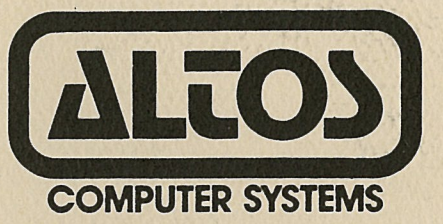

ALTOS MAGNETIC TAPE UNIT SUBSYSTEM

USER'S MANUAL

October 1981

ALTOS COMPUTER SYSTEMS

2360 Bering Drive

San Jose, Californina 95131

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ALTOS MAGNETIC TAPE UNIT SUBSYSTEM

USER'S MANUAL

1. INTRODUCTION.

The ALTOS magnetic tape unit (MTU) subsystem provides efficient back-up and restoration capabilities for program and data files. The tape unit subsystem consists of a CMTD-3400S2 tape drive from Data Electronics, Inc. This drive comes as either a stand alone unit which can be electrically connected to the ACS8000 system by cables or, as an integral part of the ACS8000 system itself. Provided with the MTU subsystem is a copy of the Tape Interchange Program (TIP). TIP is a product of Alloy Engineering Company, Inc. TIP provides all necessary capabilities to back-up and restore both floppy disk and hard disk files of any size under CP/M* and MP/M* only. With TIP tne user has the capability of backing up and/or restoring entire disk systems and individual program and data files.

This manual is divided into six sections. The remainder of section 1 provides an overview of the tape unit subsystem. Section 2 discusses installation and check-out procedures of the tape unit subsystem. Section 3 provides the operating procedures for the tape unit subsystem. Section 4 discusses the use of TIP. Section 5 discusses error conditions and provides troubleshooting and diagnostic instructions. Section 6 contains the procedure to incorporate tne tape unit (MTU-1) with the ACS8000 computers.

1.1 Tape Unit Hardware Features.

The tape unit provides high density tape cartridge storage of up to 13.4 MBytes of data on a single 1/4", 450-foot magnetic tape cartridge, using four tracks. Data is written at 6400 bits/inch in Modified Frequency Modulation (MFM) format at a data transfer rate of 192 Kbits/second. A serial recording format is used.

The tape unit operates at two speeds depending on the operation being performed:

a. READ and WRITE operations are performed at a tape speed of 30 inches/second.

b. Bidirectional search and rewind operations are performed at a tape speed of 90 inches/second.

*CP/M and MP/M are trademarks of Digital Research

The use of an integral DC motor tachometer that drives the cartridge directly (no pulleys, belts or right angle friction drives) allows the drive to sustain a start/stop time of 25-26 msec at a tape speed of 30 inches/second and 71-74 msec at a tape speed of 90 inches/second.

All code conversions (NRZ/MFM and MFM/NRZ) are done in the tape control unit thus reducing the amount of interaction required by the CPU of the ACS8000.

The tape unit contains several standard features designed to improve system reliability:

a. An integral tape cleaner which continually cleans the tape while it is moving.

b. The dual gap, read-while-write tape head insures that all written data can be read back from the tape.

c. A separate erase head insures data reliability of the tape unit to less than 1 error per 100 Mbits read by the drive.

1.2 Data Format on Tape.

The tape unit records data in serial fashion on each of four tracks of the cartridge. When data is written to the tape unit it is written first to track 1, and the tape rewinds; data is written to track 2, and the tape rewinds; data is written to track 3, and the tape rewinds; data is written to track 4. There is an early warning indicator near the end of each track. The sensing of that indicator will cause the tape to rewind.

The tape cartridge must be initialized before it is used for the first time. The initialiation procedure is described in section 4.

1.3 Error Recognition and Correction.

The design of the tape unit provides exceptional reliability. The provision of reading all data immediately after it is written is the key element to this reliability.

The tape head on the unit has both a READ and WRITE head designed so that as the data is written to the tape by the WRITE head, it is immediately read by the trailing READ head. If no errors are detected during this process the data has been properly written to the tape.

1.3 --Continued.

If an error is detected by the trailing READ head during a write operation, the tape unit attempts to re-write the file as many as 16 times. Before each attempt the unit rewinds the tape to the point at which tne file begins and the unit will then advance the tape 3 inches and attempt to write the file again erasing old file names. It will do this each time an error is detected up to a maximum of 16 attempts. If, at any time, the attempt is successful no further attempts will be made. This forward movement of the tape 3 inches from the beginning of the file each time an attempt is made ensures that the portion of tape used for a file of 2500 bytes or less is bypassed.

If an error is detected during a read operation, the tape unit will re-read the data block a maximum of 16 times before signalling an aborted read operation. The incidence of permanent read errors is very slight because of the movement of the tape past the tape cleaner and read head 16 times. This action removes many of the contaminants that cause permanent read errors. If the 16 re-tries still result in a permanent read error it is likely that the tape has physical damage or is of poor quality and should be discarded.

The tape unit has another feature to increase reliability. The built-in tape cleaner will remove contaminants from the tape media prior to passing the read/write heads. The tape unit generates a rewind of the tape each time the cartridge is inserted into the unit and at the end of most data operations. This procedure ensures that only the 36 inches of tape between the beginning of tape indicator and the load point at which data recording begins, is exposed to possible contamination by smoke, finger prints, or other foreign matter.

1.4 Magnetic Tape Cartridge Media.

The tape unit subsystem utilizes 1/4" tape cartridges that meet the ANSI X 3.55-1977 standard.

ALTOS recommends that all cartridges be certified at 6400 bpi by the manufacturer: Scotch DC-300A, Scotch DC-300XL and Verbatim TC-4450 tape cartridges are examples of acceptable media.

The tape unit has built-in sensors that identify beginning of tape, end of tape, load point and early warning location. The tape unit controller automatically recognizes these sensor indicators and ensures that data is written 6 inches beyond the loading point and will continue no more than 36 inches beyond the early warning location indicator. In order to take advantage of these sensor indictors the selected media cartridges should incorporate these features as per the ANSI compatability specifications.

Tape cartridges of both 300 and 450 feet will be accepted by the tape unit. The storage capacity of these cartridges depends upon the length of the records being written. The longer the records, the fewer the number of inter-record gaps (IRGs) and, hence, the greater the efficiency of the unit. Table 1-1 lists storage capacities of formatted tape cartridges based on differing block lengths.

Table 1-1. Storage Capacities--Formatted Tape Cartridges

BLOCK SIZE	BLOCK LTH	300' TAPE		450' TAPE	
(BYTES)	(INCHES)	(RECORDS)	(MBYTES)	(RECORDS)	(MBYTES)
125	0.2	7000	3.5	10500	5.3
1024	1.3	5110	5.3	7664	7.9
2048	2.5	3349	6.8	5024	10.3
4096	5.0	1983	8.1	2975	12.2
*8192	10.0	1092	8.9	1638	13.4

*the 8192- Byte Block is used by TIP

Handling and storage of tape cartridges are critical to the reliability and overall performance of the tape unit subsystem. Excessive heat, humidity or exposure to magnetic fields will cause substantial increases in the rate of both temporary and permanent tape media errors. The user is cautioned to follow the handling and storage recommendations of the tape manfacturer to insure satisfactory performance of the tape unit subsystem.

1.5 Tape Unit Software and Programming.

The Tape Interchange Program (TIP), which comes on either diskette or on cartridge, provides all the necessary software to use the tape unit subsystem for back-up and recovery of disk data and program files. TIP provides for automatic back-up and recovery for entire disk units or individual files. Automatic linkage of tape cartridges allows virtually unlimited back-up storage capacity utilizing TIP.

2. TAPE UNIT INSTALLATION AND CHECK-OUT.

2.1 Tape Unit Installation.

The Magnetic Tape Unit used with ACS8000 computer systems comes as either a stand alone unit which is connected electrically by ribbon cables to the host computer or as an integral part of the computer system itself. Instructions to install and connect the stand alone tape unit are sent with the MTU when it is shipped to the user. There are no installation procedures for tape units which are part of the computer system itself.

2.2 Tape Unit Check-out.

To check out the tape unit prior to using it for the first time you will need TIP. If your system has 1 or more floppy disk drives and a hard disk you will need to use your operating system disk and create a system which will warm boot from the hard disk. Once this is done you can log on to the hard disk, execute a mode command to set drive A to single density, insert the TIP disk, log on to drive A and enter TIP (carriage return). This will provide you with a menu. Select the Initialization program and the tape unit will write a data pattern to all tracks of the tape. Each of the 4 tracks will have a different pattern written to it. This ensures that two tracks are not being written to at the same time. After the write operation is complete a read operation will be performed on each track to ensure the unit is writing properly and reading properly. Once complete, file marks are written to each of the four tracks. This completes initialization.

Once initialization is successfully completed, TIP should again be used to back-up sample files to all tracks of the tape.

