

The Wang Model 2230 Fixed/Removable Disk Drive provides an extremely reliable, high-speed, direct-access external storage capability for the Wang System 2200B and 2200C.

PHYSICAL CHARACTERISTICS

As its name implies, the Model 2230 comprises two separate disk platters, a Fixed Disk Platter and a Removable Disk Platter. The Removable Disk Platter can be removed and replaced by the user. Each disk platter is divided into a series of concentric circular tracks (the number varies from one configuration to another), and each track is segmented into twenty-four 256-byte sectors. Information is transferred to and from the disk in blocks of 256 bytes, with each block occupying a sector. Records of more than 256 bytes are automatically allocated additional sectors as needed. The sectors on each disk platter are sequentially numbered and randomly accessible.

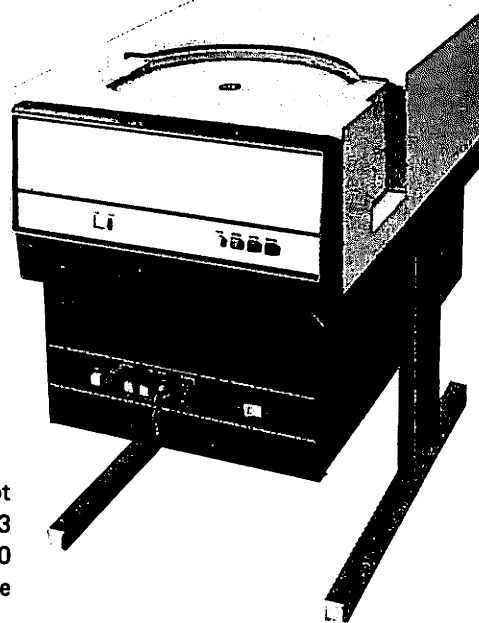
STORAGE CAPACITY

The Model 2230 is offered in three configurations:

Configuration	Storage Capacity (Bytes)
2230-1*	1,228,800 (1¼ megabytes)
2230-2*	2,457,600 (2½ megabytes)
2230-3	5,013,504 (5 megabytes)

*The Models 2230-1 and 2230-2 can be field upgraded to higher configurations.

In each configuration, one-half of the total storage capacity resides on the Fixed Disk Platter, and one-half on the Removable Disk Platter. Storage efficiency is affected by a number of factors, including the type of data being stored, and the method of storage. For example, a full-precision number (13 digits) requires nine bytes of disk storage. The PACK statement can be used, however, to reduce each number to as few as two bytes, if 13-digit accuracy is not needed. For purposes of general illustration, the Model 2230-3 can store about 557,000 full-precision numbers, or 295,000 16-character literal strings. The Models 2230-1 and 2230-2 have lesser capacities.



2230
FIXED/REMOVABLE DISK DRIVE

SPEED

In any external storage device, a necessary complement to size is speed. The capability to store large quantities of data is valuable only if the data can be retrieved in a timely manner. The Model 2230 is a high-performance disk drive which offers rapid data access in both sequential and direct access operations.

The total time required to access any given item of data on the disk can be broken down into two components, the track access time and the disk latency time:

- **Track Access Time** - The track access time is the time required to position the read/write heads to a specified track on the disk platter. The "average access time" is the time required for the read/write heads to move from track #0 to the middle track on a disk platter. Naturally, the time varies slightly among the three Disk configurations, since the number of tracks per disk platter varies from one configuration to another. On the Model 2230-3, the average access time is 41 milliseconds (about 0.04 second). This time is substantially faster on the Models 2230-1 and 2230-2.
- **Disk Latency Time** - The latency time is the time required for the desired sector on a track to rotate to the read/write head. The "average latency time" is the time required for a sector which is one-half track (12 sectors) away from the read/write head to rotate to the read/write head. Since the disk platters make one complete revolution in 40 ms, the average latency time is one-half the revolution time, or 20 ms (0.02 second). This time does not vary among the three disk configurations. The staggered arrangement of sequential sectors on a track makes it possible to perform disk copy operations with significant savings in total latency time.

AUTOMATIC FILE MAINTENANCE

Files can be maintained on disk in one (or both) of two modes: Automatic File Cataloging mode, and Absolute Sector Addressing mode. The BASIC instructions in both of these modes are built into the System 2200B and 2200C, and do not require an additional software package.

Automatic File Cataloging - This mode includes 16 BASIC statements which provide rapid, easy access to cataloged files on the disk. Catalog mode permits the user to save and load program and data files by name, without concern for where or how the files are actually stored on the disk. The system itself automatically keeps track of the size and location of each file. The BASIC instructions available in Catalog mode are listed below.

