

# IBM Disk Subsystems

## MANAGEMENT SUMMARY

IBM has enlarged the 3380 DASD (Direct Access Storage Device) family by four new models. The IBM DASD line consists of seven drive units providing storage capacity for users with various levels of storage requirements, from 64.5 megabytes (3310) to 5.04 gigabytes (3380). The drive units attach to System/370, 303X, 308X, 43XX, and 3090 processors.

The 3310 is a medium-capacity direct access storage device using a sealed, nonremovable medium which uses fixed-block architecture data recording.

The 3340 medium-capacity device uses the removable 3348 Data Module and count-key-data format.

The 3344 and 3350 are large-capacity units employing a sealed, nonremovable data recording medium and count-key-data format.

The 3370 and 3375 are large-capacity nonremovable medium units for intermediate systems. The 3370 uses fixed-block architecture data recording, while the 3375 uses count-key-data format. Both devices use two independent operating actuators on one spindle per unit.

The 3380 is a large-capacity, nonremovable medium device which uses count-key-data format. Each model includes two head disk assemblies, each with two independently operating actuators.

The 3880 control unit contains two storage directors for independent control of attached DASDs. The six available models have different attachment and feature capabilities. Models 21 and 23 have high-speed electronic cache storage with a capacity of 64 megabytes.

## COMPETITIVE POSITION

Supercomputers and large-scale mainframes have the highest storage requirements, and IBM 3380-type disk drives have become necessary to satisfy the need for high capacity disk storage. With the addition of four new models to the 3380 DASD family IBM is making progress in becoming the major supplier of high capacity disk drives. The IBM 3380 has a capacity of 5.04 gigabytes of storage and a purchase price range of \$64,440 to \$104,880.

The plug-compatible replacements for the 3380 are the Memorex 3680 HDP (High Density Package) with a total capacity of 10 gigabytes and a purchase price of \$310,310, the NAS 7380 with a capacity of 5.04 gigabytes and a purchase price range of \$104,880 to \$128,000; and the StorageTek 8380 with a capacity of 2.52 gigabytes and a purchase price range of \$63,150 to \$87,225. IBM holds the edge over the competitors in both price and capacity. ➤

IBM leads the disk drive market with its line of seven direct access storage devices, from the entry-level 3310 to the top-of-the-line 3380. Capacities range from 64.5 megabytes to 5040 megabytes.

**MODELS:** 3310 DASD, 3340/3344 DASD, 3350 DASD, 3370 DASD, 3375 DASD, 3380 DASD, 3880 Storage Control Unit.

**CONFIGURATION:** For model configurations please refer to the *Characteristics* section of this report.

**COMPETITION:** 3340—Memorex 3640; 3344—Memorex 3644; 3350—Memorex 3650/3652, NAS 7330-12, 7350-1, 7350-H, 7360, and StorageTek 8350, 8360, 8650; 3370—Memorex 3690-2; 3380—Memorex 3680, NAS 7380, and StorageTek 8380.

**PRICING:** Purchase prices range from \$5,510 (3310 Model B01) to \$134,740 (3380 Model AE4).

## CHARACTERISTICS

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

**DISK DRIVES:** 3310 Direct Access Storage Device (DASD) Models A1, A2, B1, and B2; 3340 (DASD) Models A2 and B2; 3344 DASD Model B2; 3350 DASD Models A2, B2, C2, A2F, B2F, and C2F; 3370 DASD Models A1, B1, A2, B2, A11, A12, B11, and B12; 3375 DASD Models A1, B1, and D1; 3380 DASD Models A4, AA4, AD4, AE4, B4, BD4, and BE4.

**CONTROL UNIT:** 3880 Storage Control Models 1, 2, 3, 4, 21, and 23.

## SYSTEM COMPONENTS

**3310 DIRECT ACCESS STORAGE DEVICE:** The 3310 offers four models. The Model A1 contains a controller and one disk drive. The Model A2 contains a controller and two disk drives. The Model B1 contains one disk drive and must be physically attached to a Model A2. The Model B2 contains two disk drives and must be physically attached to a Model A2. A string of 3310s can consist of one or two disk storage devices, each device containing one or two disk drives.

