The Wang Cartridge Tape Drive is a peripheral device that utilizes a 1/4 inch magnetic tape cartridge to store data. The Cartridge Tape Drive was designed primarily to provide reliable backup for Wang systems with fixed disk drives. The versatility of the Cartridge Tape Drive allows users to define other applications, including storage of word-processing documents, copying specified files (including documents) and transferring information to compatible Wang systems. Three stand-alone models are available: the Model 2229, supported by the 2200 system, and Models 6529 and 2529V, supported by OIS and VS systems respectively.

<table>
<thead>
<tr>
<th>Model</th>
<th>Wang System</th>
</tr>
</thead>
<tbody>
<tr>
<td>2229</td>
<td>2200</td>
</tr>
<tr>
<td>6529</td>
<td>OIS</td>
</tr>
<tr>
<td>2529V</td>
<td>VS</td>
</tr>
</tbody>
</table>

The 1/4 inch magnetic tape cartridge is a convenient, cost-effective medium that can replace floppy diskettes or removable hard disks in many applications. The magnetic tape is contained on two hubs within a sturdy protective shell. This shell design incorporates a cover which automatically closes over the tape surface when the cartridge is not in use. An integral write-protect selector can be engaged to prevent a tape from being inadvertently recorded over. The Cartridge Tape Drive utilizes four recording tracks and a recording density of 6400 bits per inch. Depending upon the system and application, up to 15M bytes of data can be stored on a 450 ft tape cartridge. Tape cartridges (part number 725-1227) are available from Wang Supplies Division.

The Cartridge Tape Drive is a start/stop device that employs a serpentine recording technique. This technique records (or reads) data for the entire length of one track, stops, reverses tape direction, and records (or reads) the full length of the logically adjacent track. This process continues until all 4 tracks have been recorded or read. Tape speeds are 30 inches per second (ips) during record/read, and 70 ips during rewind.

APPLICATIONS

2200 Series

The Model 2229 Cartridge Tape Drive provides an alternative to using diskettes to backup 2200 systems configured with fixed 2M, 4M, 8M, 16M, and 32M byte disk drives. Menu selections allow the user to backup a disk to tape, recover data from the disk, backup individual files to tape, recover individual or all files from tape, and view instructions. When using a 16K character block size to record data, up to 15M bytes can be stored on one tape cartridge. For instance, an LVP user can conveniently backup almost an entire 16M byte fixed disk onto one tape cartridge. Up to 16 dual-sided, double-density diskettes (each approximately 1M byte capacity) would be required to back up the same disk. In applications such as these, the tape cartridge is more economical, faster, and requires much less operator intervention.
OIS

The Model 6529 is ideally suited to backing up the OIS 105 and 115 series. These systems are configured with fixed disk drives of 4.2M, 8.4M, 16M, or 32M bytes capacity. In addition, the cartridge tape drive is compatible with all OIS systems except Models 125 and 130. The OIS Tape Utilities menu allows a choice of operations: copy, retrieve, backup, and restore (full or incremental). For copy, a volume name and partial file name are specified, then individual files can be selected for copy from disk. For retrieve, a list of tape files is displayed, then files can be specified for retrieval from tape to a specified disk volume. Full backup is performed by specifying a volume name and file name; this option does not allow individual files to be selected. The incremental backup option allows the user to specify a date; only files created or altered after the specified date are backed up. For restore, the entire tape is copied to a specific disk volume. Using 4096 (4K) character blocks, up to 9M bytes of data can be stored on a tape cartridge. The tape cartridge offers a more efficient and cost-effective alternative to the single-sided, single-density diskettes (each approximately 300K bytes capacity) used on the OIS.

VS

The Model 2529V provides an efficient means to backup VS25 and VS45 systems configured with fixed 34M and 68M byte disk drives. By using the VS Backup Utility, a specified range of files, libraries, or volumes can be backed up to or restored from a tape cartridge. Using 4K character data blocks and no tape marks, up to 13.7M bytes of data can be stored on one 450 ft tape cartridge. The Cartridge Tape Drive is supported by all VS processors.

SUMMARY OF FEATURES

- Reliable - utilizes proven recording technology
- Cost effective - one cartridge tape can replace numerous diskettes or removable hard disk cartridges
- Convenient - less operator handling required than with diskettes
- Versatile - supports multiple applications
### SPECIFICATIONS

**Tape**  
- **Width**: 0.25 in. (0.64 cm)  
- **Length**: 450 ft (137.16 m)

**Recording**  
- **Recording Density**: 6400 bpi  
- **Physical Tracks**: 4  
- **Formatted Capacity**: Up to 15 Mb with 450 ft tape  
- **Record Format**: Single Track, serial

**Tape Transport**  
- **Tape Speed**  
  - (Normal): 30 ips  
  - (Rewind): 70 ips  
- **Read Operation**: Serial/Serpentine  
- **Write Operation**: Serial/Serpentine

**Start/Stop Time**  
- **Read/Write Operations**: 25 ms  
- **Rewind/Search Operations**: 75 ms

**Start/Stop Displacement**  
- **Read/Write Operations**: 0.38 in. (0.97 cm)  
- **Rewind/Search Operations**: 3.38 in. (8.59 cm)

**Tape Head**  
- **Recording Head**: Serpentine, Read after Write, Selective Erase

**Data Transfer Rate (drive to controller)**  
- 192,000 bits per second  
- (24,000 bytes per second)
Dimensions

Height 6.69 inches (16.99 cm)
Width 15.38 inches (37.07 cm)
Depth 17.81 inches (45.24 cm)

Weight

28.5 lbs (12.96 kg)

Cables

Model 2229; 10 ft (3.05 m) parallel cable from Tape Drive to CPU

Models 6529, 2529V; 25 ft (7.6 m) dual coaxial cable from Tape Drive to CPU (optional lengths up to 2000 ft (609.6 m))

Fuses

2 amp @ 115 VAC
1 amp @ 220 VAC

Operating Environment

50° to 90° (20°C to 32°C)
35% to 65% relative humidity, noncondensing (recommended)
20% to 80% relative humidity, noncondensing (allowable)

Power Requirements

115 VAC, 50/60 Hz (98 VAC - 128 VAC allowable) consumption: 1.4 amp - 2 amp @ 115 V

220 VAC, 50/60 Hz (196 VAC - 256 VAC allowable) consumption: 0.7 amp - 1 amp @ 220 V

Controls

On-Line, Power On/Off

Indicators

On-Line
Fault
Tape Loaded
Power On
450' TAPE CAPACITY
(assuming no bad spots)

\[ \text{WANG STD.} = (2 \times \text{FILE MARKS} + 2 - 256 \text{ BYTE LABELS}) / \text{FILE} \]

\[ \text{ANSI 9-TRACK STD.} = (2 \times \text{FILE MARKS} + 6 - 80 \text{ BYTE LABELS}) / \text{FILE} \]

VOLUME LABELS AND END OF TRACK LABELS EXCLUDED

FILE SIZE
TIME TO WRITE 16K BLOCK ON TAPE: 733 m sec (inc. RAMA up/down)

TIME TO READ 16K BLOCK FROM DISK AND TRANSFER TO TAPE CONTROLLER:

16K block was read using variable VAU size, with average (defined by disk ref. as 1/3 full) seek between each VAU read –

**Phoenix**

<table>
<thead>
<tr>
<th>VAU (sect)</th>
<th>READ 16K (sec)</th>
<th>TRANSFER TO TAPE CONT. (sec)</th>
<th>TOTAL (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0.960</td>
<td>0.2</td>
<td>1.160</td>
</tr>
<tr>
<td>8</td>
<td>0.600</td>
<td>0.2</td>
<td>0.8</td>
</tr>
<tr>
<td>16</td>
<td>0.480</td>
<td>0.2</td>
<td>0.68</td>
</tr>
</tbody>
</table>