3. TAPE UNIT OPERATION AND MAINTENANCE.

3.1 Tape Cartridge Insertion and Removal.

BE CERTAIN THAT NO TAPE CARTRIDGE IS IN THE TAPE UNIT WHEN THE TAPE UNIT, OR SYSTEM, IS POWERED-ON OR POWERED-OFF. THIS WILL PROTECT THE TAPE CARTRIDGE FROM DAMAGE CAUSED BY ELECTRICAL TRANSIENTS.

The tape cartridge can only be inserted into the tape unit in one way. A keylock prevents insertion of the cartridge upside-down. Position the cartridge at the entry opening of the tape unit and slide the cartridge forward until the first detent is felt, then slide the cartridge forward until it is fully engaged.

When the cartridge is inserted it will automatically be rewound and then advanced forward to the load point. If the tape has been set to the "safe" position (a form of write protect) this will be sensed when the cartridge is inserted into the tape unit. The control unit is informed and the cartridge will have to be removed for only a write operation. There is no override for a write protected tape. To remove the tape cartridge simply pull it from the unit. **NOTE: do not attempt to remove the tape cartridge while any type of data transfer is underway.**

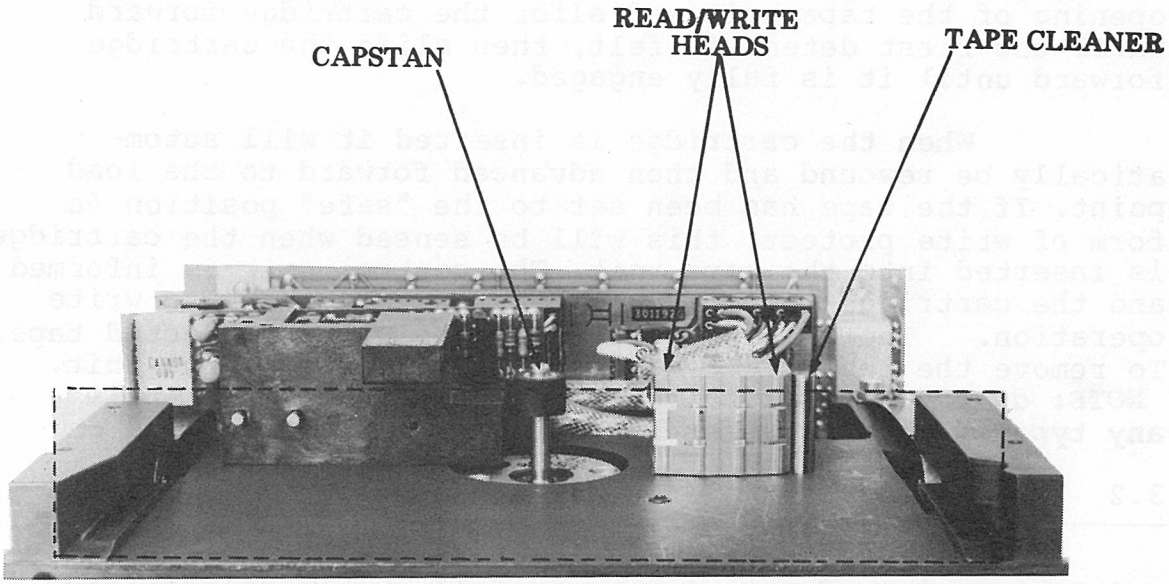
3.2 Periodic Tape Unit Maintenance.

Three components of the tape unit require periodic maintenance in order to insure overall system reliability. The cleaning removes contaminants from the tape unit components which come into direct contact with the tape media. Cleaning insures that there will be adequate direct contact between the read/write head of the tape unit and the tape itself.

The location of the components which require cleaning are shown in figure 3-1. The unit should be turned off before any cleaning is done. The components to be cleaned are accessed through the cartridge loading slot. A flashlight should be used to better view the components.

3.2.1 Read/Write Head Cleaning.

The magnetic read/write head should be cleaned daily if the tape unit is in regular use. Dirty heads may cause data drop-outs and error conditions during read or write operations. Use a non-residue, non-corrosive cleaning agent, such as Dupont Freon TF or isopropyl alcohol, and a cotton swab to clean the head assembly. Be sure to wipe off any excess and allow the heads to dry completely before operating the unit.



(Area within dotted line is seen from front panel)

Figure 3-1. Tape Unit Components Requiring Cleaning

3.2.1 --Continued.

CAUTION: SPRAY TYPE HEAD CLEANERS ARE NOT RECOMMENDED. AN OVERSPRAY MAY CONTAMINATE THE MOTOR BEARINGS. NEVER CLEAN THE HEAD WITH ANY HARD OBJECT. THIS WILL RESULT IN PERMANENT HEAD DAMAGE.

3.2.2 Tape Cleaner Component Cleaning.

The tape cleaner removes loose tape oxide and other foreign material from the tape beore it contacts the head. This foreign material accumulates in and around the tape cleaner and must be removed to ensure that the tape cleaner will continue to work effectively. The tape cleaner should be cleaned on the same schedule as the head.

To clean the tape cleaner component insert a folded sheet of paper in the bottom of the cleaning slot of the tape cleaner and lift up. This will lift out the foreign material gathered around the tape cleaner. Compressed air or an air brush can also be used. During alternate cleaning periods the same materials used to clean the heads can be used.

CAUTION: DO NOT USE ANY HARD OBJECTS TO CLEAN THE TAPE CLEANER. IF THE TAPE CLEANER SHOULD BECOME CHIPPED, IT COULD SCRATCH THE TAPE SURFACE, RESULTING IN LOST DATA AND/OR PERMANENT DAMAGE.

3.2.3 Motor Capstan Cleaning.

The drive capstan is composed of hard polyurethane and must be cleaned after foreign material has built up. Clean the capstan using isopropyl alcohol and a cotton swab. The cleaning schedule should be the same as for the other components listed earlier.

CAUTION: BE VERY CAREFUL NOT TO PERMIT CLEANING SOLVENT TO CONTAMINATE THE DRIVE MOTOR BEARING.

4. FILE BACK-UP AND RECOVERY.

4.1 File Back-up and Recovery Requirements.

The ALTOS tape unit subsystem provides both the hardware and software necessary to back-up and restore data and program files of any size. The tape unit allows total back-up of a formatted 14.5 MByte hard disk on one cartridge.

However, this system is only as reliable as the back-up procedures employed. It is the responsibility of the user to determine which capabilities of the back-up/recovery system are required for the operation involved and then implement those procedures to ensure that the required files are backed-up at the required intervals.

The reliability of the back-up/recovery system hinges on two factors:

a. The discipline with which key data files are backed-up onto tape. The most functional and reliable tape back-up system is of no value, if, at the one time it is needed, the required data and program files were not backed-up in accordance with established procedures.

b. The care with which the tape cartridge containing the backed-up files are handled. The weakest link in the reliability chain is tape media which has been stored in hot or humid conditions, or has been placed near magnetic or electrical fields.

4.2 Back-up/Recovery Capabilities.

4.2.1 Tape Interchange Program (TIP).

The ALTOS file back-up and recovery system is implemented through a program called the Tape Interchange Program (TIP). TIP is distributed on diskette and/or tape and comes as part of the MTU system. At present, TIP provides seven functions that work together to provide complete file back-up and recovery.

FUNCTION	PURPOSE
TAPE INITIALIZATION	Writes two file marks at the start of each of the four tracks of the tape. Upon completion of this function the tape can be utilized for back-up and recovery operations

4.2.1 --continued.

FUNCTION	PURPOSE
DISK-TO-TAPE BACK-UP	Places a user-specified file or files onto the tape from a user specified disk
DISK-TO-TAPE RESTORE	Restores user specified data files previously stored on tape onto a user specified disk drive
DISK-TO-TAPE APPEND	Adds additional files to a tape which already contains data or program files.
FILE VERIFICATION	Compares a file which has been backed-up to tape with a file of the same name, stored on a disk
TAPE DIRECTORY	Lists the names of all data and program files contained on the tape
RETENSION TAPE	Spools forward at 90 ips to end of tape and then rewinds a tape cartridge to ensure tape tension meets manufacturers specifications. This function will cure many error conditions which occur during tape use

4.2.2 File Back-up Utilizing TIP.

There are two general ways in which data and program files are backed-up to tape.

a. With the exception of a random write, file back-up is utilized for those applications where either an entire disk is to be backed-up or a family of data and program files are to be backed-up.

b. Individual file back-up is utilized where only individual data or program files are to be backed-up to tape.

TIP supports both types of back-up requirements through the use of ambiguous and unambiguous file names. The file naming system utilized by TIP is identical with CP/M* and MP/M* file naming conventions.