- **SCRATCH DISK** is used to create a catalog on a specified disk platter. The catalog consists of two parts, a Catalog Index and a Catalog Area.
- **MOVE END** is used to alter the size of the catalog after it has been created with SCRATCH DISK.

- **LIST DC** enables the operator to list out the names and locations of all cataloged programs and data files.
- **SAVE DC** is used to name and save BASIC programs on the disk.
- **LOAD DC**, when executed as a command, is used to load a named program from the disk into the System 2200. When executed in a program, LOAD DC can be used to chain or overlay programs from disk.
- **DATASAVE DC OPEN** is used to name and open a new data file on the disk (as many as seven cataloged files may be open simultaneously).
- **DATALOAD DC OPEN** is used to reopen an existing data file on disk. The file is referenced by name.
- **DATASAVE DC** is used to store a data record in a currently open file on disk. Multiple-sector records are written automatically.
- **DATALOAD DC** is used to read data from a currently open file on disk. Multiple-sector records are read automatically.
- **DATASAVE DC CLOSE** is used to close one or all currently open files on disk.
- **DSKIP** and **DBACKSPACE** enable the programmer to skip forward and backward over data records within a cataloged data file.
- **SCRATCH** is used to "scratch" program or data files which are no longer needed. The disk space occupied by a scratched file can be reused for a new file.
- **MOVE** is used to copy the entire catalog (the Catalog Index as well as the Catalog Area) from the fixed platter to the removable, or vice versa. MOVE also automatically deletes all scratched files from the catalog.
- **VERIFY** performs special validity checks on specified sectors to ensure that the data stored in them is correct. VERIFY is normally used following a MOVE to ensure that the catalog has been copied accurately.
- **LIMITS** enables the programmer to examine the beginning, ending, and current sector addresses of a specified file, as well as the total number of sectors used in the file.

Absolute Sector Addressing - This mode consists of eight BASIC statements which permit the programmer to address specific sectors on the disk directly, thus enabling him to design his own disk operating system. Two of the eight Absolute Sector Addressing mode instructions are special statements which can be used to read or write one sector (256 bytes) of unformatted data. These special statements enable the programmer to write his own control information in individual sectors. The BASIC instructions available in Absolute Sector Addressing mode are listed and explained below.

- **SAVE DA** is used to store programs on disk in Absolute Sector Addressing mode. The starting sector location at which the program is to be stored must be specified.
- **LOAD DA**, when executed as a command, is used to load programs from disk into the System 2200. When executed within a program, **LOAD DA** can be used to chain or overlay programs from disk. In either case, the starting sector address of the program must be specified.
- **DATASAVE DA** is used to save data records on the disk. The address of the first sector in which the record is to be stored must be specified. Multiple-sector records are written automatically.
- **DATALOAD DA** is used to read data records stored on disk. The address of the first sector in which the record is stored must be specified. Multiple-sector records are read automatically.
- **DATASAVE BA** is a special statement which writes one sector (256 bytes) of unformatted data in a specified sector on disk. (Both **DATASAVE DC** and **DATASAVE DA** automatically insert special formatting information in each record; this information is *not* automatically inserted by **DATASAVE BA**.)
- **DATALOAD BA** is a special statement which reads one sector (256 bytes) of unformatted data from a specified sector on the disk.
- **COPY** is used to copy the contents of a specified range of sectors from one platter to the corresponding sectors on the other platter.
- **VERIFY** performs a validity check on specified sectors to ensure that the data stored in them is correct. **VERIFY** is generally used following a **COPY** to ensure that all information is copied accurately.

RELIABILITY

To increase the reliability of the disk unit two different checks are made on every sector of information read from the disk. A cyclic redundancy check (CRC) and longitudinal redundancy check (LRC) are performed automatically by the system on the data in each sector when it is read from the disk. If an LRC error is detected, the system returns an error message at once; if a CRC error is detected, the system automatically rereads and rechecks the erroneous sector four times before signalling an error. In addition to the two checks performed automatically by the system, an optional read-after-write verification test can be specified by the programmer, simply by including a special parameter in the appropriate BASIC instruction.

AUTOMATIC SECTOR FORMATTING

A switch-selectable automatic sector formatting feature causes the system to format each sector on a disk platter. In addition, the formatting procedure

assigns a unique address to every sector on the platter. Each sector is formatted into four basic sections: a two-byte sector address, two bytes reserved for a CRC value, one byte reserved for an LRC value, and 256 bytes reserved for user's data. The sector address, CRC, and LRC are transparent to the user's software, and are employed by the system for data identification and verification.