**LVP - Quantum**

<table>
<thead>
<tr>
<th>VAU (sect)</th>
<th>READ 16K (sec)</th>
<th>TRANSFER TO TAPE CONT. (sec)</th>
<th>TOTAL (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>1.3</td>
<td>1.2</td>
<td>1.5</td>
</tr>
<tr>
<td>8</td>
<td>0.8</td>
<td>1.2</td>
<td>1.0</td>
</tr>
<tr>
<td>16</td>
<td>0.54</td>
<td>1.2</td>
<td>0.74</td>
</tr>
</tbody>
</table>
1/4" CARTRIDGE DRIVE BUSINESS PLAN
COMPANY CONFIDENTIAL

GREG FELLETIER
2/16/82
KENNEDY 1/4" CARTRIDGE DRIVE

A) PRODUCT NEED

To this point, flexible disk drives have served the multiple purpose of being the archive and interchange medium as well as the backup device for the 4 and 8 mbyte Winchester drives presently utilized. However, the inclusion of the 16 and 32 mbyte Quantum Winchester disk drives into our product lines requires a faster, higher capacity device to provide a cost effective, reliable backup which minimizes customer media handling and cost. Specific areas of use are: 1) 2200 LVP 2) OIS 120 and 3) VS25 and 4) Tempest applications; all of which have need for high capacity disk backup.

B) PRODUCT DESCRIPTION:

The product is the Kennedy Model 6455 1/4" tape cartridge drive utilizing serpentine recording and 4 tracks recording at 6400 Bits Per Inch. The drive is a DC only device thus meaning that there are no 50/60 Hz implications. Serpentine recording may be described as the reading/writing of data along one track in one direction only until the end of the track has been reached. Data is then read/written along the adjacent track in the opposite direction and so forth until all tracks have been used. The drive is a start/stop device which operates in read/write mode at 30 ips and rewind/search mode of 90 ips. Unlike the true streamer type drives available on the market which can be used only as a backup device due to their positioning method, this device may be used as a true tape drive since individual files and data blocks can be addressed in the same way 1/2" reel to reel tape drives are utilized. This feature allows potential usage as an archive device for word processing documents as well as for usage as a software distribution medium. For example, today the VS operating system requires 17 diskettes and these must be shipped with each system.

The drive utilizes a tape cartridge which is available in lengths of 300, 450 and 600 feet. However, the 600 foot cartridge is manufactured by 3M and is not readily available in large quantities. The other two cartridges have been in production for several years and is produced by two vendors: 3M and Verbatim both of which are suppliers for other magnetic media devices. Capacity of the drive as well as backup time is based on the block length utilized in the drive and both are shown in Figures 1 and 2 being based on a 450 foot tape.

Kennedy produces basically two models of the same drive with the difference being only physical size. The unit as originally presented to us had the same height and width dimensions as a floppy but was significantly longer than a floppy. This additional length was caused by board size only. However due to many requests to produce a unit of floppy footprint size, Kennedy has modified boards to fall in this physical size. The longer version of this drive has been in production for several months at the rate of 30 units per week and with over 800 units in the field. This production rate is not a manufacturing limitation but instead an order constraint.
C) SPECIFICATIONS

Recording Density
Number of Tracks
Recording Head

Record Format
Normal Tape Speed
Rewind/Search Tape Speed

Start/Stop Time
Read/Write
Rewind/Search

Start/Stop Displacement
Read/Write
Rewind/Search

Error Rate
Soft
Hard

Data Transfer Rate

Instantaneous Speed Variation
Long Term Speed Variation

Write
Read

Power Requirements

Total Power Consumption

Interface

Weight

Dimensions

MTBF
MTTR

Price

6400 BPI
4
Serpentine, Read after Write, Selective Erase
Single Track, Serial
30 IPS
90 IPS

25 Msec
75 Msec

0.38 Inches
3.38 Inches

1 Error in 10^{10} Bits
1 Error in 10^{11} Bits

192,000 Bits Per Sec
(24,000 Bytes Per Sec)

+/- 3%
+/- 2%

Serial - Bidirectional
Bidirectional

5 VDC +/- 5%:
2.5A Average, 5A Peak

24 VDC +/- 25%:
1.5A Average, 3A Peak

21W Idle, 27 W Read/Write
39 Watts Rewind/Search
TTL Low - True

8 Lb

8.50 in W X 4.5 in H
14.25 in D

Greater than 5000 Hours
Less than 30 Minutes

$850
D) RISKS

1) Technical Risks
There is very little technical risks on our part in the area of this drive. The design of this drive is based on historical tape technology methods and is a consistent with bit and track densities achievable with cartridge being utilized. Also, controller design is simplified and software impact is minimized by having chosen a start/stop device over a streaming device since significant throughput problems are realized if system level solutions are not implemented to keep the drive busy.

2) Marketing Risks
We have two areas of exposure in this product: Time and price.
   i) Time
      Since deliveries of the Quantum drives is not gated by delivery of the backup device, there will be higher capacity systems in the field with no means of backup other than floppy. Thus it is important to bring begin delivery of this device as quickly as possible such as to minimize our exposure in this backup area.
   in) Price
      Pricing will be an extremely sensitive area. Since this drive will primarily be used for backup, it is expected that customer demand for the drive will very elastic over a small variation in drive price. Thus the drive price should be held to a minimum to maximize customer usage.

E) PACKAGING

The Kennedy drive will be packaged in a standalone box which will contain a switching power supply, drive and a controller. The controller will come in two flavors: 1) A single serial controller for the OIS and VS will be utilized and will physically reside in same package as the drive with interconnection via a data port. 2) The 2200, on the other hand, will attach to the drive via a parallel connection with the controller residing in the CPU. Due to the particular requirements of the Tempest product; packaging considerations must be addressed separately.

F) SCHEDULE
Vendor Selection Complete 12/15/81
Functional Specification 1/22/82
Controller Design Begins 2/12/82
Build 100 Pilot Boards 8/20/82
Announce Product 7/7/82
First Customer Shipment 11/4/82

G) COMPETITION
There are many smaller system houses who have announced subsystems utilizing
some form of low cost tape backup. However, there are only two large vendors who have announced a backup device as listed below:

1) Data General
Model Number: 6125
Type: 1/2" Reel to Reel streaming tape drive
Capacity: 25 Mbyte
Manufacturer: Data General
Price: $6,800

2) Hewlett Packard
Model Number: Tape drive is packaged with either 27 or 64 mbyte 14" Winchester drive priced as shown:
27 mbyte Disk Drive with cartridge drive $12,500
64 mbyte Disk Drive with cartridge drive $15,000
Type: 1/4" Cartridge Start/Stop
Capacity: 67 Mbytes
Manufacturer: 3M
Comments: This drive utilizes a preformatted cartridge only manufactured by 3M and not readily available in large quantity.

3) IBM - Have been shipping 64 mbyte 8" fixed media product for several years utilizing floppy disks housed in a magazine type device.