4.2.3 TIP File Name Conventions.

A file name is made up of Primary and Secondary names which describe the content of the file.

a. Primary File Names--The primary name is from one to eight characters, which can be made up of all alphabetic characters, numerals and special characters **with the following exceptions:**

< > . , ; : = ? * [ ]

The following are examples of **valid** primary names:

ABCDEFGH A X123 A@\-"22Z

The following are examples of **invalid** primary names:

ABC?DEF JKL.MNO PQRSTUVWX

b. Secondary File Names--several secondary file names are utilized by operating systems and related system software to represent standard types of files. The standard secondary file names are as follows:

ASM An operating system assembler source file

BAD Utilized to indicate a file which has been written onto a bad portion of disk media. Used with Winchester hard disks to reduce system overhead which would occur each time an active file tried to utilize the bad media. TIP ignores all files with a secondary name of BAD

BAK An operating system back-up file. Several programming systems generate back-up files during processing. This is done in case the working copy is accidentally destroyed the entire file is not lost. BAK is a default secondary file name.

BAS A BASIC source file. The CBASIC* language compiler expects the program name to be followed by BAS as the secondary file name

*CBASIC is a trade mark of Compiler Systems, Inc.

COM	An operating system command file. Programs which can be loaded directly into the system and executed are given the secondary file name COM
INT	A BASIC language intermediate file. Intermediate files are generated by compilers such as CBASIC
SUB	An operating system command list file. Files which contain lists of operating system commands which may be executed by the user through the use of SUBMIT commands are given the secondary name of SUB
$$$	An operating system temporary file. System programs which must generate temporary files in the course of their execution use the secondary file name of $$$

Although it is good programming practice to utilize these operating system default secondary names it is not mandatory to do so. If an installation determines that other secondary names are more appropriate, they may be used as well.

c. Unambiguous File Names--When valid Primary and Secondary names are combined, they form an unambiguous file name. Examples of valid unambiguous file names are:

ABC.ASM 12345678.BAS A.B

d. Group File Names--In many applications, the ability to refer to families of files is useful. For example, a diskette might contain program files, data files and executable load module files. You may wish to offload all program files to a back-up tape. This would be much easier if you could refer to all program files with a single name. This is accomplished through the use of Group File Names. In converting unambiguous file names to group file names which represent families of files, two special editing characters are used:

4.2.3 --Continued.

? Whenever the operating system finds a question mark in a file name, it will consider any character to be a match

* The asterisk in either the primary or secondary file name position tells the operating system to consider any primary or secondary name marked with * to be a match.

The user's manual for your operating system gives examples of files using the two special characters described above.

4.3 Tape Interchange Program (TIP) Operation.

4.3.1 Invoking TIP and Entering TIP Commands with a Diskette.

TIP is stored as a COM file and will execute under both CP/M and MP/M operating systems. Once the TIP diskette is inserted (it is issued in single density) entering TIP and pressing return will cause the TIP menu display.
NOTE: A tape cartridge must be inserted before invoking TIP.

CODE	ACTION
I	INITIALIZE TAPE
T	RETENSION TAPE
B	DISK-TO-TAPE BACK-UP
R	TAPE-TO-DISK RESTORATION
A	DISK-TO-TAPE APPEND
V	FILE VERIFICATION
D	TAPE DIRECTORY
ESC	ESCAPE TO OPERATING SYSTEM

This menu and the explanations given are based on version 3.3 of TIP. Subsequent versions may contain more options or variations to existing options. Information on those changes, as they occur, will be explained in the TIP User's Instructions which will accompany the TIP software. Instructions on using TIP from a tape cartridge, which differ from those described in this section, will be available at a later date.

With the menu displayed, select the option you wish performed, by code letter, and press return. An invalid selection will result in an error display and a prompt to select again.

4.3.2 TIP Commands.

INITIALIZE TAPE--This function writes two file marks at the beginning of each of the four tracks of the tape. These two file mark records indicate that there is no data on the track. Thus the initialization process not only formats a new tape, it also erases any data previously written on the tape. If the tape cartridge being used is write protected (the "safe" write protection arrow has been set) the user will be prompted that the tape cannot be initialized.

RETENSION TAPE--This function rewinds the tape, performs a high speed search to the end of the tape, and again performs a rewind operation. This action retensions the tape and will often alleviate errors that have occurred while using a particular tape.

DISK-TO-TAPE BACK-UP--This function rewinds the tape cartridge and then prompts the user for the file name or names which are to be transferred from the user specified disk to the tape inserted. When the file transfer is complete, the user will be prompted for the next file to be transferred. No rewind action takes place at this time. This allows the user to stack files on the tape. If file transfer is complete, the user responds with a carriage return. TIP then writes two file mark records on the tape indicating end of data and rewinds the tape. If the user enters a file name or names which cannot be found on the disk the user will be informed by a screen display and prompted to select again. If the tape becomes full during a transfer the user will be informed that the tape is full. A fresh cartridge, which has been initialized, can be inserted and the file transfer can continue. This can be done as many times as necessary.

DISK-TO-TAPE APPEND--This function is similar to a disk-to-tape back-up except that initial tape positioning is changed. When this function is invoked the tape is rewound, then read until the two file mark records are found. They are erased and the additional file or files are added to the tape. When the last file has been added, respond to the prompt with a carriage return. TIP will then write the two file mark records on the tape, and rewind the tape. When a tape becomes full, the procedure is the same as for disk-to-tape back-up.

TAPE-TO-DISK RESTORATION--This function transfers files from the tape to the user specified disk. When the files were originally backed-up from disk-to-tape, the disk address from which the file or files originated was stored as a source device code. For example, if the user backed-up all files from disk drive A, then each file would have a source device code of A. When restoration is desired, the user may be using the same disk drive as was used for the disk-to-tape back-up or he may be using a different drive. The user will have the option of restoring all files on the tape to the current disk, or restoring only those files which were oringinally backed-up from the current disk drive. **'IGNORE SOURCE DEVICE CODE, Y OR N?'** This prompt is the key. If you wish all files to be restored to the current disk drive and it is not the drive where those files originally came from, you would respond Y to the prompt. TIP would then restore all files on the tape to the currently used disk drive. If you respond N, TIP would restore only those files which originated on the currently used disk drive.

FILE VERIFICATION--This function allows the user to compare the contents of a user specified file on tape to the contents of the same file on disk. Once both files have been identified and located, a byte by byte comparison is made between the two. If any discrepancies are found, the location of the byte in error and the tape and disk file byte values are displayed. The location of the error is supplied as the disk extent, record number and the number of the byte in error within the record. The values of the bytes found on the tape and disk are also displayed. If one file ends before the other, the remaining bytes in the other file are displayed, with "XX" being displayed as the byte value in the terminated file.

TAPE DIRECTORY--This function allows the user to list the file names of all data and program files on the tape currently inserted into the unit. If the "CNTRL P" function is entered on the keyboard, TIP will echo the directory to the printer as well.

4.3.3. TIP File Name Parameters.

For Disk-to-Tape, Tape-to-Disk and File Verification operations, the user is prompted for the file or files that are to be acted upon. The format for user response is:

FILE NAME:

[Source/Destination Disk Drive:]file.name(s)[MP/M User Number]

INPUT	DESCRIPTION
Disk Drive	This optional input specifies the source or destination disk drive. For back-up operations this input specifies the disk drive on which the data files are to be found. For restore operations this input specifies the disk drive to which the files are to be transferred. For file verification operations this input specifies two criteria which must be met. First, the file on tape must match exactly the name specified including the disk drive specified during the back-up or append operation. Second, if the disk drive is specified then the disk file to be compared is presumed to be located on the specified disk drive. The format for the disk drive specification is the drive letter followed by a colon. Example: **E:** If no disk drive entry is made the currently logged drive is used by default.
FILE-NAME	The file name indicates the or files to be backed-up or restored by TIP. As described earlier, file names may be Group or Unambiguous file names.

4.3.3 --Continued.

CP/M or MP/M	When TIP is used under either CP/M or MP/M operating systems, the user may specify that the files to be backed-up or restored must reference a specific user number. If no user number is specified then the current user number is used as the default value. An asterisk (*) indicates that all user numbers meet the match criteria. The entry requires that an opening bracket ([), letter G, user number or *, and closing bracket (]) be used. Example: [GØ]. This would indicate user 0.

4.3.4 TIP Back-up and Restore Function Examples.

4.3.4.1 Back-up Example.

In this example the user wishes to back-up all data and program files for an application called PAYROLL to the tape cartridge. The application programs are located on the floppy diskette in drive B. All of the program file names begin with PAY and are followed by other identifiers such as INP, OUT, with a file type of 'INT'. Example: PAYOUT.INT

All of the data files reside on the Winchester Hard disk and have a secondary file name of FIL.
Example: PAYDATA.FIL

The tape cartridge is new and has been inserted into the unit. The sequence is as follows:

With TIP residing on currently logged drive enter TIP (press return)

Screen Displays: (based on version 3.3 TIP)

CODE:	**ACTION:**
I	**INITIALIZE TAPE**
T	**RETENSION TAPE**
B	**DISK TO TAPE BACKUP**
R	**TAPE TO DISK RESTORATION**
A	**DISK TO TAPE APPEND**
V	**FILE VERIFICATION**
D	**TAPE DIRECTORY**
ESC	**ESCAPE TO OPERATING SYSTEM**

4.3.4.1 --Continued.

