WANG

2200

Model 2229
Cartridge Tape Drive
User Manual

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PREFACE

This manual describes the operation of the Wang Model 2229 Cartridge Tape Drive, a peripheral designed to provide reliable backup for Wang 2200LVP, MVP, and VP systems.

Information for using the Cartridge Tape Drive is organized into three chapters. Chapter 1 contains general information, Chapter 2 explains the controls and indicators, and Chapter 3 provides information for using 2229 Tape Utilities. An appendix contains physical specifications for the tape drive.

For additional information on 2200 system operations, refer to the following Wang reference manuals:

BASIC-2 Language Reference Manual (700-4080)

BASIC-2 Disk Reference Manual (700-4081)

2200LVP Introductory Manual (700-6164)

2200MVP Introductory Manual (700-4693)

2200VP Introductory Manual (700-4282)

CONTENTS

FIGURES

CHAPTER 1
MODEL 2229 GENERAL INFORMATION

1.1 INTRODUCTION

The Wang Model 2229 Cartridge Tape Drive (Figure 1-1) is a peripheral that uses a 1/4-inch magnetic tape cartridge to store data. It is compatible with Wang 2200LVP, MVP, and VP processors.

The Tape Utilities menu offers several options that allow you to back up a disk platter to tape, recover a disk platter from tape, recover a single file from tape, create a reference file, back up selected files to tape, recover selected files from tape, and tension the tape cartridge. The versatility of the cartridge tape drive allows you to define other applications to include copying removable hard disks and transferring files between compatible Wang 2200 systems.

Figure 1-1. Model 2229 Cartridge Tape Drive

1.2 CONCEPT OF OPERATION

The cartridge tape drive is a 4-track, 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 four tracks have been recorded or read. Data is recorded at a density of 6400 bits per inch (bpi). Depending upon the application and recording block size, up to 15 megabytes of data can be stored on a 450 ft tape cartridge. Tape speeds are 30 inches per second (ips) during record/read, and 70 ips during rewind.

1.3 INSTALLATION

The Model 2229 Cartridge Tape Drive must be unpacked, inspected, and installed by a Wang service representative. Upon delivery of the unit, call the Wang service office and request that this service be performed. Failure to follow this procedure voids the warranty.

CHAPTER 2
OPERATING PROCEDURES

2.1 CONTROL PANEL

The operating controls and indicators for the Model 2229 Cartridge Tape Drive (Figure 2-1) are located on the left side of the front panel.

Figure 2-1. Model 2229 Controls and Indicators

The ONLINE button places the tape drive on-line and enables it to respond to commands entered from the terminal. When you place the drive on-line, the indicator lights. When you press the button a second time, the tape drive is brought off-line, and the indicator light goes out.

The FAULT indicator lights when an unrecoverable error condition exists in the controller board or the tape drive. Generally, this type of error is not user-caused. If the light continually comes on, report it to a Wang service representative immediately.

The TAPE LOADED indicator lights when the program has finished loading a tape; it blinks while the tape is being either loaded or unloaded.

The POWER ON indicator lights when you apply power to the tape drive.

The power switch controls all operating power to the tape drive. Press 1 to apply power to the unit and 0 to remove power.

2.2 OPERATING THE CARTRIDGE TAPE DRIVE

Ensure that the cartridge tape drive is plugged into a suitable source of AC power and that it is properly connected to a compatible 2200 series processor. Press the power switch to apply power to the unit. You can insert a tape cartridge at this time or when prompted by the Tape Utilities program. To insert a tape cartridge, place it into the opening on the front panel and push until the cartridge is fully seated. To remove a cartridge, grasp it firmly and pull straight out.

2.3 WRITE PROTECT FEATURE

A write-protect selector (Figure 2-2) is located in the upper left corner of the tape cartridge. When the arrow on the write protect selector is pointing to the SAFE position, you cannot write over the tape. To engage this feature, use a flat-bladed instrument to rotate the selector clockwise until a click is heard, and the arrow is aligned with SAFE. To copy over a tape, rotate the selector counterclockwise until it clicks into position with the arrow facing away from SAFE.

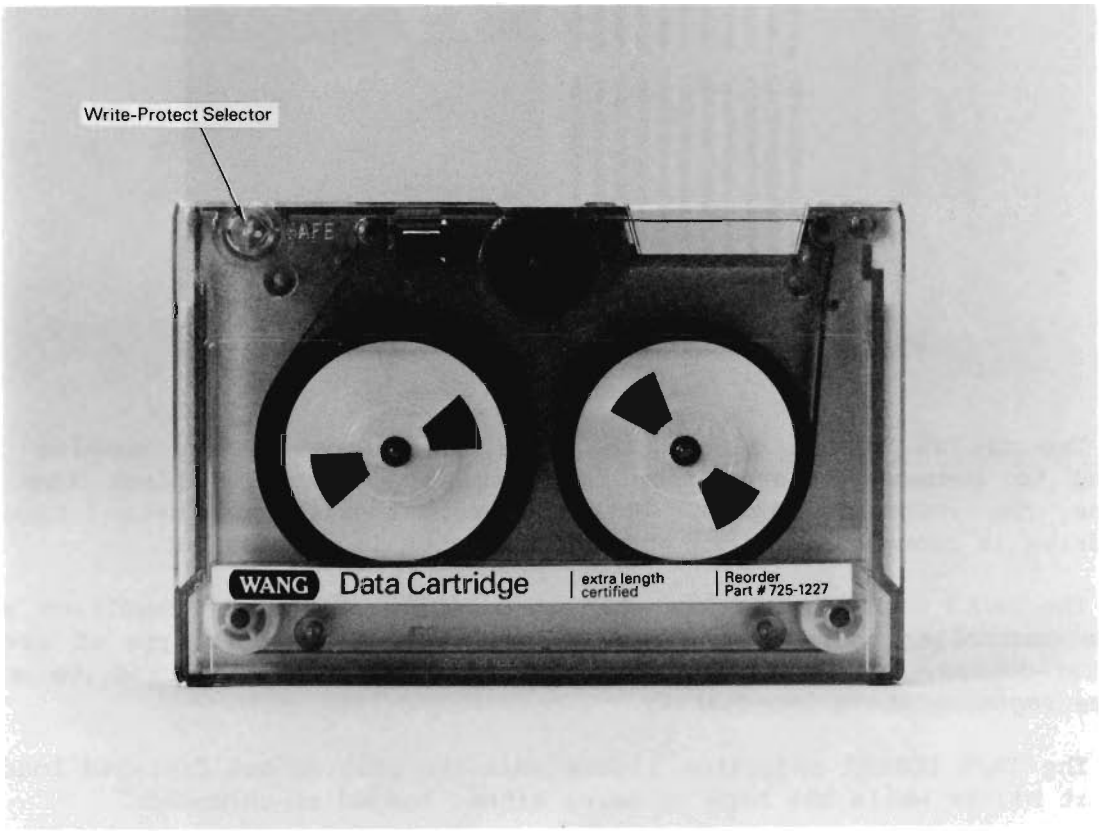

Figure 2-2. Tape Cartridge

2.4 HANDLING OF TAPE CARTRIDGES

You should observe several precautions should to protect data stored on a tape cartridge. Store the cartridges in a cool, dry place off the floor, in their protective boxes. Do not expose tapes to prolonged direct sunlight, strong magnetic fields, excessive humidity, or temperature extremes. To minimize dust contamination, the computer room should be kept clean. Smoking in the computer room is not recommended, as ashes can damage the tape's surface.

