

IBM Magnetic Tape Subsystems

MANAGEMENT SUMMARY

UPDATE: *IBM has made no changes to its line of tape drives and tape subsystems since we last updated this report. The older 3410/3411 tape drives are no longer in new production, and are available only on a limited basis. The 3420 series' availability was changed this summer from "limited new production," to "new product not available," but the market for this drive is still flourishing.*

The IBM 3420/3803 Tape Drive/Controller System has been and still is the most popular tape system in use today. Used as an input and output device for processing, archiving, backup of data files, and for convenient production of off-site storage files, this system has a proven record of reliability and user satisfaction. With the introduction of the 3480 Cartridge System in the spring of 1984, and the downgrading of the 3420 Series to "new product not available," IBM began a campaign of converting its user base to the new 3480 Cartridge Drive. When IBM began shipments of the 3480, the prices for used 3420s began to drop rapidly.

IBM's cartridge tape subsystem is designed to handle all of the normal tape requirements including processing, backup, journaling, archiving, and interchange. Featuring thin film read/write heads and a chromium dioxide-based tape medium, the 3480 has a linear density of 38,000 bits per inch (bpi), provides up to 20 percent more data storage, takes up half the floor space of the older 3420, and requires 60 percent less power and cooling capacity.

Although the 3480 introduction indicates IBM's movement towards a family of cartridge-based products, the high end of the older reel-to-reel magnetic tape subsystems have not been rendered completely obsolete. The production status of the low-end 3420 Models 3, 5, and 7 is in question because of its declining user base; the lower linear densities, ➤

IBM's family of magnetic tape subsystems consists of the 3420 and 3430 reel-to-reel tape units and the 3480 cartridge tape subsystem. The 3480 tape subsystem uses a chromium dioxide coating on the tape media, a thin film read/write head, and a linear density of 38,000 bpi.

MODELS: 3420 Series tape drives: 3420-3, 3420-4, 3420-5, 3420-6, 3420-7, and 3420-8; tape controller: 3803-1, 3803-2. 3430 Series tape drives: 3430 Model B01; tape controller: 3430 Model A01 includes one tape drive. 3480 cartridge tape drive: 3480 Model B22 includes 2 tape drives; tape controller: 3480 Model A22.

CONFIGURATION: Please refer to the Characteristics section for detailed information.

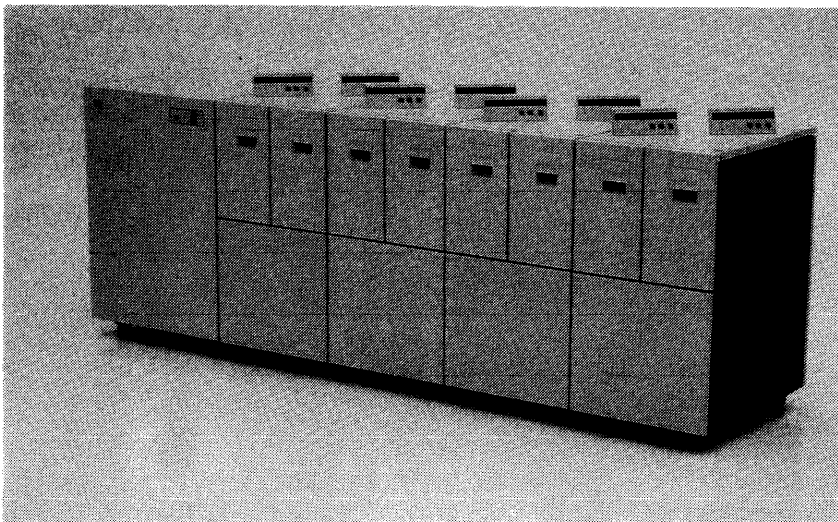
COMPETITION: Reel-to-reel tape subsystems: StorageTek 4600 Series; Memorex 3220 and 3260 Series; Telex Series 80; and NAS 7803/7420. Cartridge tape subsystem: MegaTape cartridge tape subsystem.

PRICING: Purchase prices for tape drive units range from \$11,930 to \$43,120, and purchase prices for control units range from \$20,080 to 65,430.

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, Old Orchard Road, Armonk, New York 10504. Contact your local IBM representative.

MODELS: 3420-3, 3420-4, 3420-5, 3420-6, 3420-7, 3420-8, 3430, and 3480 Model B22. ➤



The 3480 cartridge tape subsystem offers improvements in performance and reliability while featuring an innovative design which requires less floor space, and power and cooling capacity.