**3340/3344 DIRECT ACCESS STORAGE DEVICE:** The 3340 consists of a Model A2, controller with dual-drive disk storage and up to three attached dual-drive (Model B2) units. The 3344 dual-drive (Model B2) unit can be substituted for 3340 B models.

**3348 DATA MODULE:** A removable and interchangeable Data Module for the 3340 Disk Drive family. The Model 35 provides 34 megabytes of storage; the Model 70F provides 69 megabytes of storage of which 502K bytes are accessible by fixed heads. ➤

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➤ Storage Technology Corporation was the first plug-compatible to react to IBM's latest price move, by reducing the price of its 8380 disk drives and associated controllers by 10 percent. NAS has responded to IBM's new models in the 3380 family by increasing the capacity of the 7380 to 5.04 gigabytes, and Memorex has introduced a high density package version of its Model 3680.

Because of its age, there are no plug-compatible offerings for the 3310. This drive was first introduced in the late 1970s, and many users' needs surpass the capabilities of this model quickly, if not immediately.

Competition for the 3340 and 3344 is offered by Memorex with its 3640 and 3644 models. These models offer 140 to 560 megabytes of storage. The IBM 3340 and 3344 also offer 140 to 560 megabytes of storage with prices ranging from \$6,020 to \$14,820. The purchase price range of the Memorex models is \$25,200 and \$31,680.

IBM 3350 plug-compatible models are available from Memorex (3652), NAS (7330-12, 7350-I, 7350-H, 7360), and StorageTek (8350, 8360, 8650). The Memorex 3652 has a capacity of 1.27 gigabytes; purchase prices were not available. The NAS models offer capacities of 317.5 megabytes for the 7330-12 and 7350-I, 635 megabytes for the 7350-H, and 1.27 gigabytes for the 7360. The purchase price ranges from \$19,250 to \$30,000 per drive. The Storage Technology Models 8350 and 8360 have storage capacities of 635 megabytes. The purchase price ranges of the 8350 and 8360 are \$24,850 to \$32,630 and \$28,670 to \$38,500, respectively. StorageTek also offers the 8650 double-density version of the 3350 with a capacity of 1.27 gigabytes. The purchase price ranges from \$55,500 to \$150,180. The capacity and price for the IBM 3350 is 635 megabytes and \$25,360 to \$41,070, respectively.

The only plug-compatible competition for the IBM 3370 is the Memorex Model 3690-2 with a capacity of 729.8 megabytes, and a purchase price of \$26,600. StorageTek has dropped its plug-compatible Model 8370 from its marketing effort.

The Control Data 33750 was the only plug-compatible replacement for the IBM 3375. CDC has dropped out of the plug-compatible market, and manufactures disk drives only for its own computer systems.

### ADVANTAGES AND RESTRICTIONS

The 3310 provides a low-cost, entry-level storage device for small configurations. The cost per megabyte has been reduced and reliability and data availability have been improved, according to IBM. The 3340 provides data removability and portability through its use of the 3348 Data Module. It can also be intermixed with the 3344 in the same string. IBM also claims to have improved reliability and performance in its 3344, 3350, 3370, and 3375 units. The four new 3380 models not only feature a higher storage capacity and reduced price per megabyte of storage, they also require less floor space, have a lower power consumption, better heat dissipation and improved maintenance, ➤

➤ **3350 DIRECT ACCESS STORAGE DEVICE:** The 3350 consists of from one to four dual-drive disk storage units. Three types of units are available; two with a controller and drives, and one with only the drives. The first unit of each string must contain one controller (Model A2 or A2F) and dual drives. Up to three other units can be configured within the string, each consisting of dual drives.