2.5 ORDERING TAPE CARTRIDGES

Magnetic tape cartridges are available from Wang Supplies Division in 450 foot lengths (part number 725-1227). To place an order, call: 1-800-225-0234. From Massachusetts, Hawaii, and Alaska, call: (617) 256-1400.

2.6 MAINTENANCE

Wang recommends that you perform no maintenance on the cartridge tape drive. For periodic cleaning and service, you should contact a Wang field service representative. If you have a Wang service agreement, this maintenance is performed at regular intervals.

CHAPTER 3
TAPE UTILITIES

3.1 UTILITIES MENU

From the Main menu, select "2229 Utilities menu" and press RUN; the 2229 Utilities menu appears (Figure 3-1).

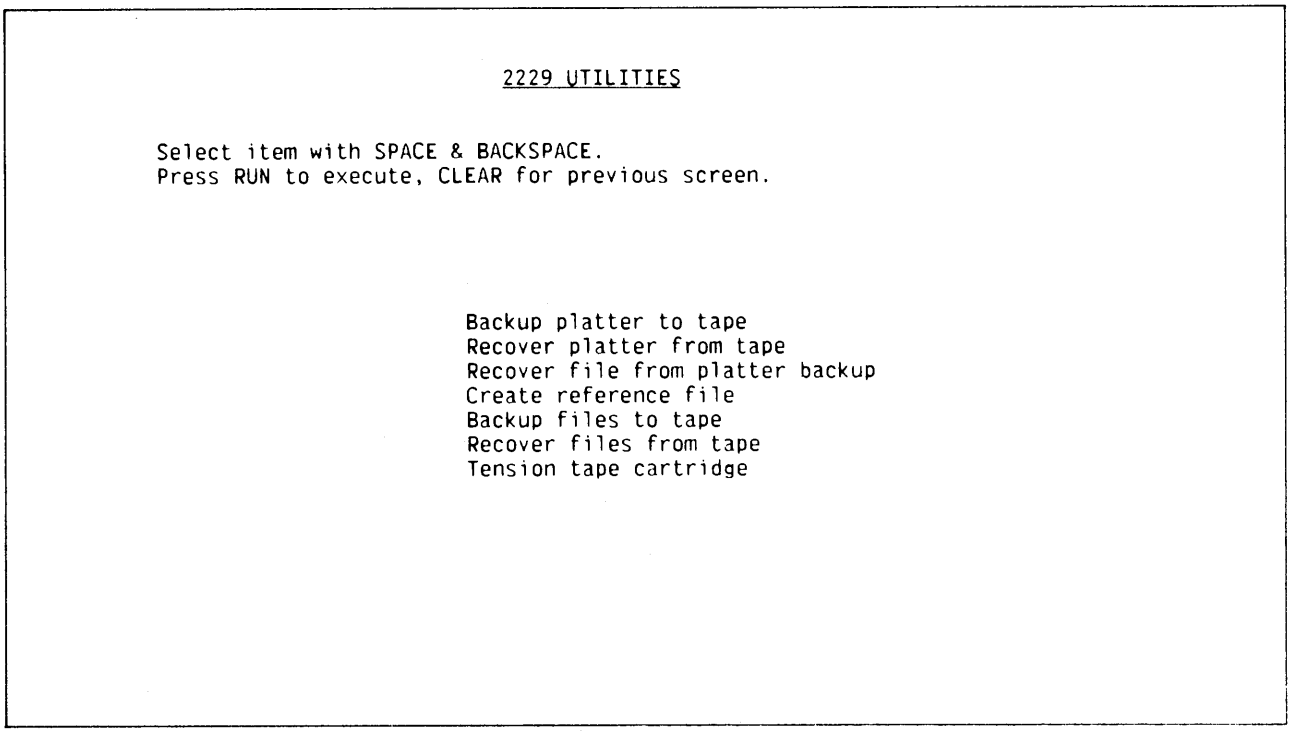

Figure 3-1. 2229 Utilities Menu

Two basic backup/recovery operations are supported by the 2229 utilities; full and selective. Full backup or recovery affects all information on a disk surface. Selective backup or recovery affects only specific files. A brief discussion of each option from the 2229 Utilities menu is presented below:

Option	Function
Backup Platter to Tape	Backs up an entire disk platter to tape(s).
Recover Platter from Tape	Retrieves all data from a backup tape(s) and writes it to disk.
Recover File from Platter Backup	Retrieves a single file from a platter backup tape and writes it to disk.
Create Reference File	Builds a reference file (on disk) of selected file names. Allows you to conveniently back up a series of files by performing Backup Files to Tape.
Backup Files to Tape	Uses the reference file created in the previous option to select designated files on disk and back them up to tape.
Recover Files from Tape	Allows you to examine files on a tape and specify which one(s) will be written to disk. Recovery options are Add, Replace, Add/Replace, Recover Single File, and Query Each File. For an explanation of these options, refer to Section 3.7 in this manual.
Tension Tape Cartridge	Winds, then rewinds a tape cartridge to create a uniform tension on the tape.

3.2 BACKUP PLATTER TO TAPE

This option backs up an entire disk platter to tape(s). Approximately 15 Mb of data can be copied onto a 450-foot tape using 16K data blocks. If the tape cartridge's capacity is exceeded, the program prompts you to mount another tape and assigns the proper sequence number to it. To execute Backup Platter to Tape, access the 2229 Utilities menu and follow these steps:

1. Select "Backup platter to tape" and press RUN.

2. Enter the 2229 utilities address and press RETURN.

3. Enter the tape controller address and press RETURN.

> **NOTE**
>
> Device address 018 is generally used for the tape controller Address. Before running 2229 utilities, make sure the device address is entered into the Master Device Table.

4. Enter the source platter address and press RETURN. The screen in Figure 3-2 appears.

```
                    BACKUP PLATTER TO TAPE

     Source Platter      D11

     INDEX SECTORS =     64
     END CAT. AREA =  52607
     CURRENT END   =   8464

     Is this the correct platter? Y
```

Figure 3-2. Disk Platter Information

5. If the source platter address is not correct, enter N and press RETURN. The program returns you to Step 4; enter the correct platter address and press RETURN.

6. If the source platter address displayed is correct (the system defaults to a Y entry), press RETURN. The screen in Figure 3-3 appears.

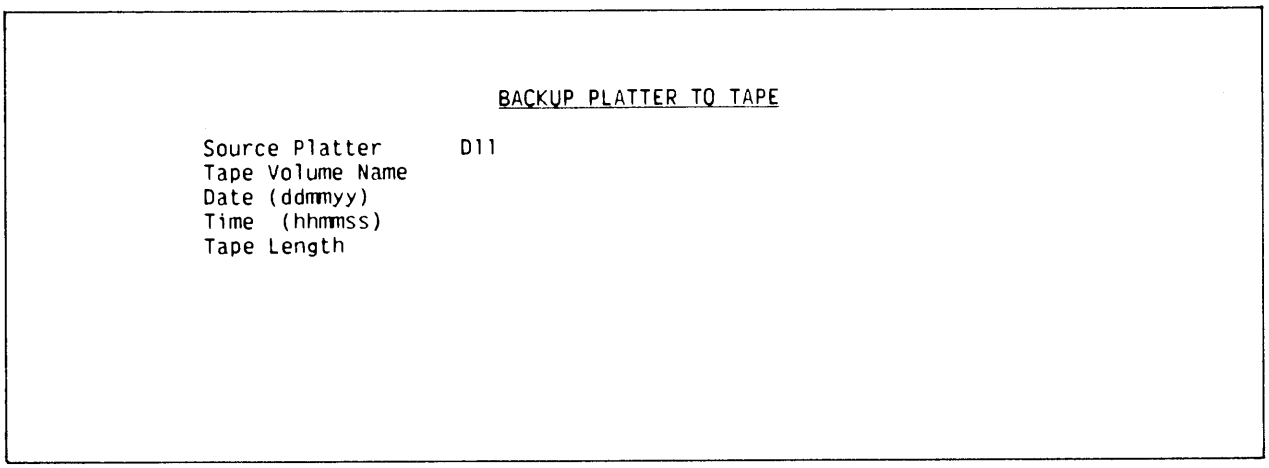

Figure 3-3. Tape Volume Information

7. Enter the tape volume name (up to 8 characters in length) and press RETURN.

8. Enter date and time (both optional). Press RETURN after each entry.

9. Enter tape length (the system defaults to 450). Only lengths of 300, 450, or 600 are accepted (Wang Data Cartridges, part number 725-1227, are 450 feet). Press RETURN.