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TABLE 1. CHARACTERISTICS

Model	3420-3	3420-4	3420-5	3420-6
Density (bits/inch)	556/800/1600	1600/6250	556/800/1600	1600/6250
Recording Mode	NRZI/PE	PE/GCR	NRZI/PE	PE/GCR
Data Transfer Rate (bytes/second)	41.7K/60K/120K	120K/470K	69.5K/100K/200K	200K/780K
Tape Speed (inches/second)	75	75	125	125
Number of Tracks	7 and 9	9	7 and 9	7 and 9
Rewind time (seconds)	60	60	60	60
Rewind/Unload Time (seconds)	66	66	66	66
Auto Loading Time (seconds)	10	10	10	10
Read (msec.)	4.0	2.3/4.0	2.9	1.6/2.6
Write (msec.)	4.0	2.1/3.0	2.9	1.5/2.0
Processor Attachment	303X, 43XX, 308X, 3090, and IBM plug-compatible	303X, 43XX, 308X, 3090, and IBM plug-compatible	303X, 43XX, 308X, 3090, and IBM plug-compatible	303X, 43XX, 308X, 3090, and IBM plug-compatible

Data transfer rates for all models are given in ascending linear density order; i.e., 556 bpi, 800 bpi, 1600 bpi, and 6250 bpi. All rewind times are for a 2400-foot reel.

▷ at which the data is recorded; and the decreasing use of NRZI type recording. The high-end 3420 Models 4, 6, and 8, although changed from "limited new" to "new product not available" production, have a large installed base that ensures the continued availability for some time to come. Users can still get 3420 field upgrades which include multitrack error correction and the ability to intermix 9-track, 7-track, 6250, 1600, 800, and 556 bpi on the same 3803 Model 2 control unit.

The 3430 Magnetic Tape Subsystem offers an upgrade path for the older, less powerful 3410s, 8809s, and 3420 Model 3 units. The 3430 provides a maximum data rate of 80K/312.5K bytes per second and features a microdiagnostics package for off-line error diagnosis and repair verification.

The reel-to-reel magnetic tape product line is rounded out with the low-end 3410 and 8809 tape units. Both of these units are no longer in new production, but are still available on a limited basis.

COMPETITIVE POSITION

The majority of the competitive effort aimed at IBM is concentrated on plug-compatible replacements for the 3420. StorageTek has had its problems keeping its financial head above water and competes with IBM only at the high end with its 4600 Series. StorageTek offers better performance than the 3420 and only the 3480 cartridge drive can better the 1.3MB per second data transfer rate of the StorageTek 4674.

Another plug-compatible challenger vying with IBM for tape dollars is Memorex. Memorex's 3220 and 3260 compete directly with the 3420 Models 4, 5, 6, and 8. The 200-inch-per-second tape speed of the 3227 and 3228 surpasses all but IBM's 3420 Models 7 and 8. Memorex's Tape Maintenance Monitor is a feature which counts the unsuccessful attempts to write on a reel of tape, and indicates when the count has exceeded a predetermined number.

The remaining plug-compatible vendors, Telex and NAS, compete well with IBM on a price/performance basis; ▷

▶ **CONTROLLERS:** IBM Model 3803-1 can be used with 3420-3, 3420-5, and 3420-7; IBM Model 3803-2 can be used with 3420-4, 3420-6, 3420-8, and IBM 3480 Model A22 control unit.

COMPUTERS INTERFACED: IBM 43XX, 308X, 3090, and IBM plug-compatibles.

CONFIGURATION: The 3420 Magnetic Tape Subsystem consists of a 3420 tape unit Model 3, 5, or 7 for use with a 3803-1 tape controller, or a 3420 tape unit Model 4, 6, or 8 with a 3803-2 tape control unit. A 3803 tape control without any switching features controls up to eight 3420 tape units. Switching options enable up to 16 tape drives to be switched among 2, 3, or 4 control units.

The minimum configuration for the 3430 Magnetic Tape Subsystem is one Model A01 which includes a tape control unit and one tape unit. Model B01 is a tape unit only that works with up to two additional B01s, all directly attached to the Model A01 for a total of four drives.

The minimum configuration of an IBM 3480 Cartridge Drive Subsystem is one A22 control unit and one 3480 B22 tape unit. A fully configured 3480 Subsystem includes up to eight B22 tape units (16) and two 3480 A22 control units.

PHYSICAL CHARACTERISTICS: The dimensions and weights of IBM's tape drives, controllers, and tape subsystems 3420, 3803, 3430, and 3480 are as follows:

	Width (in.)	Ht. (in.)	Depth (in.)	Wt. (lb.)
3420 Models 3/5/6/7/8	67.0	29.5	30.0	800
3803 Models 1/2	60.0	28.0	30.0	600
3430 Model A1	39.0	30.0	33.0	470
3430 Model B1	39.0	30.0	33.0	340
3480 Model A22	39.5	26.0	39.5	430
3480 Model B22	39.5	26.0	39.5	340

PERFORMANCE: The basic performance characteristics of the IBM Tape Subsystems are outlined in Table 1.