**3370 DIRECT ACCESS STORAGE DEVICE:** Each 3370 unit contains two actuators and a string can contain up to four units (eight actuators). Eight models are in the group: the Model A1 and Model A2 single drive units with associated controller (each can support up to three Model B1 or B2 units); the Model B1 single-drive unit; the Model B2 single-drive unit; the Models A11 and A12 single-drive units with associated controller (each can support up to three Model B11 or B12 units); the Model B11 single-drive unit; and the Model B12 single-drive unit.

**3375 DIRECT ACCESS STORAGE DEVICE:** Three models are in this group of large-capacity disk storage devices: the Model A1 disk storage unit with one head and disk assembly, two actuators and associated controller (the Model A1 can support up to three Model B1 units); the Model B1 disk storage unit with one HDA and two actuators; the Model D1 disk storage unit with one HDA and two actuators and associated controller (this model provides dual controller functions providing a second data path to each HDA.)

**3380 DIRECT ACCESS STORAGE DEVICE:** The 3380 employs a fixed-medium head and disk assembly (HDA) that contains the heads, disks, and actuators within a sealed enclosure. Each 3380 unit contains two HDAs, each with two independent movable actuators. Seven models comprise this group: the Model A4 disk storage unit with four actuators and controller; the Model AA4 disk storage unit with four actuators and controller; the Model AD4 disk storage unit with four actuators and two controllers; and the Model AE4 disk storage unit with four actuators and two controllers; the Model B4 disk storage unit with four actuators; the Model BD4 with four actuators; and the Model BE4 with four actuators. Up to three Model B units can be attached to one Model A unit. The 3380 actuators are arranged on multiple internal paths within a string with up to four actuators sharing a path.

**3880 STORAGE CONTROL:** The six models of the 3880 are Models 1, 2, 3, 4, Model 21 Paging Cache Subsystem, and the Model 23 cache controller. The Model 1 has two storage directors, each of which supports the 3330/3333, 3350, 3340/3344, 3370, and 3375 drives. The Model 2 has one storage director which supports the 3380 only. The Model 3 has two storage directors, both of which support the 3380 only. The Model 4 has a single storage director which controls the 3370 and 3375. Up to four strings of 3370 or four strings of 3375 can be configured. The Model 21 Paging Cache Subsystem has from 8 to 64 megabytes of electronic cache storage. Two storage directors manage cache and one or two attached 3350s, and the String Switch required for each 3350 Model A2. The Model 23 cache controller has from 8 to 64 megabytes of electronic cache storage. Two storage directors share cache and one or two strings of 3380s.

### HARDWARE REQUIREMENTS

The 3310 DASD requires a 3310 Model A1 or A2 and a position on the DASD Adapter of a 4321, 4331, or 4361 processor. A Model A2 is required for a Model B1 or B2. The Model A2 provides the logic to support up to two additional drives for a maximum string of four. ➤

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TABLE 1. DASD PERFORMANCE CHARACTERISTICS

Model	Capacity per unit (MB)	Average Seek Time (msec.)	Latency	Data Transfer Rate (KB/sec.)
3310	64.5/129	27	9.6	1031
3340	70/140	25	10.1	885
3344	560	25	10.1	885
3350	635	25	8.4	1198
3370	571.3	20	10.1	1859
3375	819.7	19	10.1	1859
3380	5040	16	8.3	3000

➤ according to IBM. Datapro user surveys have shown IBM drives, in particular the low-end models, to be weak in the areas of noise level, heat dissipation, and power requirements. □

➤ The 3340 DASD facility requires a 3340 Model A2 and a System/370 or 4300 processor with the appropriate attachment and features. Each 3340 drive requires a 3348 Data Module.

The 3344 DASD requires a 3340 Model A2 and any virtual storage System/370, 30XX, or 43XX processor with appropriate attachment and features.