User Inputs:

I (press return)	tape is initialized
B (press return)	
Prompt: FILE NAME:	
B:PAY*.INT (press return)	files are backed-up from disk to tape and screen will display each file name as it is copied
Prompt: FILE NAME:	
E:*.FIL (press return)	data files from hard disk are backed-up to tape
Prompt: FILE NAME:	
(press return)	end of data marks written to tape and tape is rewound

Now the user discovers that there is an additional file which must be added to the tape. The name of the additional file is PAYROLL.ERR and it currently resides on the logged-on drive. The user will re-insert the tape cartridge, invoke TIP, press return, and from the menu:

enter A (press return)	invoke the append function
Prompt: FILE NAME:	
PAYROLL.ERR (press return)	the additional file will be appended to the end of the tape
Prompt: FILE NAME:	
(press return)	this will cause the end of data marks to be placed at the end of the new file which was added

4.3.4.1 --Continued.

To obtain a printed list of the directory of the tape, the user will enter a ^P before invoking the directory command, D. After the directory has been displayed and printed, tne user will press return to execute a warm boot and return to operating system control.

4.3.4.2 Restoration Example.

A problem with the payroll system has developed. The TAXES.FIL file has been inadvertently destroyed on the disk and must be restored from the tape. The sequence, once tne proper cartridge has been inserted into the unit is:

TIP (press return)	invoke TIP
Menu is displayed	
R (press return)	invoke tape-to disk restoration
Prompt: FILE NAME:	
TAXES.FIL (press return)	
PROMPT: IGNORE SOURCE DEVICE CODE, Y OR N?	

If you want restoration of this file to be from tape to the currentıy logged-on drive, and the file was originally backed-up from the same drive, respond with either Y or N.

If you want restoration of this file to be from tape to the currently logged-on drive, and the file was not originally backed-up from tne same drive, respond with Y.

If you want restoration of this file to be from tape to the drive (disk) from which it was backed-up, and that drive is not the currently logged-on drive, respond with N. Restoration will be from tape to the drive from which tne file was originally backed-up.

This next situation is one in which the user discovers that aıl files have been lost on the disk and a total restoration is necessary. Regardless of which drive was used as tne originating drive to back-up the files, the user wants the whole tape restored to drive F. The sequence is as follows:

4.3.4.2 --Continued.

Invoke TIP (press return)	
R (press return)	Invoke tape-to disk restoration
Prompt: FILE NAME:	
F:*.* (press return)	
Prompt: IGNORE SOURCE DEVICE CODE, Y OR N?	
Y (press return)	the entire tape will be restored to drive F
Prompt: FILE NAME:	
(press return)	control returned to operating system

4.3.4.3 File Verification Example.

In this example the user has made some recent changes to a data file called MASTER.FIL. The user is not certain if the tape file has been backed-up since the last changes were made to the disk file. The original back-up was made from drive E.

Invoke TIP (press return)	
menu display	
V (press return)	Invoke Verification
Prompt: FILE NAME:	
MASTER.FIL (press return)	Specifying file to be compared
Display: FILE NOT FOUND ON TAPE	
	user forgot that the source drive was made a part of file name. Accurate file name was E:MASTER.FIL
Prompt: FILE NAME:	
E:MASTER.FIL (press return)	

4.3.4.3 --Continued.

Display: FILES BEING VERIFIED	TIP will compare the file on tape with the file on drive E since it was specified as the source device drive
Display: FILES VERIFY!	The files did match. Had they not matched a display would have shown the addresses where mis-matches occurred
Prompt: FILE NAME:	
(press return)	return to operating system control

4.3.4.4 CP/M and MP/M User Examples.

Prompt: FILE NAME:	
PAYROLL.*[G*]	This entry will result in all files with a primary name of PAYROLL to be backed-up regardless of their secondary names. It also results in those files being backed-up regardless of user number
Prompt: FILE NAME:	
*.ERR[G1]	All files with a secondary name of ERR from user number 1 will be backed-up

4.3.5 TIP Use Considerations.

The TIP program can utilize multiple tape cartridges to store all of the back-up files specified by the user. The TIP program utilizes end-of-data and end-of-tape markers which indicate whether the current tape cartridge contains the last file or whether additional cartridges were utilized. No tape labels are generated by TIP nor is the identification of the user who did the back-up operation revealed. No information concerning how many tapes make up a file are listed by TIP.

It is highly recommended that gum tape labels be used to label each cartridge as it is used. The date that the back-up was performed, who performed it, system configuration and any other relevant information should be placed on the label.

4.3.5.2 Documenting Back-up/Restore Operations.

The capabilities of CP/M and MP/M allow all output lines sent to a user terminal to be echoed to the system printer. On some operating systems this is done directly, while on others, spooler action captures the output lines and causes the print action to occur later.

ALTOS recommends the use of Control P (^P) to engage the printer while using TIP. Within TIP ^P can be entered at any time except in response to the command menu. This is the normal approach with CP/M.

TIP does cause a reduction in performance when operating under MP/M. Under MP/M it is necessary to mask the I/O interrupts while TIP is actively accessing the tape cartridge. This requirement has two major effects:

a. The MP/M time-of-day clock does not operate while TIP is actively transferring data to the tape, thus the clock will be "slow" after TIP has been utilized.

b. The performance of individual users in a multi-user environment will be substantially affected. In a four user system each user could experience a degradation of performance of up to 50%.

One way to minimize the effect of TIP in MP/M systems is to create a single user MP/M system disk which contains TIP and is only used for TIP operations. This will substantially reduce the amount of degradation and will also keep other users from accessing and altering data files which are being backed-up on tape.

4.4 TIP Tape Recording Procedure.

The TIP system writes files to tape in blocks of 8,208 bytes. Contained within this block is a 16 byte tape control block (TCB), which contains information describing the file. The file data consists of from one to sixty four 128 byte sectors as copied from the disk. If a file is over 64 sectors in length, TIP will write additional tape blocks until all of the file has been copied.

TIP utilizes the standard end-of-tape convention of two file mark records on tracks 1, 2 and 3 to indicate that the tape unit should rewind and continue on the next track. An end-of-tape indication on track 4 signals that there are additional tape volumes within the back-up/restore operation. TIP's end-of-data indication is a file mark record followed by a blank record and two additional file marks. When TIP encounters the end-of-data condition on a restore operation, it indicates to the user, by display, that the task has been successfully completed.

The Tape Control Block format is as follows:

```
US F1 F2  /  /  F8 T1 T2 T3 00 LB SD RC

00 01 02 ....   08 09 10 11 12 13 14 15
```

US	The CP/M and MP/M User Number which ranges from 00 to 0F. If no user number was specified the current user is used as the default user number
F1-F8	Primary file name in upper case ASCII
T1-T3	Secondary file name in upper case ASCII
LB	Last block indicator
SD	Address of the disk drive from which this data file was backed-up. The value ranges from 0 to F which would indicate disk drives from A to P
RC	The number of 128-byte sectors which are contained in the 8192 byte block. This value ranges from 1 to 64. If the file does not utilize the entire tape block then TIP fills the unused portion of the tape block with 00H

5. ERROR CODES, TROUBLESHOOTING AND PROBLEM DIAGNOSIS.

5.1 TIP Error Conditions.

The error conditions encountered by TIP fall into 2 categories:

a. User errors-specifying incorrect file names, incorrect spelling, improper format when entering commands

b. Tape media or tape unit problems-found by TIP and not allowing TIP to properly perform a valid user command

5.2 File Specification Errors.

If a user specifies an invalid file name, TIP will respond with the display: FILE NAME BAD, REENTER. If the user enters a file name that does not exist, TIP will display FILE NOT FOUND.

5.3 Inadequate Disk Space During Restore.

If an attempt is made to restore files to a disk that does not have sufficient space, TIP will inform the user that restoration is being aborted and return to the command menu. It is up to the user to ensure that sufficient space is available. If an abort occurs, the user must insert a new cartridge and restore, selectively, those files which were not restored on the previous cartridge.

5.4 'Full Tape Cartridge' Conditions.

TIP allows the user to back-up files to as many tape cartridges as necessary. When multiple tape back-up files are restored, TIP performs error checking to catch instances where the tapes have been inserted into the tape unit out of sequence. The display: UNEXPECTED END OF DATA indicates that a sequence error has occurred. The user should restart the restore operation using the proper sequence of tapes. The same display can occur if the user extracts a tape from the unit while the unit is attempting to back-up or restore a file or set of files. When that tape is re-inserted at a later time, the tape is rewound, but no end-of-tape or end-of-data marks are placed on the tape since it was pulled from the unit prematurely.

5.5 Tape Media and Tape Unit Malfunctions.

TIP recognizes three error conditions that generally indicate problems with the tape cartridge, tape unit or the TIP software itself. TIP provides two types of error messages.

5.5 --continued.

A general error code provides a broad indicator of the type of error which has occurred. A specific sub-error code provides additional information as to the cause of the error.