10. When the prompt "User comments" appears, enter any comments (optional) and press RETURN.

11. Insert the tape cartridge into the drive unit so that it is fully seated. Bring the tape drive on-line by pressing the Online button.

12. Press RETURN. The program loads the tape and begins the back up operation; the screen in Figure 3-4 appears.

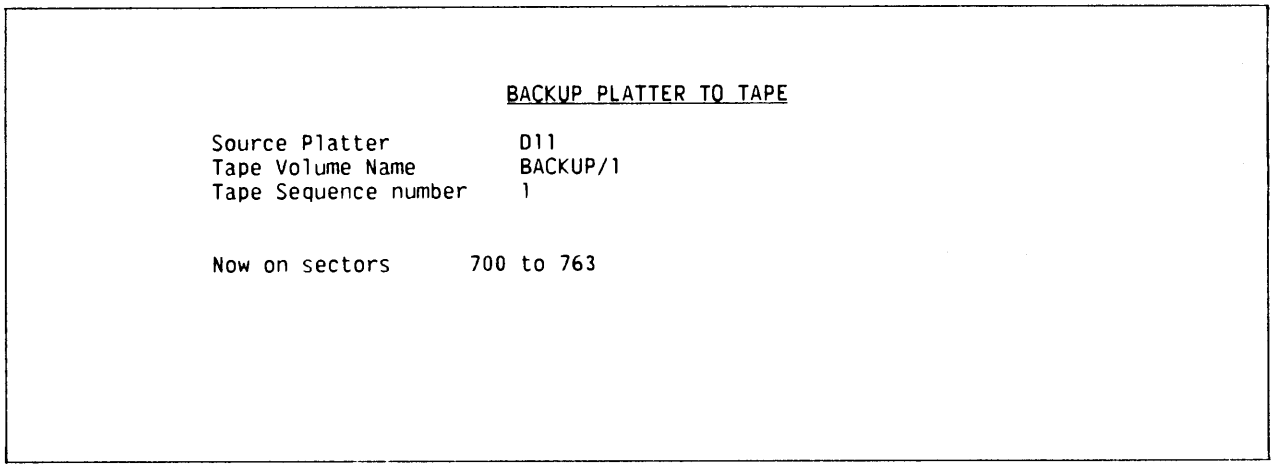

Figure 3-4. Backup in Progress

13. As the operation continues, the sector numbers being written appear on the screen. If one tape cartridge is not sufficient to back up a disk platter, the prompts "Insert new cartridge" and "Press RETURN when done" appear. Remove the tape cartridge, insert the correct tape cartridge, and press RETURN.

14. Remove the tape cartridge when the message "Backup done" appears. Press FN/Tab to restart the backup utility, or shift FN/Tab to return to the Main menu.

3.3 RECOVER PLATTER FROM TAPE

Recover Platter from Tape allows you to retrieve all data from a tape cartridge. To execute this option, access the 2229 Utilities menu and perform the following steps:

1. Select "Recover platter from tape" and press RUN.

2. Enter the 2229 utilities address and press RETURN.

3. Enter the tape controller address and press RETURN.

4. Enter the destination platter address and press RETURN. The screen in Figure 3-5 appears.

CAUTION

Be sure the destination platter address entered is correct; data on the platter will be written over and lost.

```
                    RECOVER PLATTER FROM TAPE

Destination Platter Address     D11

INDEX SECTORS =          10
END CAT. AREA =        3873
CURRENT END   =        2278

ALL DATA WILL BE OVERWRITTEN

Is this the correct platter? Y
```

Figure 3-5. Destination Platter Address

5. If the destination platter address is not correct, enter N and press RETURN. The program returns to Step 4; enter the correct destination platter address and press RETURN.

6. If the destination platter address is correct, press RETURN.

7. Insert the tape cartridge into the drive unit so that it is fully seated. Bring the tape drive on-line by pressing the Online button.

8. Press RETURN. The program loads the tape, and the screen in Figure 3-6 appears. The name of the volume mounted, the date and time it was created, and any comments are displayed.

```
                    RECOVER PLATTER FROM TAPE

Destination Platter Address     D11

Tape volume name is     BACKUP/1
Date                    260183
Time                    131500

Comments                WEEKLY BACKUP

Is this the correct volume?   Y
```

Figure 3-6. Tape Volume

9. If the tape volume name displayed is not correct, enter N and press RETURN. The program unloads the tape and prompts you to mount the correct volume. Insert the correct tape cartridge and press RETURN.

10. If the tape volume mounted is correct, press RETURN. The Recovery operation begins and the screen in Figure 3-7 appears. As recovery continues, the numbers of sectors being recovered appear on the screen.

```
                    RECOVER PLATTER FROM TAPE

Destination Platter Address     D11

Tape volume name is     BACKUP/1
Tape sequence # 1


Recovering Sectors  640  to  703
```

Figure 3-7. Recovering Disk Platter

11. When platter recovery is done (as indicated by a screen message), remove the tape cartridge. Press FN/TAB to restart the recovery utility or shift FN/TAB to return to the Main menu.

3.4 RECOVER FILE FROM PLATTER BACKUP

Recover File from Platter Backup allows you to retrieve a selected file from a tape cartridge to a designated disk. To execute this option, access the 2229 Utilities menu and perform the following steps:

1. Select "Recover file from platter backup" and press RUN.

2. Enter the 2229 Utilities address and press RETURN.

3. Enter the Tape Controller address and press RETURN.

4. Enter the file output address and press RETURN. The screen in Figure 3-8 appears.

```
                    RECOVER FILE FROM PLATTER BACKUP

File output address      D11

INDEX SECTORS =           10
END CAT. AREA =         3873
CURRENT END   =         2228

Is this the correct platter? Y
```

Figure 3-8. File Output Address

5. If the file output address is not correct, enter N and press RETURN. The program returns to Step 4; enter the correct address and press RETURN.

6. If the file output address is correct, press RETURN.

7. Insert the tape cartridge into the drive unit so that it is fully seated. Bring the tape drive on-line by pressing the Online button.

8. Press RETURN. The program loads the tape, and the screen in Figure 3-9 appears. The name of the volume mounted, the date and time it was created, and any comments are displayed.

```
                    RECOVER FILE FROM PLATTER BACKUP

File output address      D11

Tape volume name is      BACKUP/1
Date                     260183
Time                     131500

Comments                 WEEKLY BACKUP

Is this the correct volume?   Y
```

Figure 3-9. Tape Volume

9. If the tape volume name displayed is not correct, enter N and press RETURN. The program unloads the tape and prompts you to mount the correct volume. Insert the correct tape cartridge and press RETURN.