SYSTEM FEATURES: All models of the 3420 Magnetic Tape Subsystem feature automatic threading, rewinding, and unloading operations; read-back checking; full-width erasure; and GCR (group-coded recording) for improved read/write reliability. All 3420 models include a single direct-drive capstan motor which moves tape forward or backward. ▶

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TABLE 1. CHARACTERISTICS (Continued)

Model	3420-7	3420-8	3430-A1/B1	3480-A22/B22
Density (bits/inch)	556/800/1600	1600/6250	1600/6250	38,000
Recording Mode	NRZI/PE	PE/GCR	PE/GCR	GCR
Data Transfer Rate (bytes/second)	111.2K/160K/320K	320K/1250K	80K/312.5K	3000K
Tape Speed (inches/second)	200	200	50	79
Number of Tracks	7 and 9	7 and 9	—	18
Rewind time (seconds)	45	45	162	48
Rewind/Unload Time (seconds)	51	51	—	—
Auto Loading Time (seconds)	7	7	—	—
Read (msec.)	2.0	1.1/1.7	6.0	—
Write (msec.)	2.0	0.95/1.3	6.0	—
Processor Attachment	303X, 43XX, 308X, 3090, and IBM plug- compatibles	303X, 43XX, 308X, 3090, and IBM plug- compatibles	303X, 43XX, 308X, 3090, and IBM plug- compatibles	303X, 43XX, 308X, 3090, and IBM plug- compatibles

Data transfer rates for all models are given in ascending linear density order; i.e., 556 bpi, 800 bpi, 1600 bpi, and 6250 bpi. All rewind times are approximate, and for a 2400-foot reel.

▷ however, IBM's aggressive marketing stance and policy of strategic price reduction enables it to maintain a solid position with respect to its plug-compatible peripheral competition.

The control that IBM exerts over the tape drive marketplace was reinforced with the 3480 announcement. As yet none of the plug-compatible peripheral vendors have introduced a viable competitor to challenge the 3480. According to a spokesman for Cipher Data Products (a subsidiary of Control Data Corporation), the main problem that manufacturers are having with the 18-track cartridge system is the critical alignment of the thin film heads. Because the tracks are so close together, keeping the heads in alignment under production conditions is the key. As it is unlikely that IBM will make that critical manufacturing expertise available, or OEM the 3480 in the foreseeable future, PCM's and independents will have to go their own way in developing a workable system. For the present users who don't buy IBM will have to be content with the offering from MegaTape. So far it is the only vendor who has a high-end cartridge offering. Megatape Corporation currently markets a 1/2-inch cartridge tape drive that provides similar storage capacity and data transfer rate to the 3480.

As the predominant manufacturer of data processing equipment in today's market, IBM has a distinct advantage over its competition. Other vendors follow closely on the heels of IBM and attempt to gain a competitive edge vis-à-vis offering slightly higher performance at less cost, and/or repackaging the equipment in a smaller footprint. IBM, on the other hand, has a long established track record of technological breakthroughs and setting de facto standards against which all other products are compared. As long as IBM continues to lead the technological and marketing parade, PCMs and independents will be required to fall into step.

For a fuller discussion of IBM plug-compatible tape drives, see *All About Mainframe Tape Drives* in this volume of Datapro 70.

▶ Air bearings diminish friction and tape wear due to the fact that the oxide tape surface only has contact with the read/write head, the erase head, and the tape cleaner. Short, tapered vacuum columns have been designed to lessen tape inertia when starting and stopping tape.

A two-gap read/write head which allows read-back checking during a write operation provides multitrack error correction simultaneously. In addition, 9-track, 1600 bpi, phase-encoding operation enables data to be recorded parallel by bit, serial by byte, and at 1600 bpi. The data format uses eight of the 9 bits for data with the ninth bit representing a parity bit. Dual-density, single-density, and 7-track features are associated with 3420 Models 3, 5, and 7. The dual-density feature permits the tape unit to operate at 800 bpi NRZI 9-track and at 1600 bpi PE. The single-density feature allows the tape drive to read or write tapes at 1600 bpi PE. Enabling the tape unit to function at either 556 or 800 bpi NRZI, the 7-track format feature is compatible only with specific tape units equipped with 7-track heads.