5.5.1 General Error Codes.

5.5.1.1 TAPE COMMUNICATIONS ERROR, SYNTAX REJECT WITHIN TIP

This error code indicates that an invalid set of tape movement commands were sent to the tape control unit by TIP. The user should assume that the TIP.COM file has been compromised and should go back to the original distribution diskette of TIP and re-load TIP to see if the problem occurs again.

5.5.1.2 TAPE ABORT ATTEMPT WITH ATTEMPT

This error code indicates that an unrecoverable error condition has occurred and that the tape media was moved. This means that after 16 retries the tape unit was unable to complete the requested operation. On a back-up operation this error generally indicates bad media. A sub-error code will also be displayed. During a restore operation this general error code display means that after 16 tries tne block of data still could not be read. Since the inability to read data is expected only once every 100 million attempts, the error code generally indicates a tape media or tape unit problem.

5.5.1.3 TAPE ABORT WITHOUT ATTEMPT

This error code indicates that an error has occurred without the tape moving. Generally, another message would follow. One common occurrence of this error display is when the user invokes TIP without having the tape cartridge inserted in the unit. Sub-error codes are generally included with any major error display.

5.5.2 Sub-error Codes.

Following the general error code display TIP will provide sub-error codes which provide more detailed information about the error condition.

SUB-ERROR CODE	MEANING & SUGGESTED SOLUTION
00	The tape drive has executed an automatic rewind since the last TIP command was issued. Return to the command menu and proceed with the knowledge that the tape is already rewound.

01	A write operation was requested to a write protected cartridge. Use of a non-write protected cartridge is required.
02	A TIP command was issued with no tape cartridge inserted into the unit.
03	The tape unit did not respond to a valid command. This is generally caused by a hardware failure.
04-05	Not used
06	The Read-after-Write circuity indicates an error in attempting to write a file mark record. The tape should be re-initialized, the tape re-tensioned and re-try the operation. If the same failure occurs, try a new cartridge.
07	The tape unit aborted prior to completion of a valid command. This generally indicates a hardware failure.
08	A read command failed due to missing data or file mark record. This is usually caused by bad tape media. If the same problem occurs with a new cartridge, suspect a hardware failure.
09	A read command failed due to a "short" record being encountered. Ensure that the tape being read was created using TIP. Cause could be bad tape media or a hardware failure.
10	Same as 09 sub-error code.
11	A read command failed due to bad vertical parity. This is generally caused by bad tape media. If the error occurs with different tapes, suspect a hardware defect.
12	A write command failed due to a read-after-write verification error. Re-tension the tape and try the operation again. If problem persists, suspect hardware defect.

5.5.2 --continued.

13	A write command failed due to a read data indicator not being detected prior to the write operation being completed. This is generally caused by bad media. Proceed as in sub-error code 12 above.
14	A read command failed due to a file mark being detected. This is generally caused by bad tape media. Proceed as in sub-error code 12 above.

5.5.3 Error Analysis.

When a problem develops with operations involving the tape unit, the first step in troubleshooting the problem is to make a dtermination as to whether the problem is with tne user making bad input commands, tape media or hardware failure. When the user is informed that an error has occurred, the tape unit has already attempted recovery. For any Read or Write operation, the unit has attempted 16 retries. When attempting a Write operation, the unit, during each retry, will advance the tape 3 inches to bypass possible bad media. If all 16 retries failed this would mean tne tape unit had bypassed 48 inches of bad tape. This is highly unlikely unless the whole cartridge is in fact defective.

The tape unit utilizes three major design approaches to insure the ability to read data:

a. Reads eacn block as it is being written using a trailing read head.

b. Advances the unit past suspected bad media whenever write errors occur.

c. Uses a precise and clean signal during write operations. The read-after-write function is done with a 3db reduction in read head signal strength. This is done so that if the read-after-write operation is successful then later read only operations should occur without any difficulties.

5.5.4 Tape Unit Status Codes.

The tape unit returns two status codes at the completion of every operation requested by a program. One status code is for the tape drive and the other is for the tape interface. These status codes inform the calling program

whether the requested operation was completed successfully as well as the ending condition of the tape media. The status codes are returned in the form of two status bytes as follows:

DRIVE STATUS BYTE	INTERFACE STATUS BYTE
Bit 7 Reserved	Bit 7 Reserved
Bit 6 File Mark Detected	Bit 6 Data Block Available
Bit 5 Drive Rewinding	Bit 5 Command
Bit 4 "On" And Loaded	Bit 4 Status
Bit 3 Beginning Of Tape	Bit 3 Current
Bit 2 End Of Tape Warning	Bit 2 Drive
Bit 1 Auto Rewind Executed	Bit 1 Current
Bit 0 Write Enabled	Bit 0 Track

The format of the Status bytes is as follows:

Bits

7	6	5	4	3	2	1	0
S7	S6	S5	S4	S3	S2	S1	S0

The status codes returned by tne drive are the hexadecimal representation of the Drive and Interface Status Bytes. Depending upon the type of operation requested by the user more than one indicator may be ON within the status byte. For example, if the tape drive was powered-on and a tape cartridge was loaded at the beginning of the tape, the Drive Status Byte would be 15. The 10 bit indicates that tne drive is on and loaded, the 04 bit indicates that the tape is at the beginning and the 01 bit indicates that the tape is not write protected. The user should break the status codes into their component parts. The meaning of each bit in the status byte is defined below.

DRIVE STATUS	DEFINITION
Bit 7	Reserved. This bit is reserved for later use. It is always set to 1.
Bit 6	File Mark Detected. Whenever the tape unit detects a file mark record on the tape, this indicator is set.

Bit 5	Drive Rewinding. The tape unit is in the process of a high speed rewind. This flag stays set until rewind is complete.
Bit 4	On and loaded. The tape unit is powered-on and a tape cartridge has been inserted into the unit.
Bit 3	Beginning of tape. The loaded tape cartridge has been rewound and is at the beginning of tape. When a rewind occurs, the tape is rewound to the beginning of tape and then advanced to the load point. This bit shows that the tape is at the load point.
Bit 2	End of tape early warning. The tape unit has detected the early warning hole in the tape, indicating that approximately 48 inches of tape remain before the physical end of tape cartridge. Only file mark write operations are permitted when this flag is set. The flag is reset when the tape is rewound.
Bit 1	Warning flag. Since the last operation the tape drive has executed an automatic rewind. This is caused by taking the cartridge out of the unit and then re-inserting it again. The program must recognize that positional integrity of the tape has been lost, and that no operations which assume a tape location will provide expected data.
Bit 0	Write enabled. This flag tells the program whether the tape cartridge has the 'safe' indicator ON, indicating the cartridge is write protected. If this bit is set to 1 the cartridge is not write protected.

INTERFACE STATUS	DEFINITION
Bit 7	Reserved. This bit is reserved for later use. It is always set to 1.

5.5.4 --Continued.

Bit 6 — Data Block available. A tape read or search operation has been successfully completed and the data is available to be read into the control unit buffer.

Bits 5 & 4 — Command status. These bits indicate the results of every tape operation. The return codes are:

00 - Operation Successful
01 - The operation was aborted without tape movement.
01 - Read operation aborted after 16 retries
11 - The specified input parameters requesting an operation were invalid. This is usually a programming error.

Bits 3 & 2 — Current tape drive. The tape unit allows up to 4 tape units to be daisy chained on the same data bus. These bits indicate the selected drive. Presently, only 1 MTU is available to the user. These bits are thus always set to 00 indicating drive 1 is selected.

Bit 1 - 0 — Current track. These bits indicate which of the current tracks is being accessed. When the end of a track is encountered the tape unit automatically rewinds the tape cartridge and selects the next track, unless the tape was already on track four. The bit indications are as follows:

00 - track 1
01 - track 2
10 - track 3
11 - track 4

5.5.5 Error Recovery Techniques.

Always suspect the obvious. Clean the tape unit, try a different tape, retension the tape, check the error codes. This will solve many read and write problems. Tape errors caused by media problems usually result from the way the tape is stored. Heat and humidity will greatly increase the incidence of temporary and permanent tape related errors. A good example of this

5.5.5 --Continued.

is the manufacturer's statement that a minimum of 8 hours is necessary for a tape to become 'acclimated' to a new operating environment after the tape has been transported from one location to another. Another cause of media problems is tape the being wound onto a cartridge with variable tensions. If all of your attempts fail, note all of the symptoms, note all the actions that you took and call your distributor for assistance.

6. STAND-ALONE MAGNETIC TAPE CARTRIDGE BACK-UP UNIT (MTU-1) WITH ACS8000 COMPUTERS.

6.1 8200-CPU PCB and MTU-1.