H) FORECAST
In order to forecast this device it is necessary to make the following assumption:
1) 2200
   a) That 20% of all 16 mbyte sales will utilize a Kennedy cartridge
   b) That 40% of all 32 Mbyte sales will utilize a Kennedy cartridge

2) OIS
   a) That 20% of all 16 mbyte sales will utilize a Kennedy cartridge
   b) That 40% of all 32 mbyte sales will utilize a Kennedy cartridge

3) VS
   a) That 40% of all 34 mbyte sales will utilize a Kennedy cartridge
   b) That 60% of all 68 mbyte sales will utilize a Kennedy cartridge

4) Tempest: Product volume not readily definable at this time.
I) **COST/PRICING**

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive Cost</td>
<td>$850</td>
</tr>
<tr>
<td>Estimated Packaging Cost</td>
<td>$95</td>
</tr>
<tr>
<td>Estimated Power Supply Cost</td>
<td>$150</td>
</tr>
<tr>
<td>Estimated Controller Cost</td>
<td>$350</td>
</tr>
<tr>
<td><strong>TOTAL ESTIMATED SYSTEM COST</strong></td>
<td><strong>$1445</strong></td>
</tr>
<tr>
<td>Burdened at 115%</td>
<td>$217</td>
</tr>
<tr>
<td><strong>TOTAL ESTIMATED BURDENED COST</strong></td>
<td><strong>$1662</strong></td>
</tr>
<tr>
<td>Proposed Pricing</td>
<td>$4500</td>
</tr>
<tr>
<td><strong>GROSS PROFIT MARGIN</strong></td>
<td><strong>63%</strong></td>
</tr>
</tbody>
</table>

I) **FUTURE PRODUCTS**

Kennedy is in the development stage of a higher capacity 1/4" start/stop cartridge tape drive; the Model 6470. The drive will have approximately 40 mbytes of capacity and will utilize the same interface as the device available today, and will have the capability of being able to read cartridges written on Model 6455 drives.
Representatives from the OIS, VS, and 2200 groups within Wang decided to adopt a universal format to be used on Magnetic Cassette Tapes. The format had to be flexible enough to allow for differences in file naming conventions and record allocation, as well as for future expansion of each product line.

This Wang Standard Tape Volume Format will aid in direct data portability between the OIS/VS/2200 groups. This document outlines the Wang Standard Tape Volume Format and the Tape Data Format.
1.1 Definitions

1.1.1 Label Blocks

Label blocks are symmetric about the tape volume and about files. There are two types of labels – Volume and File. The first label on the tape will be the VHDR (volume header) label and the last label on the tape will be the VEND (volume end) label. These label blocks are used to give the application programs some information about the tape such as the tape’s volume name, creation date, and the length of the tape. If the VHDR label block is not found within 3 feet of the beginning of the tape (BOT) the tape is considered not initialized.

The File label blocks are used to give information that is more "file oriented" such as the file name and the number of blocks in the file. Also information about the format used to record the file data is found here. This information is used to retrieve the data from the tape. A PHDR (file header) label will be written before each file and a FEND (file end) label will be written at the end of each file. The FEND block will contain the number of blocks in the file.

1.1.2 Tape Marks

Tape Marks (File Marks) will identify the next physical block as a label block. This will aid in scanning the tape during file read/write.

1.1.3 Multi-Tape Files

If a file is being written to tape when a Logical End Of Tape (LEOT) is reached (track 3), the file must be continued onto another tape. An FEND label block, containing a non-zero "Continuation Flag" to indicate that the end of the file is on another tape, must be written. Also a VEND label block must be written.

The first PHDR of the next tape for that continued file will contain an incremented "Tape File Section" number. See "File Labels" for more information.
1.2 Tape Structure

The tape will be structured as follows:

Tape Mark  - Signifies start of valid label block
Label block (VHDR)  ---
Tape Mark
Label block (FHDR)  ---
File Block  ! Tape Volume Label Group
File Block
File Block

Tape Mark
Label Block (FEND)
Tape Mark

Files 2 through N groups

Label Block (VEND)

where:

each Label Block is 256 bytes
each File Block is 2 - 17 K bytes (hardware restrictions).
1.3 **Volume Labels**

The volume labels will be formatted as follows:

<table>
<thead>
<tr>
<th>Bytes</th>
<th>Size</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3</td>
<td>4</td>
<td>VHDR or VEND (ASCII) = four byte area defines the label block. The first label block of the tape volume is the Volume Header (VHDR) label block. The last label block on the tape will be called the Volume End (VEND) label block.</td>
</tr>
<tr>
<td>4-11</td>
<td>8</td>
<td>Tape Volume Name (ASCII). A Tape identification containing up to 8 ASCII characters.</td>
</tr>
<tr>
<td>12-13</td>
<td>2</td>
<td>Max Tape Block Size (0000 - FFFF hex). The maximum number of bytes that can be written to one tape block. This will usually be a hardware constraint.</td>
</tr>
<tr>
<td>14-19</td>
<td>6</td>
<td>Date Tape Volume Initialized ddmmyy (ASCII)</td>
</tr>
<tr>
<td>20-25</td>
<td>6</td>
<td>Time Tape Volume Initialized hhmms (ASCII)</td>
</tr>
<tr>
<td>26</td>
<td>1</td>
<td>Label Format Version ID (01 - FF hex). This number identifies this Volume/File label block's &quot;release number&quot;. It will start as '01' for the first Volume/File label block format. As fields are added to either the Volume label block or the File label block, this number will change.</td>
</tr>
<tr>
<td>27-34</td>
<td>8</td>
<td>Access Control word (unused for now). Any tape security password or access control number can be stored here.</td>
</tr>
</tbody>
</table>
| 35    | 1    | Length of Tape.  
    1 = 300'  
    2 = 450'  
    3 = 600' |
| 36-255|      | Future definition |

*For definition of these fields contact Ken Kelly or OIS Development.*
1.4 **File Labels**

The file labels will be formatted as follows:

<table>
<thead>
<tr>
<th>Bytes</th>
<th>Size</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3</td>
<td>4</td>
<td>FHDR or FEND (ASCII) = four byte area defines the label block. The first label block of each file is the File Header (FHDR) label block. The last label block of each file will be called the File End (FEND) label block.</td>
</tr>
<tr>
<td>4-5</td>
<td>2</td>
<td>Tape File Sequence number. Numbers 0001-FFFF hex are used here. The first file of this tape will have a File Sequence number of 0001. The second file of this tape will have a 0002 etc.. This number is tape oriented only and is not affected by the Tape File Section number.</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>Tape File Section number (for continuing volumes). Hex numbers 1-FF are used here. This byte informs the application programs that previous sections of the file are located on other tapes. The byte is incremented for each tape used to contain the file.</td>
</tr>
<tr>
<td>7-14</td>
<td>8</td>
<td>Tape Volume Name of the tape volume which contains the start of this file. This is needed for files which use many tapes. This could contain the current tape volume name if the start of this file is on this tape.</td>
</tr>
<tr>
<td>15-20</td>
<td>6</td>
<td>Date Tape File Created ddmmmyy (ASCII)</td>
</tr>
<tr>
<td>21-26</td>
<td>6</td>
<td>Time Tape File Created hhmmss (ASCII)</td>
</tr>
<tr>
<td>27-29</td>
<td>3</td>
<td>Tape File Block Count (used in FEND only). This is the number (000000 - FFFFFF hex) of blocks contained in the file just written. This count is tape oriented and reflects only the number of blocks following the last FHDR label block. It does not define the total number of blocks of the original file.</td>
</tr>
</tbody>
</table>
The following bytes allow extra flexibility within the Label Block structure.

30 1 Record Format (00 - FF hex) reserved as follows:
    x'01' - x'10' OIS group
    x'11' - x'20' 2200 group
    x'21' - x'30' VS group
    x'0F' Wang standard record size.

This byte will help identify the use of the Block Size and the Record Size bytes which follow.

31-32 2 Tape File Block Size for this file (hex). A "Block" is a data area which can be read or written by one read or write command.

33-34 2 Tape File Record Size for this file (hex). A "Record" is a section within a block which contains actual data. A block size of 2K for example, may contain 8 256 byte subdivisions or "8 Records". Another implementation may be that a block contains block identifiers or data identifiers and a record or records. This is to say that a record size need not be an integer division of the block size.

35 1 System ID (00 - FF hex) reserved as follows:
    x'01' - x'10' OIS group
    x'11' - x'20' 2200 group
    x'21' - x'30' VS group

This byte will help determine the type of system which wrote this file: VS-100, VS-25 etc. OR determine that the tape files have been written using Wang Standard Tape File Format.