The three device-switching options available with the 3420 tape subsystem are a two-control switch which supports 2-by-8 and 2-by-16 configurations, a three-control switch which handles 3-by-8 and 3-by-16 configurations, and a four-control switch which maintains 4-by-8 and 4-by-16 configurations. Each device switch feature requires a communicator for sending tape unit selection and device interface signals to one of two device switches. An optional two-channel switch feature allows the 3803 tape control unit to be accessed by a second channel. This two-channel switch can also be used for sharing a tape control between two systems.

The 3420 Models 4, 6, and 8 contain several enhancements over Models 3, 5, and 7. Among these additional capabilities are improved access times, automatic read amplification, a new tape cleaning mechanism, and 6250 bpi or 6250-1600 bpi density features. The 6250 density feature allows the tape unit to operate at 9-track 6250 bpi. The second density feature, 6250/1600, supports operation at 6250 bpi density as well as 1600 phase-encoded density. This feature cannot be installed with the aforementioned 6250 density feature. Model conversions are available which allow 3420 Models 3, 5, and 7 to be converted to 3420 Models 4, 6, and 8.

▶ The 3430 Magnetic Tape Subsystem is intended as a growth path alternative for users of the older 8809, 3410/3411, and 3420 Model 3 tape units. Improved reliability due to 6250 bpi density group-coded recording, expanded use of integrated circuitry, and enhanced microdiagnostics are among the

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▷ ADVANTAGES AND RESTRICTIONS

The 3480 offers the user improvements in design, performance, reliability, and serviceability. Because of its design, it requires less space, power, and maintenance. Among its more interesting innovations is a simplified cleaning procedure designed to enhance serviceability. Maintenance requirements for the 3480 have been reduced to once-a-week. This advantage, plus others, including higher recording densities, the thin film read/write head, the advanced chromium dioxide media, and expanded performance and throughput, has propelled the 3480 into the tape drive spotlight. However, there will be a substantial number of users who will be unwilling to convert their existing reel-to-reel libraries to cartridges. Confronted with no upgrade path for their existing tape drives, these current IBM users will most likely be reconfiguring their older units. Used IBM equipment has become something of a commodity as low- and mid-range users not needing all of the 3480's capabilities, but wanting more powerful 3420 models, infiltrate the market. Since the market value of existing 3420 tape drives will increase, the availability may go down while prices remain high.

The other members of IBM's reel-to-reel tape family, the 3410, 8809, and 3430, will continue to lose market value, while the 3430, with its microdiagnostics package, retains a highly competitive position against the PCMs. Overall, the future of the plug-compatible market will most likely be targeted against the 3480 instead of the older reel-to-reel models. □

▶ advanced features found in the 3430. The IBM 3430 Magnetic Tape Subsystem is a half-inch tape system that reads and writes data at 50 inches per second. During a write operation, both parity and signal amplitude are checked. During a read operation, parity is checked.

The microdiagnostics package available with the 3430 is controlled by a microprocessor in the Model A that executes various system checks. This diagnostic program examines the subsystem each time the subsystem power is turned on. In addition, each time a reel of tape is loaded onto a tape unit, a diagnostic program tests the tape unit logic and the data paths between the tape control and tape unit. All system errors are identified, coded, and analyzed before sending the information to the host processor. Temporary errors are logged in the host processor. Another 3430 capability is a Multiple Drive Attachment feature that can be used when the number of tape units in a string of units exceeds two tape units.

Touted as IBM's landmark system, the *3480 Cartridge Drive Tape Subsystem* uses an 18-track recording format on half-inch tape contained within a new magnetic tape cartridge. Standard and optional features combine to provide large-system users with improved recording densities, increased reliability and serviceability, along with enhanced

performance. The 3480 features a thin film read/write head and chromium dioxide tape media. The new media is encased in a cartridge that is approximately 4 by 5 by 1 inches. A file-protect thumbwheel selector has been incorporated into the cartridge case. Providing performance advantages over the more commonly used ferric oxide media, this new technology enables user data to be recorded at a data rate of 3 million bps and a linear data density of approximately 38,000 bpi.

Within each Model B22 tape unit is a microprocessor that controls several new tape functions. One new function is a High-Speed Search feature which allows the drive to move at twice the normal speed while searching for a desired block of data. Another new drive function is a reel-to-reel design which eliminates the need for capstans, vacuum columns, and reflective markers associated with previous IBM tape subsystems. The utilization of digital servo control and new head technology along with the addition of a new error correction code are designed to provide improved data reliability. A third capability available with the IBM 3480 operating in full-function mode is an eight-character message display that informs the operator with the volume serial number information, drive activity messages, and repair action information to assist in problem diagnosis.