The 3350 DASD requires a 3350 Model A2 or A2F and any virtual storage 4331 Model Group 2, 4341, 4361, 4381, 30XX, or System/370 processor (except 3115 or 3125) with appropriate attachment and features.

The 3370 DASD requires: a DASD Adapter base for a 4321 and 4331 Model Group 1 processors; a DASD Adapter or a 3880 Storage Control Model 1, 2, or 4 attached to the High Speed Block Multiplexer Channel on the 4331 Model Group 2 or 4361 processor; a DASD Adapter for a 4331 Model Group 11 processor; a DASD/8809 Adapter on the 4361, or a 3880 Storage Control Model 1, 2, or 4 attached to a High Speed Block Multiplexer Channel; a 3880 Storage Control Model 1, 2, or 4 connected to a two-megabyte block multiplexer channel on the 4341 or 4381 processor; an attachment feature on the System/38 5381 System Unit (Models 4, 5, 6, 7, and 8).

The 3375 DASD requires: a 3375 Model A1 to attach 3375 Model B1s; a 3880 Storage Control model 1, 2, or 4 to attach a 3375 to a processor; a block multiplexer channel with a data rate of at least 1.86 megabytes to attach a 3880 to a 4341, 4331 Model Group 2, 4361, or 4381 processor; the data streaming or speed matching buffer feature for attachment to a 3031, 3032, or 3033 processor; any block multiplexer channel for attachment to a 3081, 3083, or 3084 processor.

The 3380 DASD attaches to 4341, 4361, 4381, 3031, 3032, 3033, 3081, 3083, 3084, and 3090 processors. Model A4 attaches to 3880 Storage Control Model 2 or 3, Model AA4 attaches to 3880 Model 2, 3, or 23, while Model AD4 and Model AE4 attach to 3880 Model 3 and 23. Attachment to a 3031, 3032, or 3033 processor through a 3880 Model 2, 3, or 23 requires data streaming on those processor units.

#### CONFIGURATION

The maximum number of drives per string are as follows: 3310—four drives per string; 3340/3344—eight drives per string; 3350—eight drives per string; 3370—four drives

(eight actuators) per string; 3375—four drives (eight actuators) per string; 3380—four drives (sixteen actuators) per string.

#### PERFORMANCE CHARACTERISTICS

For the performance characteristics of each disk drive model please refer to Table 1.

#### DATA FORMAT

3310 DASD: The data recording format is fixed-block architecture.

3340/3344 DASD: Each drive is equivalent in capacity and format to four logical 3348 Data Module Model 70s. Each 3344 has two drives and requires eight logical device addresses. Each drive has 2,784 logical cylinders with 12 tracks per cylinder. Maximum track capacity is 8,368 bytes providing up to 100,416 bytes per logical cylinder.

3350 DASD: Selective data recording format is standard. Operating in native mode fixed head storage capacity is 1,144,140 bytes per drive. Each 3350 has two drives with 555 logical cylinders per drive with 30 tracks per logical cylinder, and 19,069 bytes per track.

3370 DASD: The data recording format is fixed-block architecture. Each Model 1 or 11 series drive has 512 data bytes per block, 558,000 blocks per actuator, 285.6 megabytes per actuator, and 571.3 megabytes per spindle. Each Model 2 or 12 series drive has 512 data bytes per block, 712,752 blocks per actuator, 364.9 megabytes per actuator, and 729.8 megabytes per spindle. Blocks are separately addressable and jointly form a contiguous address space.

3375 DASD: The data recording format is count-key-data. Count-key-data provides format continuity with current IBM large systems direct access storage products.

3380 DASD: The data recording format is count-key-data. Models A4, AD4, B4, and BD4 have a capacity of approximately 2.55 gigabytes per unit, up to 10.08 gigabytes per string. Models AE4 and BE4 have approximately 5.04 gigabytes per unit, and up to 20.16 gigabytes per string.