10. If the correct tape volume is mounted, press RETURN.

11. If you want a catalog listing of files on the tape, enter Y and press RETURN. If not, enter N and press RETURN.

12. Enter the name of the file you want to retrieve and press RETURN.

13. When the selected file is recovered, a prompt asks if you want to retrieve another file. Enter Y for yes or N for no; press RETURN.

14. Remove the tape cartridge when the prompt "File recovery done" appears. Press FN/Tab to restart the file recovery utility or shift FN/Tab to return to the Main menu.

3.5 CREATE REFERENCE FILE

Create Reference File allows you to create a file of selected file names. When you use this file in conjunction with the Backup Files to Tape option, you can back up a group of files by entering the name of the reference file. This option saves the time involved in backing up files individually. To execute Create Reference File, access the 2229 Utilities menu and perform the following steps:

1. Select "Create reference file" and press RUN.

2. Enter the Source Disk Address and press RETURN. A list of files (sorted alphabetically/numerically) residing on the selected disk (Figure 3-10) appears.

3. Use the space bar, backspace key, or cursor control keys (DW terminals) to position the cursor next to the file you wish to select; press INSERT. If you selected a file name by mistake, position the cursor next to the file name and press DELETE. If the file listing goes beyond one screen, press N to view the next screen and P to view the previous screen. After you have selected all desired files, press RUN. If you did not select any file names, the program returns to the 2229 Utilities menu.

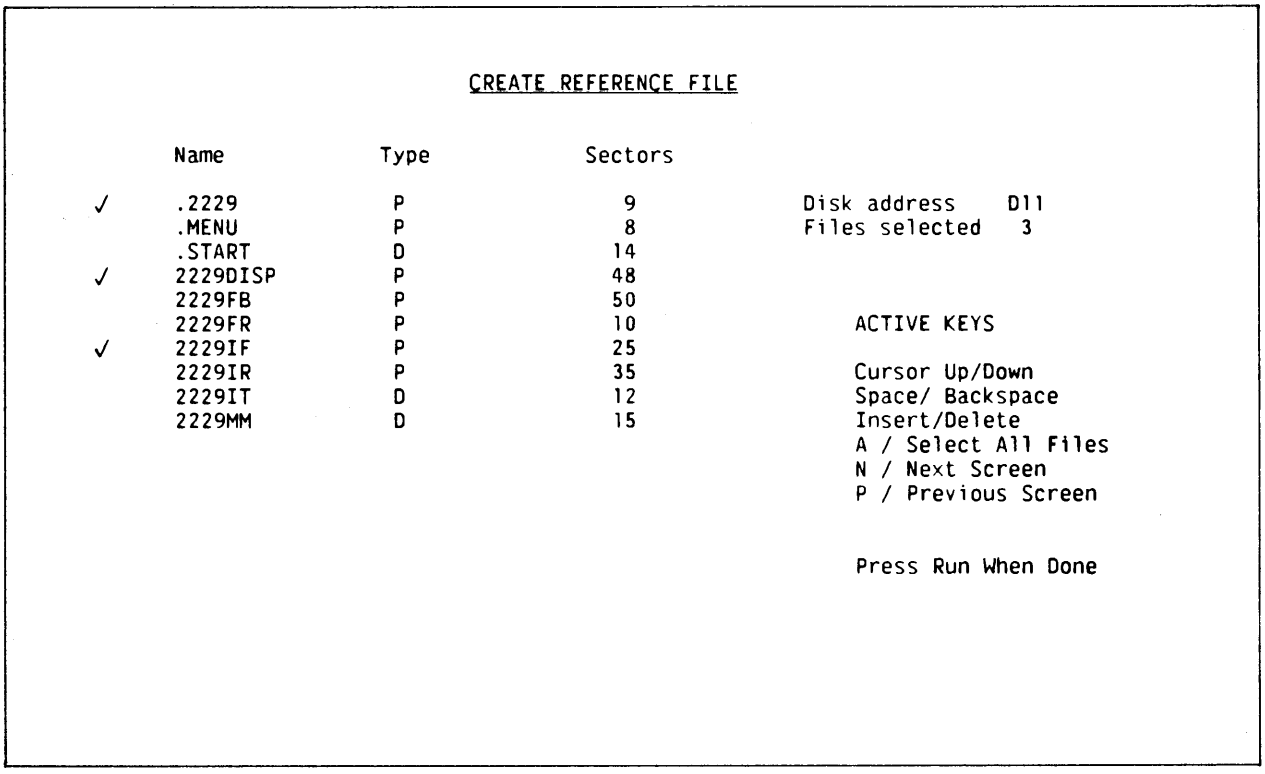

Figure 3-10. Sorted Disk Catalog

4. Enter the name of the reference file and press RETURN.

5. Enter the reference file address and press RETURN.

6. A screen message alerts you if a file of that name already exists. Enter N to choose another file name or Y to write over the existing file. Press RETURN.

7. When file creation is complete, the message "done" appears, and the program returns you to the 2229 Utilities menu.

3.6 BACKUP FILES TO TAPE

This option allows you to back up a group of files by entering the name of a reference file. The reference file contains all the file names selected in the Create Reference File option. To execute Backup Files to Tape, access the 2229 Utilities menu and perform the following steps:

1. Select "Backup files to tape" and press RUN.
2. Enter the 2229 utilities address and press RETURN.
3. Enter the tape controller address and press RETURN.
4. Enter a reference file name and press RETURN.
5. Enter the address of the reference file and press RETURN. The screen in Figure 3-11 appears.

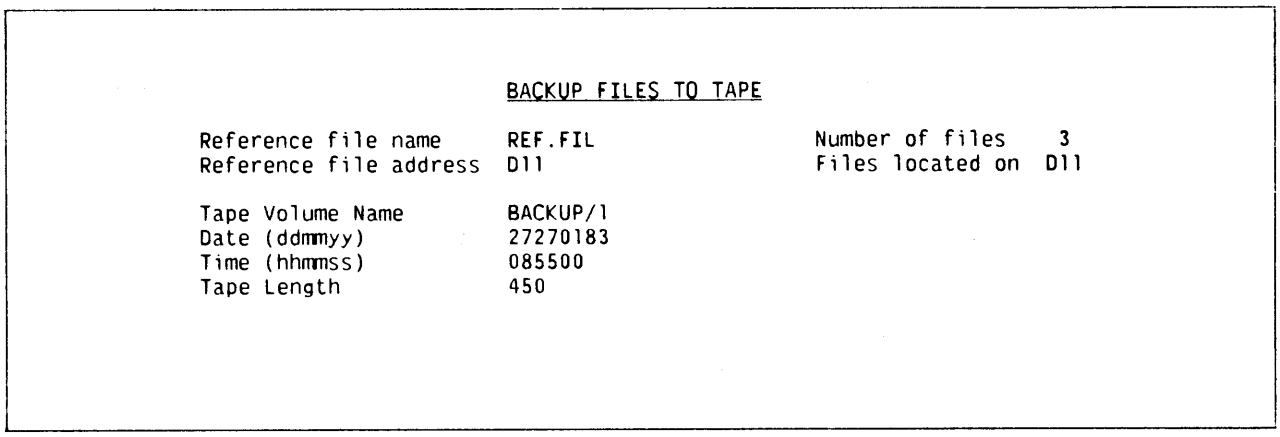

Figure 3-11. Backup Information

6. Enter the tape volume name (that contains the desired reference file) and press RETURN.
7. Enter date and time (both optional). Press RETURN after each entry.
8. Enter tape length. Only lengths of 300, 450, or 600 will be accepted (the system defaults to 450). Press RETURN.
9. Enter any comments (optional) and press RETURN.

10. Insert the tape cartridge into the drive unit so that it is fully seated. Bring the tape drive on-line by pressing the Online button.