The 3480 control unit, Model A22, incorporates a 512K-byte buffer to dynamically manage the data flow between channels and tape drives. This buffer is partitioned among the attached active drives under internal buffer-management control. During read-mode operations, the availability of this buffer allows the control unit to grant responses to host Read commands by prereading multiple data records, from drives, into the buffer. On the other hand, multiple data records can be transferred from the host processor to the control unit's buffer at channel speeds during write-mode operations. The inclusion of this read/write buffering feature results in improved channel utilization. In addition, the Model A22's microprocessor can start error recovery actions for both read and write operations. This built-in microprocessor also handles the interpretation of channel commands, the control of data flow, and the management of buffer operations. With an optional Dual Control Unit Communications Coupler, two 3480 control units can be attached together to monitor and balance the workload of this larger, combined system.

Two modes of writing can be chosen when using a 3480 Tape Subsystem: Buffered Write Mode and Tape Write Immediate Mode. The Buffered Write Mode indicates task completion once the data transfer has been validated. The subsystem then handles all error recovery actions needed to physically write the data block on tape. Tape Write Immediate Mode is provided for data file creation applications requiring system connection until the data has been written to tape and verified by the control unit. Other 3480 features include an enhanced error correction method for reducing read errors called Adaptive Cross Parity and a Processor Assignment function which allows drives to be reserved to a particular host system (or group of systems) in a multisystem installation.

PRICING AND SUPPORT: The IBM Reel-to-Reel Tape Models 3420 and 3430 are available on a lease, rental, or purchase basis. The 3480 cartridge tape is available on a rental or purchase basis. With the 3480, 20 percent of the monthly rental charge during the first six months following installation is applied as a credit toward purchase. Monthly maintenance charges support 24-hour, 7-day per week maintenance service. ▶

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EQUIPMENT PRICES

		Purchase Price (\$)	Monthly Maintenance (\$)	Monthly Rental (\$)	2-Year Lease (\$)
3420 Series					
003	Magnetic Tape Unit	11,930	266.00	596	544
004	Magnetic Tape Unit	15,340	193.00	834	762
005	Magnetic Tape Unit	16,000	211.00	804	734
006	Magnetic Tape Unit	17,920	211.00	961	869
007	Magnetic Tape Unit	17,920	253.00	952	869
008	Magnetic Tape Unit	19,880	311.00	1,141	1,042
3550	Dual-Density Feature (Models 3, 5, and 7)	3,705	96.50	180	165
6407	Seven-Track Feature (Models 3, 5, and 7)	2,870	84.00	138	126
6420	6250 bpi Density Feature (Models 4, 6, and 8)	1,600	58.50	81	74
6425	6250/1600 bpi Dual Density Feature (Models 4, 6, and 8)	2,205	77.00	118	108
6631	Single-Density Feature (Models 3, 5, and 7)	2,870	58.00	138	126
3430 Series					
A01	Magnetic Tape Subsystem (includes Control Unit and Tape Drive)	33,400	251.00	2,175	—
B01	Magnetic Tape Subsystem (Tape drive only)	16,900	176.00	1,155	—
4991	Multidrive Attachment (permits attachment of up to 4 B01 Tape Units)	600	5.00	35	—
3480 Tape Cartridge Series					
A22	Control Unit	65,430	385.00	3,880	—
B22	Magnetic Tape Unit (includes 2 tape drives)	43,120	240.00	2,545	—
1511	First Channel Attachment	5,785	21.00	331	—
1512	Second Channel Attachment (prerequisite 1511)	5,785	21.00	331	—
1513	Third Channel Attachment (prerequisite 1512)	5,785	21.00	331	—
3803 Tape Controllers					
Model 1	For 3420 Tape Drives Models 3, 5, and 7 only	20,680	144.00	1,125	945
Model 2	For 3420 Tape Drives Models 3 through 8	27,550	199.00	1,640	1,378
5310	9-track NRZI feature (permits the connection of an 800 bpi drive to a 3803-2)	3,080	2.00	158	133
6320	7-track NRZI feature (permits connection of 800 bpi drive to a 3803-2, 5310 feature is a prerequisite)	1,515	2,000	79	66
	Multiple Tape Control Switches (permits switching of up to 16 3420s among up to 4 3803s):				
	1792 for 2 tape controls	6,130	14.00	328	276
	1793 for 3 tape controls	7,820	23.00	425	357
	1794 for 4 tape controls	9,195	23.00	498	418
	6148 Remote Switch Attachment	910	NA	48	40
	8100 Two-Channel Switch	4,600	6.50	243	204

NA—Not applicable. □