#### SYSTEM FEATURES

3310 DASD: The 3310 features Rotational Positioning Sensing which permits the disk storage device to disconnect during rotational delay. Availability of the device for other operations is thereby increased. Error Correction is provided with the capability to correct single data error bursts of up to a 3-bit span as well as detecting all single error bursts of up to a 14-bit span. Recovery of field data is provided at the plant of manufacture. ➤

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► **3340 DASD:** The 3340 contains an air filtration system, a Read-Only switch provided on each drive, and an automatic load/unload mechanism for the 3348 Data Module. The 3348 Data Module contains the disks, access arms, read/write heads and spindle. The modularity of this design provides multiple capacity options on each drive. The 3340 also provides a Fixed Head Feature which is available on all virtual storage System/370 and 43XX processors. Rotational Position Sensing is also available on the 3340; however, this feature is not supported by the 4321 or 4331 processor 3340/3344 Direct Attachment Feature. The String Switch feature is used to attach the 3340 Model A2 to a 3880 Storage Control Unit.

**3344 DASD:** The 3344 features a Read-Only switch, Rotational Position Sensing, and Data Recovery.

**3350 DASD:** The 3350 features Write Format Release which frees the subsystem while the drive erases from the end of a formatted write record to the end of the track. Command Retry allows the storage control to recover from errors without interfering with the system error recovery procedures. The 3350 also features the Remote Switch Attachment to connect the string switch to the configuration control panel of a System/370. The String Switch links the 3350 to a 3880 Storage Control Unit. The 3350 features a Read-Only switch, Rotational Position Sensing, Data Recovery, and an optional Fixed Head Feature.

**3370 DASD:** The 3370 features Automatic Position Sensing within its fixed block architecture. This architecture provides for relative block addressing. The channel automatically disconnects during a period of rotational delay. The 3370 also features Error Correction, Command Retry, Data Recovery, and String Switch.

**3375 DASD:** The 3375 features Error Correction, Rotational Position Sensing, Data Recovery, and String Switch.

**3380 DASD:** The 3380 features Dynamic Path Selection which attaches to two 3880 storage directors and controls access to the actuators, providing paths via both storage directors to all actuators in the string. The Device Level Selection (DLS) function permits concurrent data transfer from any two actuators within a string including those of the same HDA. The 3380 also features Error Correction, Rotational Position Sensing, Format Write Release, and Data Recovery.

**3880 Storage Control Unit:** File organization and format are under program control. Data integrity is provided through extensive error detection and correction capabilities. The Remote Switch Attachment removes the enable/disable switches from the 3880 operator panel and allows them to be moved to a remote configuration control panel. The Speed Matching Buffer supports attachment of 3380 DASDs to a 1.5-megabyte data and non-data streaming block multiplexer channel. Two paging storage directors handle four simultaneous data transfers, cache to DASD, and channel to cache on each. The 3880 also features a two-channel, four-channel, and eight-channel switch option.

### MODEL UPGRADABILITY

Model changes between 3310 Model A1 and A2 or between Model B1 and B2 are field installable. Model changes between 3310 Model A and Model B units cannot be done.

Changes from 3344 Model B2 to Model B2F are field installable.

Changes between 3350 Model A and Model B units or Model C and Model B units are available at time of manufacture only. Upgrades between 3350 Model A and Model C units are recommended for field installation. Model changes between A2 and A2F units, or B2 and B2F units, or C2 and C2F units are field installable.

Model changes between 3375 Models A1 and B1 or between Models A1 and D1 are available at time of manufacture only. A model change from a B1 to a D1 is permitted in the field. A model change from D1 to B1 is not recommended for field installation.

3380 model upgrades are field installable. Model AD4 can be upgraded to a Model AE4. Model BD4 can be upgraded to a Model BE4. Model A4 and AA4 cannot be upgraded to a Model AD4 or AE4, and Model B4 cannot be upgraded to a Model BD4 or BE4.

### PRICING

The IBM Direct Access Storage Devices are available for purchase, monthly rental, and two-year lease. Maintenance included in the two-year lease plan is 24 hours per day, 7 days per week.