11. Press RETURN. The program loads the tape and starts the backup operation; the screen in Figure 3-12 appears. The number and names of files being backed up are displayed.

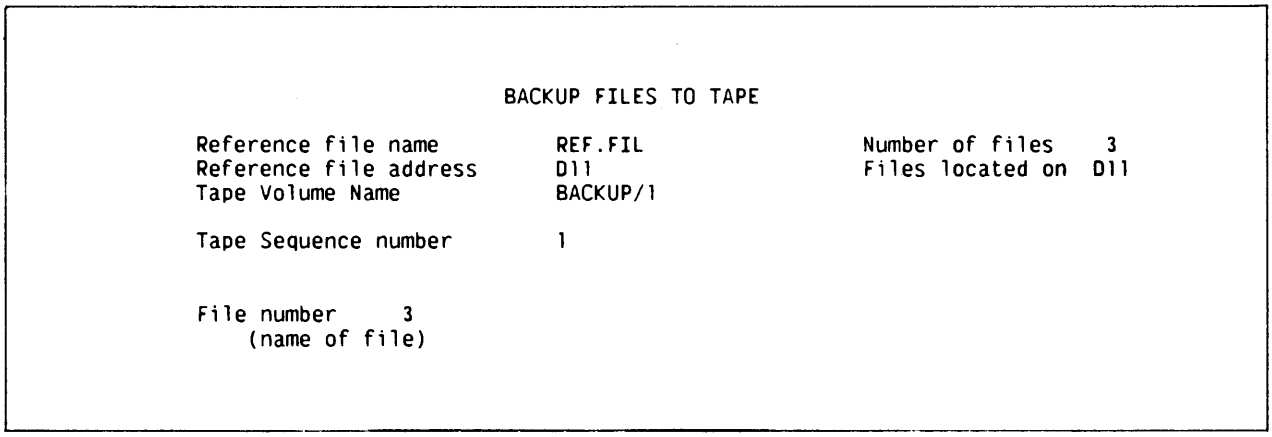

Figure 3-12. File Backup in Progress

12. If one tape cartridge is not sufficient to back up a group of files, a message prompts you to insert a new cartridge and press RETURN.

13. Remove the tape cartridge when the message "Backup done" appears. Press FN/TAB to restart the utility or shift FN/TAB to return to the Main menu.

3.7 RECOVER FILES FROM TAPE

Recover Files from Tape retrieves selected files from a tape cartridge and writes them to a designated disk address. To execute this option, access the 2229 Utilities menu and perform the following steps:

1. Select "Recover files from tape" and press RUN.

2. Enter the 2229 utilities address and press RETURN.

3. Enter the tape controller address and press RETURN.

4. Enter the file output address and press RETURN. The screen in Figure 3-13 appears.

```
                    RECOVER FILES FROM TAPE

File output address D11

INDEX SECTORS =     10
END CAT. AREA = 3873
CURRENT END   =     2278


Is this the correct platter? Y
```

Figure 3-13. File Output Address

5. If the file output address is not correct, enter N and press RETURN. The program returns to Step 4; enter the correct destination platter address and press RETURN.

6. If the file output address is correct, press RETURN.

7. Insert the tape cartridge into the drive unit and press the Online button.

8. Press RETURN. The program loads the tape, and the screen in Figure 3-14 appears.

```
                    RECOVER FILES FROM TAPE

Destination Platter Address     D11

Tape volume name is     BACKUP/1
Date                    270183
Time                    085500

Comments                MONTHLY TOTALS

Is this the correct volume?   Y
```

Figure 3-14. Tape Volume

9. If the tape volume is not correct, enter N and press RETURN. The program unloads the tape and prompts you to mount the correct volume. Insert the correct tape cartridge and press RETURN.

10. If the tape volume mounted is correct, press RETURN. If you wish to examine the tape index, enter Y and press RETURN. A listing of files contained on the tape volume appears on the screen. If you do not wish to view the index, enter N and press RETURN. The screen in Figure 3-15 appears.

```
                    RECOVER FILES FROM TAPE

File output address      D11
Tape volume name         BACKUP/1
Tape sequence number     1

1 - Add
2 - Replace
3 - Add/Replace
4 - Recover single file
5 - Query each file

Select recovery option? _
```

Figure 3-15. Select Recovery Option

11. Recovery options and their functions are listed below. Select an option and press RETURN.

    a. Add - If files are not on disk, they are added.

    b. Replace - If files are on disk, they are written over.

    c. Add/Replace - Combines the above options. Files are written to disk as new files or they replace existing files of the same name.

    d. Recover Single File - The single file you select is written to disk.

    e. Query Each File - File names are displayed individually, and a prompt asks if you want to retrieve that file. Enter Y if yes, and N if no. Press RETURN after each entry.

12. Remove the tape cartridge when the message "File recovery done" appears. Press FN/TAB to restart the utility or shift FN/TAB to return to the Main menu.

3.8 TENSION TAPE CARTRIDGE

To execute this option, access the 2229 Utilities menu and perform the following steps:

1. Select "Tension tape cartridge" and press RUN.

2. Enter the 2229 utilities address and press RETURN.

3. Enter the tape controller address and press RETURN. The screen in Figure 3-16 appears.

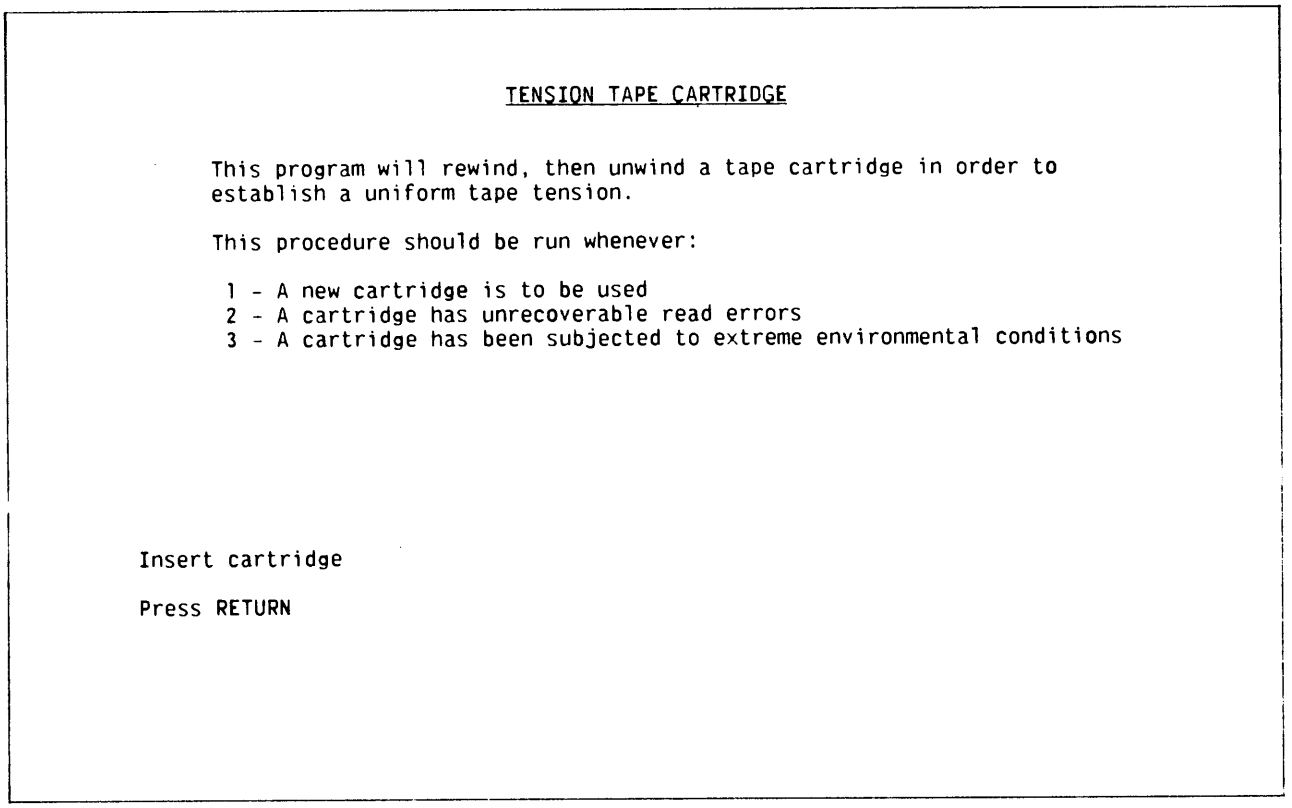

Figure 3-16. Tension Tape Cartridge

4. Insert the tape cartridge and make sure the tape drive is on-line. Press RETURN.

5. Remove the tape cartridge when the message "DONE" appears. Press FN/TAB to restart the utility or shift FN/TAB to return to the Main menu.

APPENDIX A
MODEL 2229 SPECIFICATIONS

Tape

Width
  0.25 in. (0.64 cm)
Length
  450.00 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
Tape Speed (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 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 (39.07 cm)
Depth
  17.81 inches (45.24 cm)
Weight
  28.5 lbs (12.93 kg)

Cables

10 ft (3.05 m) parallel cable
 (tape drive to CPU)

Fuses

2 amps @ 115 VAC
1 amp @ 220 VAC

Operating Environment

Temperature
  50° F to 90° F
  (10° C to 32° C)
Relative Humidity (noncondensing)
  35% to 65% (recommended)
  20% to 80% (allowable)

Power Requirements

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

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

Controls/Indicators

Power Switch
Power On
Tape Loaded
Fault
Online

WANG

Customer Comment Form

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Title 2200 MODEL 2229 CARTRIDGE TAPE DRIVE USER MANUAL

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Model 2229
Cartridge Tape Drive
User Guide Addendum
PRO-7716.01

PRELIMINARY VERSION 1.0

PREFACE

This addendum is written for users of the Wang Model 2229 Cartridge Tape Drive. A basic knowledge of the Wang 2200 system and familiarity with the Model 2229 Cartridge Tape Drive is assumed.

The Model 2229 Cartridge Tape Drive User Manual (700-7716) contains complete operating instructions on the existing 2229 utilities. All information in the user manual is correct; this addendum provides additional information related to 2229 Utilities Release 2.0.

Section 1 provides information on two new 2229 utilities. Section 2 discusses the changes and corrections to the existing 2229 utilities. Section 3 contains information and $GIO commands for writing your own tape drive routines.

CONTENTS

SECTION 1
NEW 2229 UTILITIES

1.1 UTILITIES MENU

From the Main menu, select 2229 Utilities and press RUN; the following revised menu appears:

Figure 1-1. 2229 Utilities Menu

1.2 VERIFY TAPES

Overview

This new utility allows you to verify the integrity of either a recent or old tape backup. In particular, you should run this utility on all data cartridges made prior to the 2229 Utilities Release 2.0. The utility prompts you to load the data cartridge(s). As it reads your complete tape (or tape set), it tests for the following conditions:

- 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 is on the tape.
- The correct number of sectors and blocks is in each file.
- The correct number of tapes (in a tape set) is found.

This utility is similar to a disk verify; the data is verified that it can be read, but it is not compared to the platter data since the disk files may have changed. Run this utility immediately after a backup to ensure the operation was successful, or at any later time to again verify the tape's integrity. Performing Verify Tapes coupled with 2229 Diagnostic (refer to Section 1.3 of this addendum) should give you confidence in your backups and tape drive/controller.

Operating Instructions

Use the following step to run the Verify Tapes utility:

1. Instructions and screen dumps here.

Information and Error Messages

The following is a list of information and error messages that you may encounter when running the Verify Tapes utility:

Data block not a multiple of 256 bytes (unlikely to appear)

Meaning/Action: This message may indicate a hardware problem with the tape controller or tape drive. Run the 2229 Diagnostic utility (refer to Section 1.3 of this addendum) on a blank tape, and if it shows any errors, contact your customer engineer.

File header block count not = 0

Meaning/Action: This message indicates a non-2200 tape, or a tape produced by an aborted backup. It may also indicate a tape drive or controller problem.

File mark found - label expected

Meaning/Action: This message indicates a non-2200 tape, or a tape produced by an aborted backup. It may also indicate a tape drive or controller problem.

File trailer block count incorrect (unlikely to appear)

Meaning/Action: This message may indicate a hardware problem with the tape controller or tape drive. Run the 2229 Diagnostic utility (refer to Section 1.3 of this addendum) on a blank tape, and if it shows any errors, contact your customer engineer.

File trailer label not 256 bytes (unlikely to appear)

Meaning/Action: This message may indicate a hardware problem with the tape controller or tape drive. Run the 2229 Diagnostic utility (refer to Section 1.3 of this addendum) on a blank tape, and if it shows any errors, contact your customer engineer.

First record is not File Mark

Meaning/Action: This message indicates a non-2200 tape, or a tape produced by an aborted backup. It may also indicate a tape drive or controller problem.

First record is not Volume Header

Meaning/Action: This message indicates a non-2200 tape, or a tape produced by an aborted backup. It may also be indicative of tape drive or controller problems.

Incorrect record length in file label

Meaning/Action: This message indicates a non-2200 tape, or a tape produced by an aborted backup. It may also indicate a tape drive or controller problem.

Maximum block size incorrect

Meaning/Action: This message indicates a non-2200 tape, or a tape produced by an aborted backup. It may also indicate a tape drive or controller problem.

Missing data block (unlikely to appear)

Meaning/Action: This message may indicate a hardware problem with the tape controller or tape drive. Run the 2229 Diagnostic utility (refer to Section 1.3 of this addendum) on a blank tape, and if it shows any errors, contact your customer engineer.

Missing sectors in file (unlikely to appear)

Meaning/Action: This message may indicate a hardware problem with the tape controller or tape drive. Run the 2229 Diagnostic utility (refer to Section 1.3 of this addendum) on a blank tape, and if it shows any errors, contact your customer engineer.

Not a 2200 backup tape

Meaning/Action: This message indicates a non-2200 tape, or a tape produced by an aborted backup. It may also indicate a tape drive or controller problem.

Record/Block count incorrect

Meaning/Action: This message indicates a non-2200 tape, or a tape produced by an aborted backup. It may also indicate a tape drive or controller problem.

Record format byte incorrect

Meaning/Action: This message indicates a non-2200 tape, or a tape produced by an aborted backup. It may also indicate a tape drive or controller problem.

Record found - expected file trailer (unlikely to appear)

Meaning/Action: This message may indicate a hardware problem with the tape controller or tape drive. Run the 2229 Diagnostic utility (refer to Section 1.3 of this addendum) on a blank tape, and if it shows any errors, contact your customer engineer.

Sector count does not match file trailer (unlikely to appear)

Meaning/Action: This message may indicate a hardware problem with the tape controller or tape drive. Run the 2229 Diagnostic utility (refer to Section 1.3 of this addendum) on a blank tape, and if it shows any errors, contact your customer engineer.