36-43 8 User Defined Bytes 1-8. Some of these bytes are defined for the Wang Standard Tape File Format.

44 1 Continuation Flag used in the FEND label block. Defined as:
    00 hex = End of entire file
    FF hex = File continued onto another Tape Volume.
Company Confidential

The File Name starts here:

45-52  8  System name: 8 ASCII characters left justified padded with x'00'.

53-60  8  Volume name: 8 ASCII characters left justified padded with x'00'.

61-68  8  Library Name: 8 ASCII characters left justified padded with x'00'.

69-169  10  File Name terminated by x'00'.

168-255  Future definition*

* For definition of these fields contact Ken Kelly or OIS Development.
The Wang Standard Tape Data Format uses the Tape Volume Format as described in the previous sections. The purpose of the standard data format is to allow complete data transportability between the various Wang systems. For example this will allow files written onto a tape by VS to be read from the tape by the 2200 as though it were written by the 2200. This means that all file storage/retrieval programs will normally be looking for the data in this format. Any application programs which handle multiple format types must handle the Wang format as the "normal" type. This standard must also be adopted by new systems using tape as a file storage media to assure media compatibility with all other Wang products.
TO: Distribution
FROM: John Thibault
SUBJ: MARKET REQUIREMENTS - 1/4 INCH TAPE CARTRIDGE
DATE: May 3, 1982

The following outlines the "major" product applications for the 1/4 inch tape device currently under development. These requirements apply to both the 2200 and VS product lines. Obviously, Wang cannot force a customer to use a device in which they purchased for any specific application. In addition to the base functionality which will allow this device to be at minimum, a functional tape drive, we must offer the utilities specific to this device which allows for a "user friendly" interface to the systems.

1. **Back-up** - Without doubt, the primary use of this device will be for system back-up. We highly recommend users back-up their systems on a regular basis for protection. With the availability of high capacity (10-15 MEG) back-up device, the time and effort required to back-up fixed disks are reduced. The basic functionality required is twofold: 1) The user must have the ability to back-up and restore a complete disk surface regardless of content; 2) The user must also have the ability to selectively back-up or restore any portion of a disk surface. This could be defined in any number of ways (i.e. volume, library, file or combination thereof) and driven by a reference file or procedure. These functions must be executable at the users discretion in either interactive or batch mode.

2. **SOFTWARE TRANSPORT** - The user must have the ability to effectively use the cartridge as a transport medium. This could be in either of two modes, alike-type system to system (i.e. VS to VS) or product line to product line (i.e. 2200 to VS) in any combination. This assumes a compatible tape format, and it is understood the VS will not support a compatible format until early Spring 1983.

3. **ARCHIVING** - Since all Wang systems support word processing, it is highly desirable to have the ability to create WP archive tapes. This must be in a compatible archive format so all systems can read/write WP archive files without USER conversion.

4. **SYSTEM IPL** - It's worth noting that due to the transfer speed of tape devices, and as long as Wang systems continue to offer system diskettes, there is not a requirement to IPL systems from 1/4 inch tape.

5. **SOFTWARE DISTRIBUTION** With the capacity available today, and the anticipated capacity increases in the near future the tape cartridge presents itself as a very attractive software distribution medium. A utility should be developed for the purpose of formatting and creating tapes for distribution. This would be used internally by our software distribution group and major accounts/vendors/system houses for their own distributions.
The base functionality mentioned above should cover most functions provided by a diskette, except system IPL. This outlines product marketing primary requirement. I am sure there are many uses/applications for this device not listed in this document which should also be considered. Any input would be appreciated.

John Thibault

0056S/EMS
TO: Distribution
FROM: Scott Tagen
SUBJ: $GIO commands for 1/4" Cartridge Tape Controller
DATE: 01/11/83

This document represents the final $GIO commands for the 2229 cartridge tape drive.

Distribution:

Neeraj Sen
Pete Seymour
Max Blomme

Bruce Patterson
Jerry Sevigne

Tried it up as well as, what?
Should ever see any of this?
Will manual describe when to use commands,
as well as, what they are?
<table>
<thead>
<tr>
<th>COMMAND</th>
<th>hex code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard Reset</td>
<td>01</td>
</tr>
<tr>
<td>Board status</td>
<td>02</td>
</tr>
<tr>
<td>Rewind</td>
<td>03</td>
</tr>
<tr>
<td>Load</td>
<td>04</td>
</tr>
<tr>
<td>Unload</td>
<td>05</td>
</tr>
<tr>
<td>Erase to end of track</td>
<td>07</td>
</tr>
<tr>
<td>Space IBG</td>
<td>08</td>
</tr>
<tr>
<td>Space reverse IBG</td>
<td>09</td>
</tr>
<tr>
<td>Space File Mark</td>
<td>OA</td>
</tr>
<tr>
<td>Space rev File Mark</td>
<td>OB</td>
</tr>
<tr>
<td>Read</td>
<td>OC</td>
</tr>
<tr>
<td>Write</td>
<td>OD</td>
</tr>
<tr>
<td>Write File Mark</td>
<td>OF</td>
</tr>
<tr>
<td>Erase IBG</td>
<td>12</td>
</tr>
<tr>
<td>Endwrite</td>
<td>20</td>
</tr>
<tr>
<td>Soft reset</td>
<td>30</td>
</tr>
<tr>
<td>Error status</td>
<td>31</td>
</tr>
<tr>
<td>Change write current</td>
<td>32</td>
</tr>
<tr>
<td>Download</td>
<td>40</td>
</tr>
<tr>
<td>End download</td>
<td>41</td>
</tr>
</tbody>
</table>

Any other commands will return ILLEGAL result (ret rn code = hex(01))

NOTE: Download and end download function only when operating out of PROM. Soft reset, hard reset and board status function out of both PROM and RAM. All other commands function out of RAM only.

The default address for the 2229 is 018. All response codes are in hex unless otherwise indicated.
2229 $GIO commands

HARDWARE RESET

This command functions identical to a power on sequence. The microcode will have to be downloaded after the powerup diagnostics complete (see DOWNLOAD).

CBS 01

Note that the CBS command does NOT wait for ready. The controller will go busy until the powerup diagnostics are complete.

$GIO/018 (4501)

BOARD STATUS:

WR/CBS x'02'

WR/IBS xx # of status bytes to follow (not counting this one)

WR/IBS
- Controller PROM rev 2 ASCII
- Controller software rev 2 ASCII
- Tape drive PROM rev 1 hex
- Controller switches 1 hex (low 4 bits valid)
- Last TAPE STATUS 1 1 hex
- Last TAPE STATUS 2 1 hex
- Code execution 1 hex
- Fault byte 1 hex
- Powerup diagnostic list 6 hex

DIM S$30, R$16

$GIO/018 (4402 8701 1800 C340,R$)STR(S$,1,VAL(STR(R$,1,1)))

Explanation of Board Status bytes:

Controller PROM rev  This is the revision of the 2732A PROM mounted on the tape controller daughter board (L6 on 8259 board). It contains the powerup diagnostics, the bootstrap for downloading, as well as most of the board repair diagnostics.

Controller software rev  If the controller microcode has been loaded, this will reflect the current revision.

Tape drive PROM rev  This is the revision of the 2732 PROM located on the formatter board of the Kennedy tape drive.
Controller switches

Status of 4 bit switch on daughter board (SW1 on 8260 board).

Switch 4 is on for normal use, off for diagnostic use.
Switch 1 is on for a 4 track drive, off for 7 track drive
Switches 2 and 3 are not normally used at this time.

Last TAPE STATUS bytes

These 2 status bytes are from the tape drive, and represent the results of the last tape operation.