The MTU-1 package provides the components necessary for modifying all the ACS8000 systems built on the 8200 chassis. ACS8000 computers built on the 8000 or the 8100 chassis can not be field upgraded to support the ALTOS Tape Subsystem. MTU-1 contains the following items:

- MTU-1 Chassis Containing the Mag Tape Drive, #530-10809
- Tape Controller Printed Circuit Board (PCB), #330-10265
- 50-pin Internal Tape Interface Connector Cable, #510-10529
- Connector Cable with 37-pin Connector on one end, and a 34-pin Connector and a Pig-tail 6-pin Connector on the other end, #510-10292
- 50-pin Interconnect Cable Assembly, #510-10513
- 37-pin Interconnect Cable Assembly, #510-10286
- Power Cord, #230-10233
- Floppy Diskett Containing TIP and TIP Manual, #580-10825
- Blank Magnetic Tape Cartridge, #180-10267

6.1.1 Installation of the MTU-1.

Follow the procedure below when installing the MTU-1:

a. With the power off, lay the ACS8000 on a flat working surface. Loosen the six screws that secure the top cover. Remove the top cover from the computer.

b. Refer to Figure 6-1 for circuit chips and connector locations of the 8200 PCB for the steps below.

c. Remove the Z80 CPU chip at location 14M. Be careful that no pins are bent in this operation.

d. Place the Z80 CPU chip in the Tape Controller PCB. The notched end should be toward the embossed letters "CPU".

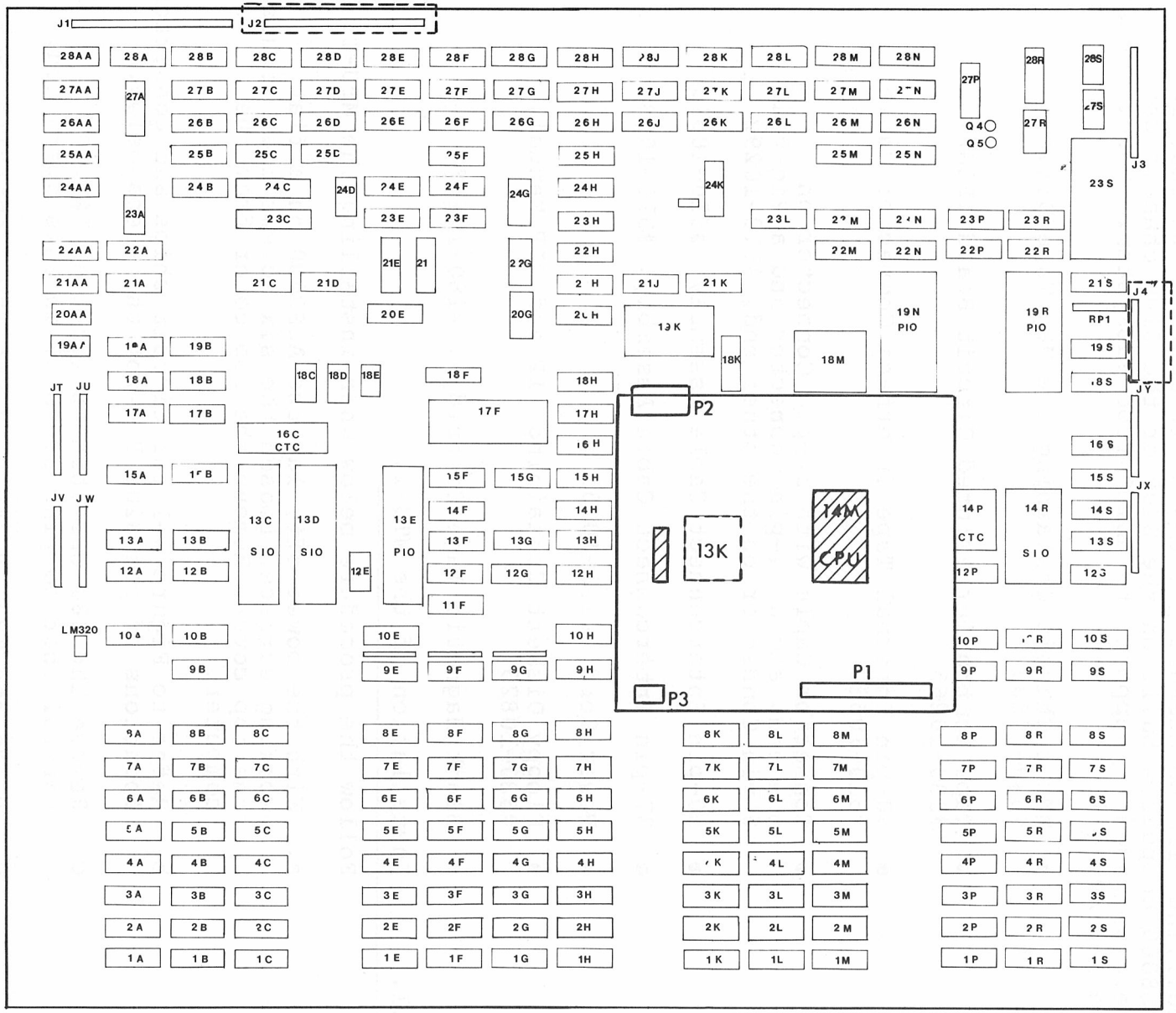


Figure 6-1 8200 PCB with Tape Controller PCB Mounted

e. Locate and remove the white six-wire power connector; it is to the left of Matrix position 13K on the 8200 CPU PCB (See Figure 6-1).

f. Install the Tape Controller PCB onto the 8200 chassis in location 14M. The PCB makes two interconnections on the 8200 chassis:

1. The pins on the PCB will mate with the 40 pin socket at location 14M

2. The pins from which the plastic connector was removed in step (e) above will mate with the 6 pin connector on the 8200 PCB when placed properly.

g. Insert the white six-wire power connector removed in step (e) above onto the six-pin connector on the rear of the Tape Controller PCB at P2. The red wire of the connector should be on the right when viewed from the front of the 8200 PCB. Be sure the lip on the connector securely inter-locks with the lip on the Tape Controller PCB.

h. Remove the 50-pin rear panel additional disk connector (Figure 6-2) from the 8000 computer and from the header at J2 of the 8200 PCB (Figure 6-1). Save the hardware for next step.

i. Attach the 50-pin ribbon cable supplied with the Tape Controller to the rear panel of the 8000 computer at the additional disk connector shown in Figure 6-2 and secure it with the hardware from step (h) above.

j. Attach the other end of the 50-pin ribbon cable connector to the Tape controller PCB at P1. The red stripe along one side of the ribbon should be on the right side of the connector when viewed from the front of the 8200 board.

k. Remove the 37-pin cable slot from the Parallel Port slot on the rear panel of the 8000 computer (See Figure 6-2); remove the other end of the cable connector (34-pin) from the header at J4 on the 8200 PCB. Save the hardware for the next step.

l. Attach the 37-pin slot end of the connector cable supplied with the MTU-1 to the parallel port slot on the rear panel of the 8000 computer and secure it with the screws from step (k) above.

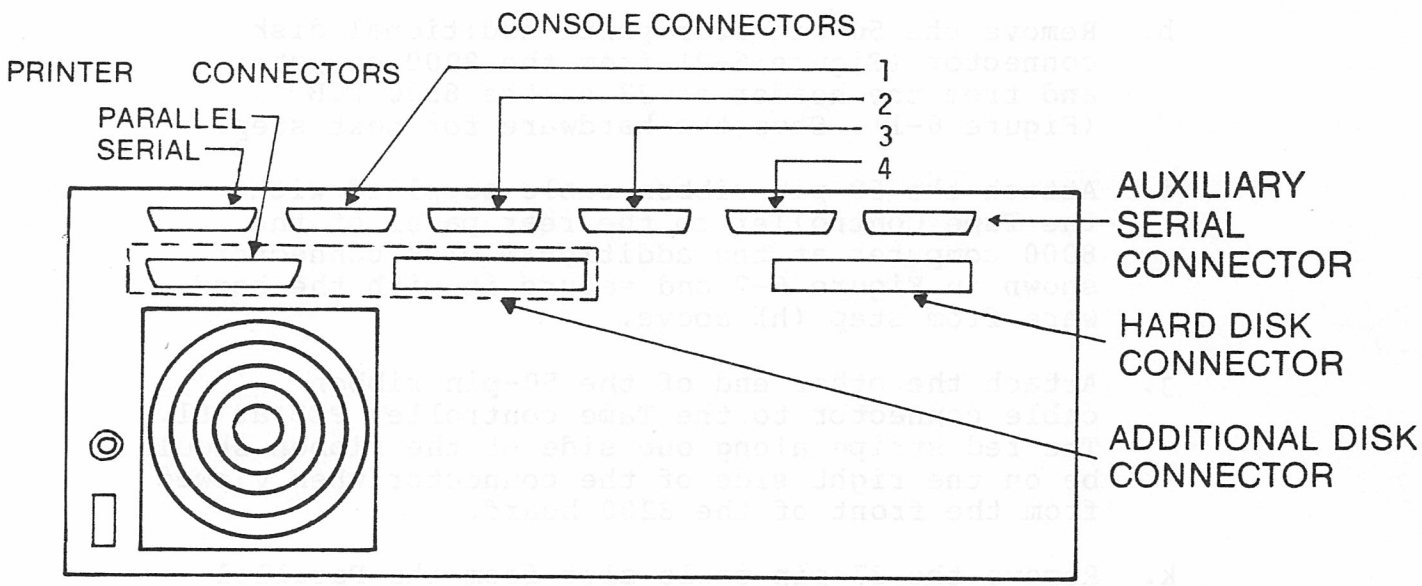


Figure 6-2 Rear Panel of ACS8000 Computer

6.1.1. --Continued

m. Connect the 34-pin end of the connector cable onto the header at J4 on the 8200 PCB. Connect the 6-pin pig-tail to the six-pronged plug on the Tape Controller PCB at P3. The pigtail connector is keyed and can only go in one way.

n. Attach the 50-pin interconnect cable from the ACS8000 (additional disk) connector to the rear of the MTU-1 chassis. It is the only 50-pin connector on the MTU-1 rear panel.

o. Attach the 37-pin interconnect cable from the ACS8000 Parallel Port Connector to the rear of the MTU-1 Chassis it is the only 37-pin connector on the rear panel.

p. Replace the cover of the ACS8000 computer and tighten the six screws on that hold the cover in place.

q. Install the power cord supplied with the MTU-1.

r. Switch on the computer and the MTU power switch.

s. Insert the tape cartridge. The front panel should be lit and the tape should rewind to the beginning of tape.