Tape block larger than 16K - Possible problem with tape driver or controller

Meaning/Action: This message indicates a hardware problem with the tape controller or tape drive. Run the 2229 Diagnostic utility (refer to Section 1.3 of this addendum) on a blank tape, and if it shows any errors, contact your customer engineer.

Tape file sequence number incorrect (unlikely to appear)

Meaning/Action: An out of order file was found on the tape.

Tape read error on file label

Meaning/Action: This message indicates a non-2200 tape, or a tape produced by an aborted backup. It may also indicate a tape drive or controller problem.

Tape read error on first block

Meaning/Action: This message indicates a blank tape, non-2200 tape, or a tape produced by an aborted backup. It may also indicate a tape drive or controller problem.

Tape read error on Volume Label

Meaning/Action: This message indicates a blank tape, non-2200 tape, or a tape produced by an aborted backup. It may also indicate a tape drive or controller problem.

Tape verifications done - No errors found

Meaning/Action: This message indicates proper termination of the 2229 Verification utility.

Volume Label expected - File mark found

Meaning/Action: This message indicates a non-2200 tape, or a tape produced by an aborted backup. They may also be indicative of tape drive or controller problems.

Volume Label format version incorrect

Meaning/Action: This messages indicates a non-2200 tape, or a tape produced by an aborted backup. This may also indicate a tape drive or controller problem.

Unexpected end of tape (unlikely to appear)

Meaning/Action: The end of tape is encountered without the proper File and Volume trailers. It may indicate a tape drive or controller problem.

Unknown record found - expected file header

Meaning/Action: This message indicates a non-2200 tape, or a tape produced by an aborted backup. It may also indicate a tape drive or controller problem.

Unrecoverable read error

Meaning/Action: An unreadable record was found on the tape. It may be possible to recover part of the platter, or some/all of the files. Refer to Section 2 of this addendum describing the enhancements to the Recovery utilities.

Volume mounted is tape sequence number X
Expected sequence number Y
Press return to unload tape

Meaning/Action: This message indicates that the tape backup spans multiple data cartridges, and that you have inserted the cartridges out of order. After you unload the data cartridge, the utility prompts you to insert the correct cartridge.

X files found - Y files expected (unlikely to appear)

Meaning/Action: This message may indicate a hardware problem with the tape controller or tape drive. Run the 2229 Diagnostic utility (refer to Section 1.3 of this addendum) on a blank tape, and if it shows any errors, contact your customer engineer.

1.3 2229 DIAGNOSTIC

Overview

This utility is added to verify the functionality of your 2229 tape drive subsystem. The 2229 Diagnostic utility exercises the tape drive and controller in a manner similar to the actual tape utilities.

CAUTION:
This diagnostic will overwrite any data on the tape. Make sure your tape does not contain any useful data.

The utility writes random-length records of random data on the tape. The tape is then completely read. Any errors found terminates the test, and a message appears. The test will run continuously until either you stop it (press RESET) or an error occurs. This test should be left running overnight, if possible.

Operating Instructions

Use the following steps to run the 2229 Diagnostic utility:

1. Instructions and screen dumps here.

Information and Error Messages

The following is a list of information and error messages that you can encounter when running the 2229 Diagnostic utility:

Data compare error

Meaning/Action: This message may indicate a tape controller problem.

Error on read

Meaning/Action: This message indicates that a record could not be read within the maximum number of retries. A bad tape drive or data cartridge is the most likely problem.

Error on tape load

Meaning/Action: This message indicates the tape drive is off line, powered off, or a cartridge is not inserted. Also, a bad controller, tape drive, or unconnected cable could cause the problem.

Error on write

Meaning/Action: An error occurred during a tape write. This may indicate a fault with the tape drive or data cartridge, or possibly the controller.

Error X

Meaning/Action: Error messages also may produce an error or result byte (e.g., ERROR 3 ON TAPE LOAD).

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

Illegal record length

Meaning/Action: A record was read which was outside the range of records written to the tape. This may indicate a bad controller or tape drive, or the tape controller is possibly not the latest hardware version.

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

Meaning/Action: This message may indicate a controller problem, or the tape controller is possibly not the latest hardware version.

Unexpected end of tape on read

Meaning/Action: 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 indicates either a bad controller or tape drive.

SECTION 2
2229 UTILITIES CORRECTIONS/ENHANCEMENTS

The following corrections and enhancements have been made to the first and only release (Version 1.01) of 2229 Utilities.

2.1 RECOVER PLATTER FROM TAPE

Problem/Correction

When recovering a platter backup that spanned more than one data cartridge, the utility would terminate with the message "Tape cartridge is file backup, not platter backup - run 'Recover Files From Tape' utility".

Enhancement

When you recover a platter backup, a bad tape block does not halt the recovery. The unrecoverable sectors (e.g., sectors 128 to 191) are displayed, and then you will have the option of skipping the block and continuing. The utility continues to write to the platter at the correct spot upon finding the next good block. You should record the sectors displayed to determine which file(s) on the platter backup were not completely recovered.

After the utility reads a record from the tape, it initiates the next tape read before writing the data to the disk. This makes platter recovery run faster.

2.2 RECOVER FILE FROM PLATTER BACKUP

Problem/Correction

If the platter image on the tape had an index sector size of 1, only the first file name was displayed when you printed out the catalog index.

2.3 BACKUP FILES TO TAPE

Problem/Correction

The file names written in the tape index file were not being saved properly. If the tape contained more than 204 file names, the excess names were replicated in the tape index. The actual files on tape were saved correctly; only the index of file names was incorrect (which caused the displaying of the file names to appear incorrect).

If the number of sectors in a file was 1 greater than an even number of 16K blocks, the last sector (the 2200 file trailer record) was not written to the tape. This did not cause any problems other than possibly causing the 'sectors used' field to be displayed incorrectly.

2.4 RECOVER FILES FROM TAPE

Enhancement

When you recover a file from the tape, a bad block does not halt the recovery. The unrecoverable sectors (e.g., sectors 128 to 191) are displayed, and you have the option of skipping the block and continuing. The utility continues to write to the platter at the correct spot upon finding the next good block. You should record the sectors displayed to determine which files on the platter backup were not completely recovered.

After the utility reads a record from the tape, it initiates the next tape read before writing the data to the disk. This makes recovery run faster.

For file backups made with Version 2.0, the status of the file (scratched/unscratched) is saved on tape. When recovering files, the following enhancement has been made for files on the tape that are marked as scratched:

- If the file is not on the disk, and the utility has to create the file in the disk index, the user will be asked "UNSCRATCH SCRATCHED FILES?". Answering "Y" will result in the creation of an unscratched file. Answering "N" will cause any recovered scratched files to be scratched.

- If the file to be recovered already exists in the disk index, the status will be left as is, regardless of the status of the file on tape.

- Version 1.01 of the utilities did not save the file status on the tape. This new version (2.0) of the utilities will function properly, except that the query "UNSCRATCH SCRATCHED FILES?" will not be displayed, and the operation will be as in Version 1.01.

with tapes created under version 1.01

2.5 CREATE REFERENCE FILE

Problem/Correction

A maximum of 1000 files were saved in the reference file, rather than up to 2048. If you selected ALL FILES, and there were greater than 1000 files in the disk index, only the first 1000 were saved.

The disk index search for file names stopped at one plus the last index sector, rather than at one plus the last sector. This caused some file names to be replicated in the reference file.

Enhancement

Special function keys 00, 01, 02, and 03 now allow the user to select for inclusion in the reference file all active Programs, all active Data, all Scratched Programs, or all Scratched Data files (refer to Figure 2-1).