Status Byte 1

<table>
<thead>
<tr>
<th>Bit</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>Not ready</td>
</tr>
<tr>
<td>40</td>
<td>Drive fault</td>
</tr>
<tr>
<td>20</td>
<td>No cartridge</td>
</tr>
<tr>
<td>10</td>
<td>Formatter error</td>
</tr>
<tr>
<td>08</td>
<td>Command error</td>
</tr>
<tr>
<td>04</td>
<td>Parity error</td>
</tr>
<tr>
<td>02</td>
<td>Length error</td>
</tr>
<tr>
<td>01</td>
<td>Data error</td>
</tr>
</tbody>
</table>

Status Byte 2

<table>
<thead>
<tr>
<th>Bit</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>Logical load point</td>
</tr>
<tr>
<td>40</td>
<td>Logical end of tape</td>
</tr>
<tr>
<td>20</td>
<td>File mark detected</td>
</tr>
<tr>
<td>10</td>
<td>Write protected</td>
</tr>
<tr>
<td>08</td>
<td>End of tape</td>
</tr>
<tr>
<td>04</td>
<td>Track bit 2</td>
</tr>
<tr>
<td>02</td>
<td>Track bit 1</td>
</tr>
<tr>
<td>01</td>
<td>Track bit 0</td>
</tr>
</tbody>
</table>

Code execution

00 = prom, 01 = ram

Fault byte

If the controller response to a command is Drive/controller fault, hex (08), this byte can be checked to see what caused the fault.
2229 $GIO commands

**DRIVE/CONTROLLER FAULTS:**

<table>
<thead>
<tr>
<th>decimal code</th>
<th>error description</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>CBSY true when no command executing</td>
</tr>
<tr>
<td>12</td>
<td>Control Request timeout (Cable not connected)</td>
</tr>
<tr>
<td>13</td>
<td>CBSY not set true after command strobe</td>
</tr>
<tr>
<td>14</td>
<td>Tape drive received command from controller with bad parity</td>
</tr>
<tr>
<td>15</td>
<td>Track status incorrect on track select command</td>
</tr>
<tr>
<td>16</td>
<td>Track select command failed</td>
</tr>
<tr>
<td>17</td>
<td>Track status incorrect on track select command</td>
</tr>
<tr>
<td>18</td>
<td>Track select command failed</td>
</tr>
<tr>
<td>19</td>
<td>Tape status byte 1 shows fault before LOAD or REWIND command</td>
</tr>
<tr>
<td>20</td>
<td>LOAD command failed</td>
</tr>
<tr>
<td>21</td>
<td>LOAD command did not bring tape to LLP</td>
</tr>
<tr>
<td>22</td>
<td>UNLOAD command failed</td>
</tr>
<tr>
<td>23</td>
<td>UNLOAD command did not bring tape to EOT</td>
</tr>
<tr>
<td>24</td>
<td>REWIND command failed</td>
</tr>
<tr>
<td>25</td>
<td>REWIND command did not bring tape to LLP</td>
</tr>
<tr>
<td>26</td>
<td>ERASE TRACK command did not bring tape to LEOT</td>
</tr>
<tr>
<td>27</td>
<td>ERASE TRACK command failed</td>
</tr>
<tr>
<td>28</td>
<td>SKIP FILE MARK command failed</td>
</tr>
<tr>
<td>29</td>
<td>SKIP FILE MARK REVERSE command failed</td>
</tr>
<tr>
<td>30</td>
<td>SKIP FILE MARK REVERSE command failed</td>
</tr>
<tr>
<td>31</td>
<td>SPACE IBG command failed</td>
</tr>
<tr>
<td>32</td>
<td>SPACE IBG REVERSE command failed</td>
</tr>
<tr>
<td>33</td>
<td>WRITE FILE MARK command did not detect File Mark</td>
</tr>
<tr>
<td>34</td>
<td>WRITE FILE MARK command failed</td>
</tr>
<tr>
<td>35</td>
<td>ERASE GAP command failed</td>
</tr>
<tr>
<td>36</td>
<td>Overflow of Kennedy parity errors</td>
</tr>
<tr>
<td>37</td>
<td>Repositioning error during write error recovery</td>
</tr>
<tr>
<td>38</td>
<td>Read error while repositioning tape</td>
</tr>
<tr>
<td>39</td>
<td>Error on read (not Data Error)</td>
</tr>
</tbody>
</table>

**Powerup diagnostic list**

6 bytes of error information, only valid if Fault byte is x'0A' (dec 10)

**NOTE:** Ram parity error will flash all lamps on drive and lamp on controller. This condition can be cleared only by resetting the controller.
REWIND:

WR/CBS   x'03'

WR/IBS   00  Operation OK
        03  Drive not ready
        05  Write results pending
        08  Drive/controller fault

$GIO/018 (4403 8701,R$)

Rewind will position tape at Logical Load Point on the first track, clear all caches, and wait for a new command. Note that a LOAD command is not required after a rewind.

LOAD:

WR/CBS   x'04'

WR/IBS   00  Operation OK
        03  Drive not ready
        05  Write results pending
        08  Drive/controller fault

$GIO/018 (4404 8701,R$)

LOAD causes the tape formatter to perform a self-test, followed by a tape tensioning procedure. No other commands (except STATUS, RESET and ERROR STATUS) can be executed until a LOAD is successful.

UNLOAD:

WR/CBS   x'05'

WR/IBS   00  Operation OK
        03  Drive not ready
        05  Write results pending
        08  Drive/controller fault

$GIO/018 (4405 8701,R$)

UNLOAD causes a fast forward to the end of tape, after which the tape cartridge can be removed.
2229 $GIO commands

ERASE to end of track:

WR/CBS x'07'

WR/IBS 00 Operation OK
02 Out of tape
03 Drive not ready
04 Write protected
05 Write results pending
08 Drive/controller fault

$GIO/018 (4407 8701,R$)

The tape is erased from the present position to the end of the track.

SPACE IBG:

WR/CBS x'08'

WR/IBS 00 Operation OK
02 Out of tape
03 Drive not ready
05 Write results pending
07 File mark detected
08 Drive/controller fault

$GIO/018 (4408 8701,R$)

The tape will position itself to the next Inter-Block Gap. If a File Mark or End of Tape is encountered, it will be reported.

SPACE REVERSE IBG:

WR/CBS x'09'

WR/IBS 00 Operation OK
02 Out of tape
03 Drive not ready
05 Write results pending
07 File mark detected
08 Drive/controller fault

$GIO/018 (4409 8701,R$)

This command is same as SPACE IBG, except that tape moves in reverse direction.
SPACE FILE MARK:

WR/CBS  x'0A'

WR/IBS  00  File mark found
         02  End of Tape
         03  Drive not ready
         05  Write results pending
         08  Drive/controller fault

$GIO/018 (440A 8701,R$)

This command will advance to tape to the next File Mark, or end of tape, whichever comes first.

SPACE FILE MARK REVERSE:

WR/CBS  x'0B'

WR/IBS  00  File mark found
         02  Out of tape (at beginning of tape)
         03  Drive not ready
         05  Write results pending
         08  Drive/controller fault

This command is same as Space File Mark, except tape moves in reverse direction.

$GIO/018 (440B 8701,R$)
$GIO\ commands$

READ RECORD:

WR/CBS  x'0C'

WR/IBS  00  Read successful
         02  Out of Tape
         03  Drive not ready
         05  Write results pending
         06  Data error
         07  File Mark detected
         08  Drive/controller fault

(Operation continues only if previous byte was 00)

WR/IBS  High byte of byte count
WR/IBS  Low byte of byte count

WR/IBS  data block

NOTE:  Read data array must allow for maximum record length that is
       written on tape

$GIO/018 (440C 8701,R$)  If STR(R$,1,1) = hex (00) then continue

$GIO/018 (8702 8703,R$)  Get record byte count

$GIO/018 (1800 C340,R$) STR(A$(),1,VAL(STR(R$,2,2),2))
WRITE:

WR/CBS x'OD'

WR/OBS High byte of block count
WR/OBS Low byte of block count

WR/IBS 00 OK
       01 Illegal length
       02 End of Tape
       03 Drive not ready
       04 Write protected
       05 Write results pending
       08 Drive/controller fault

Operation continues only if previous byte was 00

WR/OBS Data Block

Write tells the controller to accept a new block of data. The tape controller can cache two blocks of data in order to allow overlap of disk reads and tape writes. Write commands will be accepted continuously until either an error occurs or the end of tape is reached. The block length can be from 2 bytes to 16386 bytes. Any other length will generate an ILLEGAL response.