6.2 8500-CPU and MTU-2.

The MTU-2 package provides the necessary components to upgrade your 8500 CPU system--ACS8000-10 and ACS8000-15. Your upgrade kit will contain the following items:

- MTU-2 Chassis Containing the Mag Tape Drive, #530-10809
- Tape Controller Printed Circuit Board (PCB), #500-10762-001
- 13-inch 34-pin internal interface ribbon cable (8500 board to tape controller board) #510-10529
- 22-inch 50-pin internal connector cable (tape controller to computer rear panel) #510-10542
- 72-inch 50-pin interconnect ribbon cable, #510-10513
- Associated hardware
- Power cord
- MTU-2 Upgrade kits for the ACS8000-10 will have an 8 1/2-inch 6-wire power cable #510-10658

Note 3 kinds of cables

Interface cable--Printed circuit board to printed circuit board connection

Connector cable--Printed circuit board to rear panel connection

Interconnect cable--Computer rear panel to U/K rear panel connection

To install your MTU-2 to your system you will need the following items:

- o Regular Screw Driver
- o 5/16 open ended wrench or equivilent

6.2.1 Installation of MTU-2.

Disconnect the power cord on your computer. Remove the top cover by **loosening** the side panel screws with a regular screw driver. Carefully, lift off the top cover and set it aside. When installing any ribbon cables, **be sure that the red strip is to the right as you face the computer.** Refer to Figure 6-3 when installing your upgrade kit. Follow the steps below to install your MTU-2.

a. If you have an ACS8000-10 or U/K-10, you have a hard disk controller board on the right side 8500 board. You will have to remove the 5 nuts that secure the hard disk controller board to the 8500 board to access J5 Pinning for the MTU controller board. You do not have to remove any cables connected to the hard disk controller board--after removing the nuts, simply fold the controller board to the rear of the computer.

b. Insert the 13-inch 26-pin interface cable at Matrix position J5 on the 8500 board.

c. Place the Tape Controller board onto the standoffs provided on the **left** side of the 8500 board as you face the front of the computer. Secure the nuts finger-tight and then snug with the wrench. Do not overtighten.

d. Fold the 13-inch interface cable installed in step (a) above over the Tape Controller board and insert into the Tape Controller board at matrix position J5. Verify that the red strip is on the **right** as you face the front of the computer.

e. Connect one end of the 22-inch 50-pin cable connector at J2 on the tape controller board and the other end into the rear panel of the Computer at JC. Secure with nuts and screws provided with your kit.

f. If you have an ACS8000-10 or and U/K-10 take the 6-wire power cable connector and insert one end at P1 on the tape controller board and the other end at J3 on the power supply inside the rear panel of the computer.

g. If you do not have a hard disk controller board connected to the 8500 board, there are two power connectors bound together by plastic wrapping Carefully cut the plastic wrapping that binds the 2 white power connectors on the 8500 board.

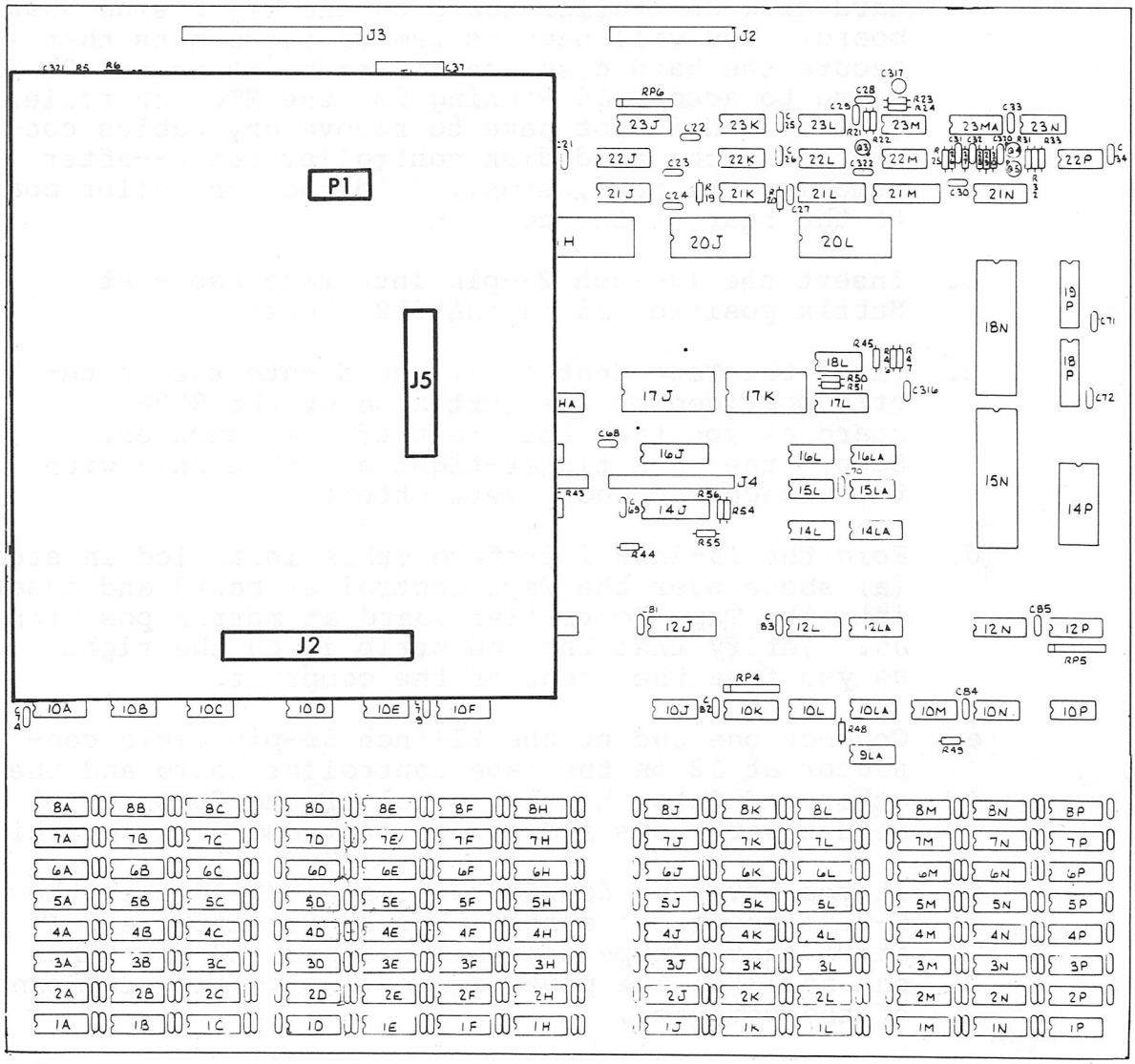


Figure 6-3. 8500 Central Processing Board and MTU-2 Controller Board.

6.2.1 --Continued.

h. When fully extended, insert the end connector into P1 position on the Tape Controller board. Be sure that the red wire is to the **right** as you face the computer.

i. If there is no Hard Disk controller, let the other 6-wire connector rest in the computer so that is does not obstruct any ICs or interfere with the power supply or the fan.

j. Secure the tape controller board to the 8500 board in the four standoffs positions with the nuts provided.

k. Attach the 72-inch 50-pin interconnect cable from the rear panel of the computer at JC to the rear panel of the MTU-2 Chassis.

l. Verify all the steps above.

m. Before replacing the top cover install the power cords and check to be sure the system work properly.