AVAILABLE DISK UTILITIES

Wang supports its complete line of 2200 Series disk drives with a variety of disk utility programs. Although new utilities are always being developed, the following utilities are available at the present:

- **KFAM (Keyed File Access Method):** KFAM is a sophisticated file maintenance system which provides the user with rapid, direct random access to individual records in a cataloged file.
- **Disk Sort:** The disk sort utility sorts records in a cataloged disk file in ascending key sequence. A maximum of 65,534 records can be sorted.
- **Compression:** The disk compression program reads source programs stored on disk (or tape) and compresses them. The resultant compressed program can be saved back onto the disk.
- **Decompression and Cross-Reference:** Source and compressed programs stored on disk (or tape) are read into memory, decompressed, and cross-referenced. The decompressed and cross-referenced programs can be listed on a printer or displayed on the CRT screen.
- **Disk Utilities:** The Disk Utilities comprise a set of three programs: (a) Standards Utilities; (b) Standards Date Subroutines; (c) Initialize Scratch Volumes. Each program consists of a number of subroutines which can be called from the disk to perform various special functions, such as converting calendar dates to Julian dates, positioning the CRT cursor to any point on the screen, etc.
- **Disk Dump Utility:** This utility is a useful debugging tool. The Disk Dump generates a listing of a program or data file stored on disk. Included in the listing are all program text or data, as well as the HEX code for each character; for data files, the location, type, and number of bytes in each field are listed.
- **Copy/Verify:** Copies specified files from disk to disk, disk to tape, or tape to disk, and verifies each file copied.
- **Sort Disk Catalog:** prints or displays a sorted Catalog Index listing. File names may be sorted alphabetically, or sequentially according to the files' starting sector addresses.
- **Disk Sector Condense:** deletes scratched cataloged files, and moves valid files up to take up the space left vacant by the deleted files. This routine may be used instead of performing a MOVE.

DATA SHEET

SPECIFICATIONS

STORAGE CAPACITY

	2230-1	2230-2	2230-3
Sectors per Platter	2,400	4,800	9,792
Total Sectors	4,800	9,600	19,584
Bytes per Platter	614,400	1,228,800	2,506,752
Total Bytes	1,228,800	2,457,600	5,013,504

PERFORMANCE

Rotation Speed

All configurations - 1,500 rpm

Access Time (position head to track)

Minimum (one track)	9 ms
Average (across one-half available tracks)	
2230-1	21 ms
2230-2	28 ms
2230-3	41 ms
Maximum (across all available tracks)	
2230-1	42 ms
2230-2	56 ms
2230-3	82 ms

Latency Time (platter rotation to sector on track)

Average (one-half revolution) 20 ms

Read/Write Time

One 256-byte sector (including CPU/Controller Overhead) 13 ms

Raw Transfer Rate

195,000 bytes/sec

MOVE/COPY Time (Entire Disk Platter)

2230-1	1.2 min (Approx)
2230-2	2.4 min (Approx)
2230-3	4.9 min (Approx)

Dimensions

Height	32-1/2 in. (82.6 cm)
Width	17-1/2 in. (44.5 cm)
Depth	29 in. (73 cm)

Weight

126 lbs (57 kg)

Power Requirements

115 or 230 VAC \pm 10%
50 or 60 Hz \pm 1/2 cycle

Cabling

10 ft (3.7 m) cable with connector to female receptacle on the CPU

Operating Environment

50°F - 90°F (10°C - 32°C)
20% - 80% Relative Humidity

Recommended Operating Environment

40% - 60% Relative Humidity

Standard Warranty Applies.

ORDERING SPECIFICATIONS

A fixed/removable disk drive unit capable of storing and retrieving data for the WANG System 2200B and 2200C. The Disk Unit must be available in at least three configurations of 1,228,800 bytes, or 2,457,600 bytes, or 5,013,404 bytes of storage capacity. Smaller configurations must be field upgradable to a larger configuration. The Disk Unit must consist of two separate disk platters, each of which contains one-half of the total storage capacity of the Disk Unit, and one of which can be removed and replaced. The two disk platters must be addressable interchangeably. It must be possible to read or write multisector records of any length to and from the disk, and to use entire arrays as arguments. Each configuration of the Disk Unit also must provide the capability to produce backup copies of all or part of a disk platter. The system must provide a built-in internal data management system as well as a number of statements and commands which permit the programmer to design his own operating system. All of these features, as well as all interface and control electronics, must be included in the quoted price for the Disk Unit; none are to be considered as optional extras. The Disk Unit must be compatible with other I/O and storage devices in the system. A single system must be capable of supporting a minimum of eight Disk Units.

Wang Laboratories reserves the right to change specifications without prior notice.

WANG

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