B = length of record (2 to 16386 bytes)

\[
\text{STR(R$2,2)} = \text{BIN}(B,2)
\]

convert byte count to hex

\[
\text{$GIO/018 (440D 4220 4230 8701,R$)}
\]

operation continues if \(\text{STR(R$,1,1)} = \text{hex (00)}\)

\[
\text{$GIO/018 (1300 A000,R$)} \text{STR(A$(2,1),VAL(STR(R$,2,2),2))} \text{ transfer data}
\]

NOTE: The last write command must be followed by an ENDWRITE command. Also, if the response byte is 05 (results pending), the next command MUST be an ENDWRITE command.
WRITE FILE MARK:
WR/CBS  x'OF'
WR/IBS  00  OK
         02  End of Tape
         03  Drive not ready
         04  Write protected
         05  Write results pending
         06  Data error
         08  Drive/controller fault

$G10/018 (440F 8701,R$)

ERASE IBG:
WR/CBS  x'12'
WR/IBS  00  OK
         02  End of Tape
         03  Drive not ready
         04  Write protected
         05  Write results pending
         08  Drive/controller fault

$G10/018 (4412 8701,R$)

ENDWRITE:

Endwrite terminates a sequence of 1 or more write commands by requesting the final results as well as any blocks unwritten (in the case of an error condition). Once a write command has been accepted, no other commands except additional writes or a reset will be accepted until an endwrite is performed.

WR/CBS  x'20'
WR/IBS  00  All writes successful
         02  End of tape
         03  Drive not ready
         06  Data error
         08  Drive/controller fault
WR/IBS  xx  Number of blocks unwritten

$G10/018 (4420 8701 8702,R$)
B = VAL(STR(R$,2,1))  B = number of blocks not written
SOFTWARE RESET

The software reset will terminate any operations in progress, clear all caches, and clear the tape formatter. This is identical to the HARDWARE RESET except that the microcode in the controller is not cleared. Note that if the 2200 RESET key is pressed in the middle of communication to the tape controller, a HARDWARE RESET may be the only way to re-establish communications.

WR/CBS 30 $GIO/xyz (4530,R$)

The controller will respond by going busy until all the above operations are complete.

ERROR STATUS:

WR/CBS x'31'

WR/IBS xx # of status bytes to follow (not including this one)

WR/IBS
Write retries (last write) 1 hex
Read retries (last read) 1 hex
Accumulated write retries 2 hex
Accumulated read retries 2 hex
Tape to Controller parity errors 1 hex
Controller to tape parity errors 1 hex

All error information is cleared after taking error status.

CHANGE WRITE CURRENT:

WR/CBS x'32'

WR/IBS
00 Command complete
03 Drive not ready
05 Write results pending
08 Drive/controller fault

The currently available tape cartridges are DC300 (300') and DC300XL (450'). If and when 600 foot cartridges are available, the write current will be different. The tape drive defaults to the 'normal' current for 300 and 450 foot tapes. Executing the CHANGE WRITE CURRENT command will allow 600 foot tapes to be used. A SOFT RESET or HARD RESET will change the current back to 'normal'.
2229 $GIO commands

These 2 commands only function when the controller is operating out of PROM. The controller can always be brought back to the PROM code by executing a HARD RESET.

DOWNLOAD:

WR/CBS x'40'
WR/OBS Address of data (high byte, low byte)
WR/OBS # of bytes
WR/OBS data block

The download sequence will repeat for all sectors of the microcode data file.

END DOWNLOAD:

WR/CBS x'41'

This command terminates the download routine and starts code execution at the start of ram (x'1000').

SUGGESTED DOWNLOADING PROCEDURE:

Controller status should be read to insure that the power up diagnostics passed (see BOARD STATUS command)

10 DIM R$16,X$2,X1$3,X$(4)60,D$3
20 LINPUT "Disk Address ",D$
30 SELECT#1 [D$]
40 LIMITS T#1, '@2229",A,B,C,D
50 IF A =2THEN60
60 DATALOAD DC OPEN T#1, "@2229"
70 DATALOAD DC #1, X$,X1$,X$( )
80 IF END THEN 150
90 IF STR (X$,1,1) = HEX(01) THEN 120
100 REM else record is comment - X$( ) can be printed if desired
110 GO TO 70
120 STR(R$,1,2)=X1$
130 STR(R$,3,1)=STR(X1$,3)
140 $GIO/018 (4440 4210 4220 4230 1800 1300 A000,R$)
150 $GIO/018 (4441, R$)

Board status should then be read to check if code is now executing out of RAM.
2229 Diagnostic Test

This test will exercise the 2229 controller and tape drive in a manner similar to the actual tape utilities.

WARNING:

This diagnostic will overwrite any data on the tape!!!

Overview of diagnostic:

The tape is filled with random length records of random data. The tape is then completely read. Any errors found will terminate the test. The test will run continuously until either stopped by the user (by pressing RESET) or an error occurs. This test should be left running overnight if possible. The failure messages and test conditions are as follows:

'Unexpected end of tape on read'

This message indicates that the number of records written on the tape were not equal to the number of records read from the tape. This would be either a bad controller or tape drive.

'Error on tape load'

The tape drive is offline, powered off, or a cartridge is not inserted. Also, a bad controller, tape drive; or unconnected cable could cause the problem.

'Error on write'

An error occurred during a tape write. This would probably be a fault with the tape drive or tape cartridge, or possibly the controller.

'Error on read'

This error indicates that a record could not be read within the maximum number of retries. A bad tape drive would be the most likely problem.

'The number of bytes read is not equal to the number of bytes written'

This is most likely a controller problem.

'Data compare error'

This is most likely a controller problem.

'Illegal record length'

A record was read which was outside the range of records written to the tape. The controller or tape drive would be the most likely suspects.
Error messages also may produce an error or result byte (i.e. ERROR 3 ON TAPE LOAD). Some of the errors should never happen, but they are listed here anyways.

ERROR 1        ILLEGAL COMMAND
ERROR 2        OUT OF TAPE
ERROR 3        TAPE NOT READY
ERROR 4        TAPE WRITE PROTECTED
ERROR 5        WRITE RESULTS PENDING
ERROR 6        DATA ERROR (read or write)
ERROR 7        TAPE FILE MARK FOUND
ERROR 8        DRIVE CONTROLLER FAULT

The test is named '2229DIAG'. Copy the file to the disk which contains the 2229 utilities (this test MUST be on the same disk, as it uses some of the files provided by the utilities). Select the disk which contains the utilities (i.e. SELECT DISK D11), and type LOAD RUN "2229DIAG" (press RETURN). The test will start up in the same way as the 2229 utilities. The operator will be warned about the test destroying the data on the tape, and prompted to press SF '00 to start the test.
PURPOSE:
To inform the field of known problem with the 2229 cartridge tape drive.

EXPLANATION:
There is a known intermittent problem with the 2229 Controller board, when restoring from a backup tape. If the condition exists, then during the restore one of several errors may occur. They could be intermittent error code '8', Tape Read Error, Label is not 256 bytes, Data not on Page or any other error during system backup. When restoring from the 2229, the data will appear to be garbage even though the original backup appeared to run without a problem, but now the data has random 00's or FF's in it.

