.8 mips) but with virtually the same I/O performance.

As with the rest of the 7/6X series, the 7/63 is compatible with most IBM products and, in particular, with the models in the 4300 series. The 7/6X series including the 7/63, will have a dual address space possibility and will run in ECPS/VSE mode, in System 370 mode, and in ECPS/MVS.

The main memory capacity of the 7/63 extends from a basic two megabytes to eight megabytes in two megabyte increments. The standard 7/63 has four Block Multiplexer Channels and one Byte Multiplexer Channel. This can be extended by either an extra Byte Multiplexer Channel or an extra Block Multiplexer Channel. Thus the maximum configuration can be either four Block-MPXs and two Byte-MPXs or 5 Block-MPXs and one Byte-MPX. The maximum data rate is 12 megabytes a second.

As with the other two members of the series, the 7/63 uses the latest technology in the form of 64K-bit chips with an average access time of 150 nanoseconds together with a buffer of up to 64K bytes with an average access time of 18 nanoseconds.

The remaining features of the 7/63 are identical with the other members of the series.

At the time of writing no prices of the 7/63 are available from BASF.