## EQUIPMENT PRICES

		Purchase Price (\$)	Monthly Maint. (\$)	Monthly Rental (\$)	2-Year Lease (\$)
<b>3310 Direct Access Storage Device</b>					
A01	Direct Access Storage	6,960	68.00	580	494
A02	Direct Access Storage	11,570	110.00	962	819
B01	Direct Access Storage	5,510	62.50	457	389
B02	Direct Access Storage	10,120	104.00	839	714
<b>3340 Direct Access Storage Device</b>					
A02	Direct Access Storage Facility	8,600	124.00	1,862	1,585
B02	Direct Access Storage Facility	6,020	107.00	1,316	1,120
4301	Fixed Head Feature for Model A02 or B02	1,165	2.50	78	66
6202	Rotational Position Sensing for Model A02 or B02	590	1.50	40	34
8150	String Switch	4,915	16.00	371	316
<b>3344 Direct Access Storage Device</b>					
B02	Direct Access Storage Facility	14,820	123.00	1,674	1,425

NC—No charge.

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		Purchase Price (\$)	Monthly Maint. (\$)	Monthly Rental (\$)	2-Year Lease (\$)
<b>3350 Direct Access Storage Device</b>					
A02	Direct Access Storage	32,030	173.00	2,103	1,740
A2F	Direct Access Storage	39,970	224.00	2,622	2,230
B02	Direct Access Storage	25,360	130.00	1,674	1,425
B2F	Direct Access Storage	33,300	182.00	2,191	1,865
C02	Direct Access Storage	33,130	182.00	2,191	1,865
C2F	Direct Access Storage	41,070	234.00	2,708	2,305
1320	Primary Controller Adapter	220	1.50	14	12
6148	Remote Switch Attachment	—	—	—	—
8150	String Switch	3,690	9.50	257	219
<b>3370 Direct Access Storage Device</b>					
A01	Direct Access Storage	35,480	147.00	1,563	1,330
A02	Direct Access Storage	35,480	134.00	2,030	—
A11	Direct Access Storage	35,480	147.00	1,563	1,330
A12	Direct Access Storage	35,480	134.00	2,030	—
B01	Direct Access Storage	26,600	110.00	1,173	998
B02	Direct Access Storage	26,600	101.00	1,520	—
B11	Direct Access Storage	26,600	110.00	1,173	998
B12	Direct Access Storage	26,600	101.00	1,520	—
8150	String Switch	3,830	1.50	168	143
<b>3375 Direct Access Storage Device</b>					
A01	Direct Access Storage	38,040	139.00	1,563	1,330
B01	Direct Access Storage	28,770	105.00	1,251	1,065
D01	Direct Access Storage	36,290	128.00	1,486	1,265
4951	Model D1 Attachment for Model A1	2,590	6.00	95	81
4952	Model A1 Attachment for Model B1	—	—	—	—
8150	String Switch	3,795	1.50	168	143
<b>3380 Direct Access Storage Device</b>					
AA4	Direct Access Storage	88,780	325.00	5,105	4,345
A04	Direct Access Storage	77,680	285.00	4,481	3,805
B04	Direct Access Storage	64,440	240.00	3,707	3,155
AD4	Direct Access Storage	88,780	295.00	4,730	—
BD4	Direct Access Storage	64,440	215.00	3,440	—
AE4	Direct Access Storage	134,740	295.00	7,030	—
BE4	Direct Access Storage	110,400	215.00	5,735	—
<b>3880 Storage Control Unit</b>					
001/002/003	Storage Control Unit	60,270	176.00	3,819	3,250
004	Storage Control Unit	35,000	82.50	2,195	—
D21	Storage Control Unit; 8 megabytes of memory	143,750	575	7,765	—
E21	Storage Control Unit; 16 megabytes of memory	183,750	600	10,470	—
G21	Storage Control Unit; 32 megabytes of memory	263,750	650	14,800	—
H21	Storage Control Unit; 48 megabytes of memory	343,750	700.00	19,130	—
J21	Storage Control Unit; 64 megabytes of memory	423,750	750.00	23,460	—
D23	Storage Control Unit; 8 megabytes of memory	143,750	575	8,350	—
E23	Storage Control Unit; 16 megabytes of memory	183,750	600	10,470	—
G23	Storage Control Unit; 32 megabytes of memory	263,750	650	14,800	—
H23	Storage Control Unit; 48 megabytes of memory	343,750	700.00	19,130	—
J23	Storage Control Unit; 64 megabytes of memory	423,750	750.00	23,460	—
<b>3880 Model Upgrades</b>					
	Model 1 to Model D21	83,480	—	—	—
	Model 1 to Model E21	123,480	—	—	—
	Model 1 to Model G21	203,480	—	—	—
	Model 1 to Model H21	283,480	—	—	—
	Model 1 to Model J21	363,480	—	—	—
	Model D11 to Model D21	80,000	—	—	—
	Model D11 to Model E21	120,000	—	—	—
	Model D11 to Model G21	200,000	—	—	—
	Model D11 to Model H21	280,000	—	—	—
	Model D11 to Model J21	360,000	—	—	—
	Model D21 to Model E21	55,000	—	—	—
	Model D21 to Model G21	135,000	—	—	—
	Model D21 to Model H21	215,000	—	—	—
	Model D21 to Model J21	295,000	—	—	—
	Model E21 to Model G21	80,000	—	—	—
	Model E21 to Model H21	160,000	—	—	—
	Model E21 to Model J21	240,000	—	—	—
	Model G21 to Model H21	80,000	—	—	—