Figure 2-1 Create Reference File Screen

2.6 ALL UTILITIES

Problem/Correction

A controller reset is added to the tape load routine to handle a load attempt when the tape drive is powered off.

Enhancement

Records read from the tape are checked for an illegal length, which is a symptom of a tape controller problem. The following message has been added to the 2229 utilities:

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

Meaning/Action: This message appears if an illegal-length record is found. It indicates a problem with the tape controller.

Many existing information and error messages have been changed for clarity (e.g., the message 'Read error' has been changed to 'Tape read error').

SECTION 3
2229 $GIO COMMANDS

The following information may be useful if you want to write your own tape routines:

3.1 INITIALIZATION

Upon powerup, the controller is running out of a bootstrap PROM. The tape microcode must be downloaded into the controller before ANY tape operations can be done (see the Download and End Download commands).

3.2 TAPE WRITES

Write commands to the controller are cached which allows overlapping of disk reads and tape writes. This results in a significant improvement in performance as compared to performing a write command and waiting for the results. Write commands (that conform to block length, etc.) are acknowledged immediately, and are queued in the controller until the previous blocks are done. Any incomplete write (such as a tape fault) will cause a 'Write results pending' response to any subsequent commands. An Endwrite command will then complete the operation by responding with the result byte as well as the number of blocks (if any) that have not been written.

Since data cartridges are not randomly accessible (in the sense of a disk, where a recalibrate to track zero followed by reading sector ID's can be done at any time), it is suggested that the following block format be used (this is what the Wang utilities use):

Each block of data (e.g., 4096 bytes), is preceded by a 2 byte 'block count'. The block count represents the number of blocks written on the tape since the last file mark. This block count is not a separate record on tape, it is actually part of the data block; in this case the block would be 4098 bytes long. Upon reading a data block, the application would discard the first 2 bytes, after verifying that the block just read was indeed the next sequential block. The 2229 microcode uses these block counts in repositioning routines in order to verify tape position during write and read retry operations.

3.3 OUT OF TAPE

Upon encountering an Out Of Tape response to a write command, the user should immediately terminate the backup operation by whatever file method is being used (write a file mark, file trailer, etc.). The length of tape remaining at this point is about 30 inches, which does not allow room for any extensive blocks of data (a 16K block uses about 22 inches of tape). Only one Out Of Tape response will be given for each data cartridge; it is the users responsibility to finish his backup operation within the remaining tape, and continue the backup on another data cartridge.

3.4 FILE BACKUP/RECOVERY

When writing a file header, include the file size (in addition to the usual name, date, etc.). This allows file recovery to a disk upon which there is no file to overwrite. This prevents the problem of having to expand a file, which is not easily done with the 2200 file structure.

3.5 COMMANDS

The following is a list of $GIO commands you can use to write your own tape routines. Any other commands will return an ILLEGAL result (return code = hex(01)).

Command	Hex Code	
Hardware Reset	01	
Board Status	02	
Rewind	03	
Load	04	
Unload	05	
Erase To End Of Tape	07	
Space IBG	08	
Space Reverse IBG	09	
Space File Mark	0A	
Space Reverse File Mark	0B	
Read	0C	
Write	0D	
Write File Mark	0F	
Erase IBG	12	
Endwrite	20	
Software Reset	30	
Error Status	31	
Change Write Current	32	
Download	40	See Note below
End Download	41	

NOTE:
Download and End Download commands 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 (RAM = after the tape microcode has been downloaded).

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

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 (currently 16) 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 board-repair diagnostic use. Switch 1 is on for a 4 track drive, off for 7 track drive (normally on) 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

Bit	Meaning
80	Not ready
40	Drive fault
20	No cartridge
10	Formatter error
08	Command error
04	Parity error
02	Length error
01	Data error

Status Byte 2

Bit	Meaning
80	Logical load point
40	Logical end of tape
20	File mark detected
10	Write protected
08	End of tape
04	Track bit 2
02	Track bit 1
01	Track bit 0

Code execution	00 = PROM, 01 = RAM (Downloaded)
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.

Drive/Controller Faults

Decimal Code	Error description
11	CBSY true when no command executing
12	Control Request timeout (Cable not connected)
13	CBSY not set true after command strobe
14	Tape drive received command from controller with bad parity
15	Track status incorrect on track select command
16	Track select command failed
17	Track status incorrect on track select command
18	Track select command failed
19	Tape status byte 1 shows fault before LOAD or REWIND command
20	Load command failed
21	Load command did not bring tape to LLP
22	Unload command failed
23	Unload command did not bring tape to EOT
24	Rewind command failed
25	Rewind command did not bring tape to LLP
26	Erase To End Of Tape command did not bring tape to LEOT
27	Erase To End Of Tape command failed
28	Skip File Mark command failed
29	Skip Reverse File Mark command failed
30	Skip Reverse File Mark command failed
31	Space IBG command failed
32	Space Reverse IBG command failed
33	Write File Mark command did not detect File Mark
34	Write File Mark command failed
35	Erase Gap command failed
36	Overflow of Kennedy parity errors
37	Repositioning error during write error recovery
38	Read error while repositioning tape
39	Error on read (not Data Error)

Powerup diagnostic list	6 bytes of error information, only valid if Fault byte is x'0A' (decimal 10)

NOTE:
RAM parity error will flash all lamps on the drive and the lamp on the controller. This is indicative of a fault in the controller card. The condition can be cleared only by resetting the controller. To clear it, the utility must be restarted. If this condition persists, contact your customer engineer.

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 data cartridge can be removed.

Erase To End Of Tape

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 tape.

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 the tape to the next File Mark, or End of Tape, whichever comes first.

Space Reverse File Mark

```
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

$GIO/018 (440B 8701,R$)
```

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

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 the 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'0D'

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)
STR(R$,2,2) = BIN(B,2)                  convert byte count to hex
$GIO/018 (440D 4220 4230 8701,R$)       operation continues if STR(R$,1,1)
                                        = hex (00)

$GIO/018 (1300 A000,R$)STR(A$(),1,VAL(STR(R$,2,2),2)) 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'0F'

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

$GIO/018 (440F 8701,R$)
```

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

$GIO/018 (4412 8701,R$)
```

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

$GIO/018 (4420 8701 8702,R$)
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

$GIO/018 (4530,R$)
```

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.

```
$GIO/018 (4431 8701 1800 C340,R$)STR(A$(),1,VAL(STR(R$,1,1))
```

NOTE:
A small number of write retries is normal.

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 data cartridges are DC300 (300 feet) and DC300XL (450 feet). 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 Software Reset or Hardware Reset will change the current back to 'normal'.

$GIO/018 (4432,R$)

These 2 commands function only when the controller is operating out of PROM. The controller can always be brought back to the PROM code by executing a Hardware 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$3
20 LINPUT "Disk Address",D$                get disk address
30 SELECT#1 <D$>                           select disk
40 LIMITS T#1, "@2229",A,B,C,D             check that microcode file is on disk
50 IF A =2THEN60                           else error
60 DATALOAD DC OPEN T#1, "@2229"           open data file
70 DATALOAD DC #1, X$,X1$,X$()             read data
80 IF END THEN 150                         jump if end of file
90 IF STR (X$,1,1) = HEX(01) THEN 120      jump if data
100 REM else record is comment - X$() can be printed if desired
110 GO TO 70
120 STR(R$,1,2)=X1$                        starting address
130 STR(R$,3,1)=STR(X1$,3)                 byte count
140 $GIO/018 (4440 4210 4220 4230 1800 1300 A000,R$)
    STR(X$(),1,VAL(STR(X1$,3))):GO TO 70    send data

150 $GIO/018 (4441,R$)                     send 'end download'
```

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