ECO has been processed, so that more boards (#210-8260) can be updated & sent out.
**WORKSTATION 113 - USER PEM - PAUL MORIN X-60350**

10:19:05 AM    MONDAY    MAY 20, 1985

* * *
* 1* VS EXPRESS: DISPLAY A MEMO
* 2* (1/15) SAVE/PRINT
* 3* (2) REROUTE
* 4* (4/5) PREV/NEXT MEMO
* 5* (8) DELETE MEMO
* 6* (13) SPECIAL OPTIONS
* 7* (14/14) INS/DEL LINE
* 8* (16/16) RETURN/EXIT

* * *

* 1* TO: PAUL MORIN VS100-1
* 2* FROM: KEN MAILLoux VS100-1
* 3* SENT: 1/15/85 9:29
* 4* SUBJECT: 2229 UTILITIES CREATE REF

* * *

--- IN THE 2229 CARTRIDGE UTILITIES: CREATE REFERENCE FILE PROGRAM WILL

APPEAR TO ACCEPT MORE THAN 1000 FILES. HOWEVER THE REFERENCE FILE THAT IS
ACTUALLY CREATED WILL CONTAIN ONLY THE FIRST 1000 FILES CHOSEN. WHEN THE
UTILITY "BACKUP FILES TO TAPE" IS SUBSEQUENTLY USED WITH THE BOGUS
REFERENCE FILE, ONLY THE FIRST 1000 FILES WILL BE RECOVERED. CIRCUMVENTION:
USE "BACKUP PLATTER TO TAPE" FOR NOW. SCOTT TAGEN WILL BE SENDING US A FIX
SHORTLY.

--- MESSAGE REPLY FROM (KEN MAILLoux VS100-1) -------

* * *
** VS EXPRESS: DISPLAY A MEMO  (1/15)  SAVE/PRINT  *
  * 2*  route  *
  * 3*  TO:  PAUL MORIN VS100-1  (4/5)  PREV/NEXT MEMO  *
  * 4*  FROM:  KEN MAILLOUX VS100-1  (8)  DELETE MEMO  *
  * 5*  SENT:  1/15/85  9:29  ("13)  SPECIAL OPTIONS  *
  * 6*  SUBJECT:  2229_TAPE_CARTRIDGEE  (14-14)  INS/DEL LINE  *
  * 7*  **  (16-15)  RETURN/EXIT  *
  * 8*  **
  * 9*  **

** IN THE 2229 UTILITIES:  **
  * 10*  IF RECOVER PLATTER OPTION ENDS PREMATURELY WITH THE MESSAGE:  **
  * 1*  "DATA NOT ON PAGE BOUNDARY"  **
  * 2*  **
  * 3*  **
  * 4*  **
  * 5*  THE ORIGINAL BACKUP TAPE WAS WRITTEN INCORRECTLY WITH THE  **
  * 6*  BACKUP PLATTER UTILITY AND THE ERROR IS JUST NOW SHOWING UP.  **
  * 7*  **
  * 8*  THE PROBLEM INDICATES THAT THE CONTROLLER HAS AN INCORRECT  **
  * 9*  CHIP IN LOCATION 14. IT SHOULD BE AN INTEL 40 PIN CHIP BUT  **
  * 20*  SOME BOARDS ARE OUT THERE WITH 80 CHIPS.  **
  * 1*  **
  * 2*  ONE SECTOR OF DATA IS BAD ON THE TAPE AND IF IT IS ESSENTIAL  **
  * 3*  R&D WILL BE ABLE TO RECOVER IT FOR THE CUSTOMER.  **
  * 4*  **
10:17:32 AM  MONDAY  MAY 20, 1985

1*  VS EXPRESS: DISPLAY A MEMO
  (1/15)  SAVE/PRINT  *  1*
2*  REROUTE  *  2*
3*  TO:  PAUL MORIN VS100-1  (4/5)  PREV/NEXT MEMO  *  3*
4*  FROM:  KEN MAILLOUX VS100-1  (8)  DELETE MEMO  *  4*
5*  SENT:  1/15/85  9 31  (13)  SPECIAL OPTIONS  *  5*
6*  SUBJECT:  2229_TAPE_CASSETTES-----  (14/14)  INS/DEL LINE  *  6*
7*  ------  (16/16)  RETURN/EXIT  *  7*
8*  9*  PRICE OF THE CARTRIDGES USED WITH THE 2229 IS $34.50  *  9*
10*  PART # 725-1227  *  10*
1*  MESSAGE REPLY FROM (KEN MAILLOUX VS100-1 )  *  1*
2*  *  2*
3*  *  3*
4*  *  4*
5*  *  5*
6*  *  6*
7*  *  7*
8*  *  8*
9*  *  9*
20*  *  20*
1*  *  1*
2*  *  2*
3*  *  3*
4*  *  4*
5*  *  5*

1*  2*  3*  4*  5*  6*  7*  8*  9*  10*
1. VS EXPRESS: DISPLAY A MEMO

2. TO: Paul Morin VS100-1

3. FROM: Ken Mailoux VS100-1

4. Sent: 1/15/85 9:15

5. Subject: 2229_FILE_BACKUP_FIX

6. (1/15) SAVE/PRINT

7. (4/5) PREV/NEXT MEMO

8. (8) DELETE MEMO

9. (13) SPECIAL OPTIONS

10. A CUSTOMER WHO HAS LARGE DATA FILES AND CHOSSES FILE BACKUP INSTEAD OF

11. PLATTER BACKUP CAN HAVE A PROBLEM. IF THE FILES ARE LARGE ENOUGH TO SPAN

12. TAPE 1, THE RECOVERY WILL NOT WORK. RECOVER FILES FROM TAPE WILL RECOVER THE

13. FIRST TAPE CORRECTLY AND THEN PROMPT FOR THE SECOND TAPE. THE USER LOADS

14. TAPE 2 AND THE ERROR MESSAGE "MOUNT FILE BACKUP, TAPE MOUNTED IS PLATTER

15. BACKUP" AND THE RECOVERY PROCESS (ABOUT 75% COMPLETE) CANNOT CONTINUE.

16. THANKS TO LEE AND SCOTT TAGE(LEE SPOKE TO HIM ON A FRIDAY AND HE CALLED

17. LEE BACK FIRST THING ON A MONDAY AFTER WORKING

18. ON IT OVER THE WEEKEND) WE HAVE A FIX:

19. PROGRAM IS 2229FP INSERT GOTO 300; TO LINE 295. IT WILL BE THE

20. FIRST STATEMENT IN THE LINE, YOU MIGHT WANT TO SLEEP THE OTHER SIX.

21. YOURS TRULY IN MAGNETIC MEDIA,

22. K. Denis Mailoux

* *
Version 1.8 of the 2229 utilities is now ready for internal test. Please DO NOT send it to anyone outside of the city limits of Lowell until it is officially released. Read the following pages before starting any testing. If you know of any other problems, let me know ASAP. The utilities disk has @MENU, etc., so you can select the disk and type LOAD RUN to start.

Please test the following FIRST:

Run tape verification (2229VER) on all old tape backups, both File and Platter. The utility should run on all existing tapes. Any errors found will stop the utility. You may find that tapes written with controllers which were recently updated with the hardware fix may have unrecoverable read errors, or garbage records. Successfull completion will print the message 'Tape Verification Done - No Errors Found'. If you find any tapes which will not pass the verification test, save them and call me.

Run the tape diagnostic (a modified BTEST41, if you know what that means). It will show any problems with your controller or drive. Note that it prints out the drive PROM revision - it should be 16.

Run Platter or File recovery on all old tape backups. The new recovery programs should run on old backups. Again, call me if you have any problems.

If all goes well, try the changes to 'Create Reference File'.