NC—No charge.

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	Purchase Price (\$)	Monthly Maint. (\$)	Monthly Rental (\$)	2-Year Lease (\$)
Model G21 to Model J21	160,000	—	—	—
Model H21 to Model J21	80,000	—	—	—
Model X21 to Model X23	2,745	—	—	—
Model 3 to Model D23	83,480	—	—	—
Model 3 to Model E23	123,480	—	—	—
Model 3 to Model G23	203,480	—	—	—
Model 3 to Model H23	203,480	—	—	—
Model 3 to Model J23	283,480	—	—	—
Model B13 to Model D23	80,000	—	—	—
Model B13 to Model E23	120,000	—	—	—
Model B13 to Model G23	200,000	—	—	—
Model B13 to Model H23	280,000	—	—	—
Model B13 to Model J23	360,000	—	—	—
Model D13 to Model D23	80,000	—	—	—
Model D13 to Model E23	120,000	—	—	—
Model D13 to Model G23	200,000	—	—	—
Model D13 to Model H23	280,000	—	—	—
Model D13 to Model J23	360,000	—	—	—
Model D23 to Model E23	55,000	—	—	—
Model D23 to Model G23	135,000	—	—	—
Model D23 to Model H23	215,000	—	—	—
Model D23 to Model J23	295,000	—	—	—
Model E23 to Model G23	80,000	—	—	—
Model E23 to Model H23	160,000	—	—	—
Model E23 to Model J23	240,000	—	—	—
Model G23 to Model H23	80,000	—	—	—
Model G23 to Model J23	160,000	—	—	—
Model H23 to Model J23	80,000	—	—	—
6148 Remote Switch Attachment	NC	NC	NC	NC
6149 Remote Switch Attachment, Additional	NC	NC	NC	NC
6150 Remote Switch Attachment for Eight-Channel Switch	NC	NC	NC	NC
6550 Speed Matching Buffer for 3380	9,705	40.00	553	471
8170 Two-Channel Switch Pair	6,225	11.00	390	332
8171 Two-Channel Switch Pair, Additional	16,610	38.50	1,053	896
8172 Eight-Channel Switch	22,850	53.50	1,451	1,235

NC—No charge. ■