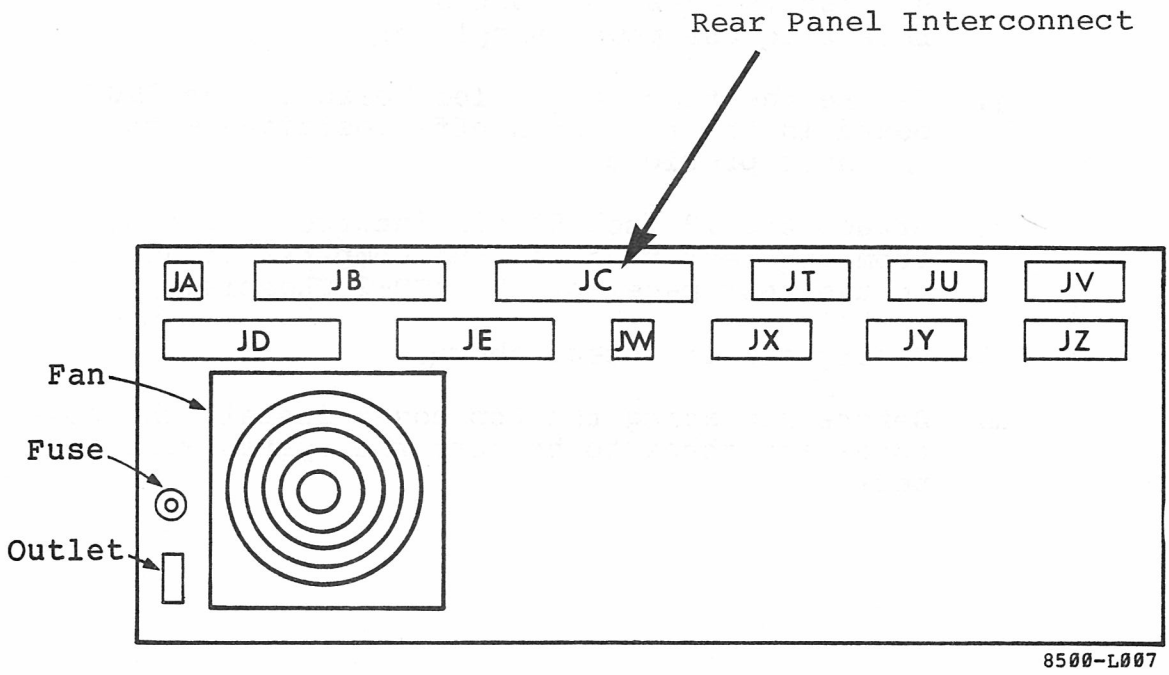


Figure 6-4. Rear Panel of ACS8000 Computer.

REVISIONS			
A	RELEASED AS DRAWN	6/18/80	MTS
B	ROTATED Z-80 180°	4/17/80	MTC

Z80 CPU

J1 (D0)14 (D1)15 (D2)12 (D3)6 (D4)7 (D5)9 (D6)10 (D7)13 (A0)30 (A1)31 (A2)32 (A3)33 (A4)34 (A5)35 (A6)36 (A7)37 I/ORQ*20 RD*21 WR*22 RESET*26 WAIT*24 — D0 D1 D2 D3 D4 D5 D6 D7 A0 A1 A2 A3 A4 A5 A6 A7 I/ORQ* RD* WR* RESET* — R1 330 — WAIT B*

J1 1 2 3 4 5 6 11 16 17 18 19 23 25 27 28 29 38 39 40

M12 74LS244: D0 D1 D2 D3 D4 D5 D6 D7 → DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7

M13 74LS244 (octal buffers 3-states): D0 D1 D2 D3 D4 D5 D6 D7 → DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7

M15 74LS27 — M16 74LS10 — OUTG*

M16 74LS10 — WR* ADDSEL (1B5) — INPG*

74LS27: A4 A5 A6 → M15 → A7 → M14 (74LS10); WR* RD* → M16 (74LS10); M15 → 74LS27 → INPG* (1B6) OUTG*; I/ORQ* ADDSEL

C1 150PF — M2 — VCC

VCC → WQS M9 74LS123 (Q, Q, VCC)

DH(1A3) — A3 — DHSEL* — M14 74LS10 — WAIT B*

M1 7406 — WAIT B*

M5 8212: DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7 VCC → D Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8; DS2 DS1 MD STRB C

P3 1 2 6 → 3 KEY PIN

P1 21 → 28 SL1* 8 → 30 SL2* 17 → 50 TR1* 10 → 46 TR2* 15 → 32 SL4*

M6 8212: DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7 VCC → D Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8; DS2 DS1 MD STRB C

P1 19 → 20 REV* 6 → 22 FWD* 4 → 24 HSP* 21 → 26 WEN* 17 → 18 RWD*

C2 1000PF

M1 7406 → 34 SLG*

74LS10 M14 — RESET* — 74LS240 M3

M10 74LS138: A0 A1 A2 → A B C; I/O 0-7 → G1 G2A G2B; A3 → G2A; Y0 Y1 Y2 Y3 Y4 Y5 Y6 Y7

M2 4.7K PUP — VCC

74LS240 M3: WDS*48 RNZ*36 RDS*38 DAD*40 → TXC RXC DCD RXD; DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7

D.H. M4 2651: TXEMT TXRDY RXRDY; D0 D1 D2 D3 D4 D5 D6 D7 → DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7; A0 A1 R/W RESET CTS CTI OE DSR GND; TXD RTS

DHSEL* (1D4)

M2 4.7K PUP — VCC

74LS240 M3: DB4 DB5 DB6 DB7

P2 +12 -5 SVCC SVCC GND GND → 6 3 5 4 1 2

E2 E1 — C3 50UF 12VDC — C4 C5 C6 C7 C8 .1UF 100VDC — PVCC

P1 1,3,5,7,9,11,13,15,17,19, 21,23,25,27,29,31,33, 35,37,39,41,43,45,47, 49

M8 4.7K PUP — VCC

P1 SLD* 2 BSY* 14 WND* 6 FUP* 12 FLG* 8 EWS* 16 LPS* 10 RDY* 4

M7 74LS240 octal inverting buffers (3-states): DR STAT0 → DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7

7406 M1 — P1 44 WNZ*

74LS240 M3 — 7406 M1 — P1 42 WDE*

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   A. ALL RESISTORS VALUES ARE IN OHMS AND ARE 1/4W, ±5%
   B. ALL CAPACITORS VALUES ARE IN MICROFARADS
   C. C.P.U. (Z80) SIGNALS ARE NOT REFERENCED WITH COORDINATES

ALLOY ENGINEERING COMPANY

COMPUTER PRODUCTS DIVISION

DZ-80 INTERFACE SH 1 OF 1

SD10065 B

J1-1 GND
-2 GND
-3 -12 V
-4 +5V
-5 +5V
J1-6 +12V
C1 10µf
C4–C12 .1µf

C2 150pf
RP1- 4.7K +5
7C 74LS123
TPWAIT
+5

AB3 4C 74LS00 HDSEL

TPWR 6C 74LS32 IOWR
TPRD 6C IORD

AB4 AB5 AB6 74LS32 6C 74LS32 6C
5C 74LS10
AB7 IORD IOWR 4C 74LS00
5C 74LS10
4C 74LS00

MRRESET 4C 74LS00 1C 74LS240

AB0 AB1 AB2 3C 74LS138 AB3
Y0 Y1 Y2 Y3 Y4 Y5 Y6 Y7

D0 D1 D2 D3 D4 D5 D6 D7 +5
2A 8212
SL1 SL2 TR1 TR2 SL4

D0 D1 D2 D3 D4 D5 D6 D7 +5
2B 8212
REV FWD HSP WEN RWD SLG
7406
1000pf C3

J5-3 TPWAIT
-8 TPDMA
-28 IORD
-5 IOWR
-32 MRRESET
-24 TPWR
-26 TPRD
-23 D0
-19 D1
-15 D2
-11 D3
-21 D4
-20 D5
-18 D6
-13 D7
-34 AB0
-31 AB1
-29 AB2
-27 AB3
-16 AB4
-12 AB5
-7 AB6
-4 AB7
J5-2 Y14

4.7K RP2- +5
D0 D1 D2 D3 D4 D5 D6 D7
2D 74LS240
SLD BSY WND FVP FLG EWS LPS RDY

4.7K RP1- +5
4.7K RP1- +5
74LS240
WDS RNZ RDS DAD
TXC RXD RXC DCD
TXEMT TXRDY RXRDY
A0 A1 R/W RESET CTS OE DSR GND
D0 D1 D2 D3 D4 D5 D6 D7 TXD RTS
2C 2651
AB0 AB1 AB2 WND HDSEL
74LS240 D4 D5 D6 D7
7406 WNZ WDE
74LS240 7406

SLD J2-2
RDY -4
WND -6
FLG -8
LPS -10
FVP -12
BSY -14
EWS -16
RWD -18
REV -20
FWD -22
HSP -24
WEN -26
SL1 -28
SL2 -30
SL4 -32
SLG -34
RNZ -36
RDS -38
DAD -40
WDE -42
WNZ -44
TR2 -46
WDS -48
TR1 J2-50
J2-1 thru J2-49 odd are grounded

SCHEMATIC
8500/ TAPE DRIVE CONTROLER
8500-0011 REV A