Finally, test the remaining utilities in any way you can. There are some additional menu picks which will NOT be on the 'real' release. You may use them for your testing purposes, but please DO NOT give them to customers or other field organizations. They are hacks which I used for my testing - they are very crude, and can easily crash due to user errors. They function as follows:

'File Compare' - compares 2 files, and displays them on the screen. Press a key to see the next 256 bytes.

'Another File Compare' - Doesn't stop on each screen - look fast at the 'Same/Not Same' message.

'Display tape records' - The tape microcode must be loaded, and a cartridge inserted for this to work. It will read and display the Volume and File labels, as well as the data records.

'Compare two platters (sector compare)' - Enter two platter addresses, and all sectors (up to the current catalog end of the reference platter) will be compared. Any sectors which differ will be printed on the screen.

'Compare all files on two platters' - The index is searched on the reference platter for all files on the disk. Each file is then compared to the test disk for existence, size, and data. Any discrepancies are displayed on the screen.
The following menu picks are primarily for my use – be careful if you play with them:

'Make uCode file' – You won't need this.

'Command exerciser' – (This is 'BU' in disguise). This allows one to exercise individual tape commands. You can play with it, but I don't know what you will gain.

'Copy files to floppy' – This is used for moving all of the tape related files to another disk. (I use it for backup during development). It will not expand files, so if you have problems, use '@MOVEFIL'.
The following changes have been made to the 2229 utilities since the first
(only) release. If you know of any other problems, please let me know ASAP.

All files:

Copyright notices have been added
A comment 'version 1.8' has been added
Many messages have been made clearer (i.e. the message 'Read error' has been
changed to 'Tape read error')

Platter Backup:

The 'System ID', byte 35 of the File Header and Trailer, has been changed
from x'11' to x'12' in order to recognize tapes made with the new utilities.

Platter Recovery:

The System ID is checked for the proper range (x'11' to x'20) which
identifies 2200 backups.
When recovering a platter, a bad block will not halt the recovery. The
unrecoverable sectors will be displayed (i.e. sectors 128 to 191), and the
user will have the option of skipping the block and continuing. The utility
will pick up writing the disk at the correct spot upon finding the next good
block.
After reading a record from the tape, the next tape read is initiated
before writing the data to the disk. This makes platter recovery run faster.

Recover Individual File from Platter Backup:

The System ID is checked for the proper range (x'11' to x'20) which
identifies 2200 backups.
If the disk image on tape had an index sector size of 1, only the first
file name would be displayed when the user printed out the catalog index.

File Backup:

The 'System ID', byte 35 of the File Header and Trailer, has been changed
from x'11' to x'12' in order to recognize tapes made with the new utilities.
If the number of sectors in a file was 1 greater than an even number of
16K blocks, the last sector (the trailer record) would not be written to the
tape.
The file names contained on the tape were not being properly saved in the
index (PROBE F40019).
File Recovery:

The System ID is checked for the proper range (x'11' to x'20') which identifies 2200 backups.

When recovering a file, a bad block will not halt the recovery. The unrecoverable sectors will be displayed (i.e. sectors 128 to 191), and the user will have the option of skipping the block and continuing. The utility will pick up writing the disk at the correct spot upon finding the next good block.

After reading a record from the tape, the next tape read is initiated before writing the data to the disk. This makes recovery run faster.

Create Reference File:

The disk index search for file names stops at the last index sector, rather than one plus the last sector (PROBE # F009109).

A maximum of 2048 files are saved in the reference file, rather than only the first 1000 (PROBE # F400190).

Special function keys 00, 01, 02, and 03 now allow the user to select all Active Programs, Active Data, Scratched Programs, or Scratched Data files to be included in the reference file (see attached screen dump).

Subroutines (Used by backup and recovery programs):

A controller reset was added to the tape load routine to handle a possible problem with a load being attempted when the tape drive was powered off.

The 'start look-ahead read' subroutine was added.

The read routine was modified to allow handling of bad blocks.

Records read from the tape are checked for an illegal length, which is a symptom of a problem in the tape controller. If an illegal length record is found, the following message is printed:

"Drive/Controller error - tape record too large"
"Tape controller possibly not latest hardware revision"

Tape Diagnostic:

A diagnostic has been added to allow users to test the drive/controller. This diagnostic has proven effective in determining whether the controller has the recent hardware problem (see attached screen dump).
Verify tapes:

This new utility allows the user to verify the integrity of either a recent or old backup. The complete tape (or tape set) is read, testing the following:

All file marks, labels, and data blocks can be read
All data blocks and labels are the proper length
All label information is intact and correct
The correct number of files are on the tape
The correct number of sectors and blocks are in each file
The correct number of tapes (in a tape set) are found

This utility works similar to a disk verify; the data are verified that they can be read, but are not compared to the disk data. This coupled with the tape diagnostic, should give the user confidence in his backups (See the sample screen dumps attached).

NOTE: Tapes written with controllers which did not have the recent hardware E.C.O. are likely to fail this test - in other words, this test will find problems with the tape writing process. If you have any questions regarding the results of this test, call me at 77197.
**CREATE REFERENCE FILE**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Sectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>.2229</td>
<td>P</td>
<td>9</td>
</tr>
<tr>
<td>.STARTD</td>
<td>SD</td>
<td>3</td>
</tr>
<tr>
<td>2229COMP</td>
<td>P</td>
<td>9</td>
</tr>
<tr>
<td>2229CONV</td>
<td>P</td>
<td>14</td>
</tr>
<tr>
<td>2229DIAG</td>
<td>P</td>
<td>16</td>
</tr>
<tr>
<td>2229DISP</td>
<td>P</td>
<td>48</td>
</tr>
<tr>
<td>2229FB</td>
<td>P</td>
<td>50</td>
</tr>
<tr>
<td>2229FR</td>
<td>P</td>
<td>62</td>
</tr>
<tr>
<td>2229FS</td>
<td>P</td>
<td>46</td>
</tr>
<tr>
<td>2229IFR</td>
<td>SP</td>
<td>46</td>
</tr>
<tr>
<td>2229FB</td>
<td>P</td>
<td>72</td>
</tr>
<tr>
<td>2229FC</td>
<td>P</td>
<td>10</td>
</tr>
<tr>
<td>2229PFC</td>
<td>P</td>
<td>24</td>
</tr>
<tr>
<td>2229FR</td>
<td>P</td>
<td>54</td>
</tr>
<tr>
<td>2229SAVE</td>
<td>SP</td>
<td>10</td>
</tr>
<tr>
<td>2229STRT</td>
<td>P</td>
<td>16</td>
</tr>
</tbody>
</table>

**Disk address** D22

**Files selected** 2

**ACTIVE KEYS**

- Cursor Up/Down
- Space/Backspace
- Insert/Delete
- A / Select all files
- N / Next Screen
- P / Previous Screen
- SF '00 - All P
- SF '01 - All P
- SF '02 - All SP
- SF '03 - All SP

Press RUN when done.

---

**NEW CREATE REFERENCE FILE**

**SF '02 key has been pressed - thus selecting all Scratched Programs.**

(The printer is responsible for the indentation problem)
Sample diagnostic program output
TAPE VERIFICATION

Tape volume name: SYSFILES
Date: 030386
Time: 112317
Comments: D2O SYSTEM FILES - PLATTER BACKUP - MAR 3, 1986

Tape Sequence number: 01
819 sectors in backup

Reading file number 1
D20 BASIC-2 platter backup

Sectors read: 192
Blocks read: 3

SAMPLE TAPE VERIFICATION
ON PLATTER BACKUP
TAPE VERIFICATION

Tape volume name SYSFILES
Date 030386
Time 111800
Comments: D21 SYSTEM FILES BACKUP - MARCH 3, 1986

Reading file number 5 @GENPART

Sectors read 280
Blocks read 5

SAMPLE SCREEN FOR TAPE VERIFICATION OF FILE BACKUP