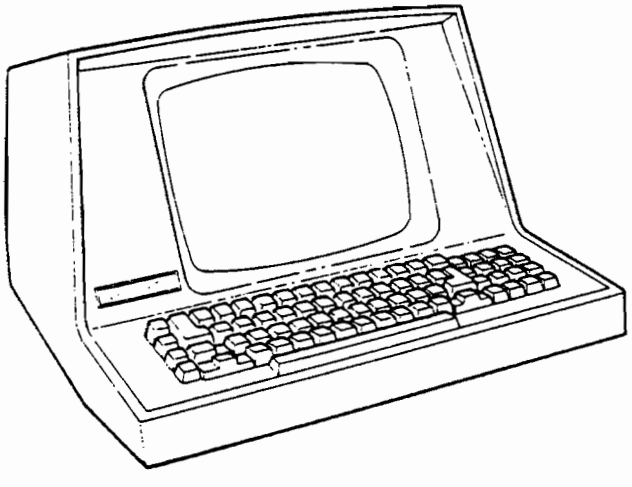
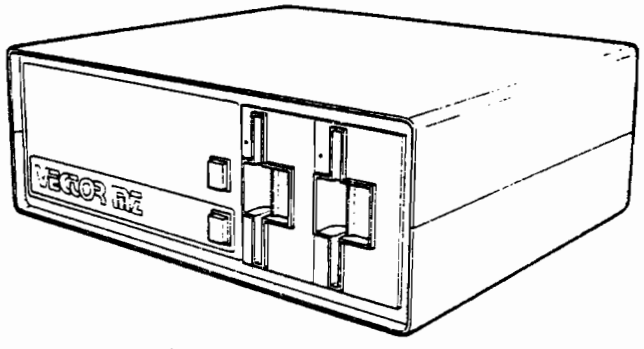
MZOS

Users Guide





VECTOR GRAPHIC INC.

M Z O S

MZ Operating System

by Vector Graphic Inc.

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INTRODUCTION

The Vector MZ operating system, MZOS, was designed specifically for the MZ system. It is a file-oriented disk operating system, allowing you to maintain and use files on the disk. Also provided are subroutines which may be used by the assembly language programmer to interface other software to the disk system, or for programs like BASIC to load and save files on the disk.

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This manual reflects version 1.5 of MZOS.

FILE STRUCTURE

First, it is necessary to understand the layout of the disk and the files on it. Thorough understanding of this section will greatly enhance ease of operation of this system.

The disk contains 77 concentric tracks, similar to the grooves in a record. Each track is divided into 16 sectors, and each sector contains one page (256 bytes) of data. Thus the capacity of the entire disk is around 315K bytes. The tracks are numbered 0-76, and the sectors 0-15. For our purposes, however, the disk should be thought of as 1232 sectors, numbered 0-1231, forgetting about tracks altogether.

The first four sectors on the disk are reserved for the directory. The purpose of the directory is to keep track of the files on the disk. There are 64 entries allowed, therefore you may have as many as 64 files on the disk. Each entry in the directory uses 16 bytes. The format of each entry is as follows:

FILENAME	ADDRESS	LENGTH	TYPE	START	VERSION
0-7	8-9	10-11	12	13-14	15

The meanings of each field are as follows:

FILENAME
An eight-byte field, this contains the name of the file. It may contain any printing ascii character, expect spaces, commas, or lower-case letters.

ADDRESS
This two-byte field contains the address on the disk where the file begins. This address is actually just the sector number of that particular sector. Sector 278 would have a disk address, then, of 278.

LENGTH
The length of the file is the number of sectors it occupies.

TYPE
The type of a file is a special reference to what the file might be used for. A file may be of type 0 through 99. Certain file types have already been defined. They are:

0	Default type unless changed.
1	Executable machine language program.
2	BASIC program.
3	BASIC data file.
4	Ascii text file.
5-7	Reserved.
8	XEK Assembler source file
9	Reserved.

File types 10-99 are not currently used or reserved, so they can be used for special purposes.

START
The start bytes are used to define the loading/starting address for type 1 (machine language) files. In the case of BASIC files, they're used to define the amount of valid data within the file.

VERSION
This byte is used to define the version or revision of the file. This is used by the Memorite II system, but it not implemented other than that.

The remaining 1228 sectors on the disk are available for files. There is a restriction that a file may only be 256 sectors long. This is not unreasonable, since it would be rather difficult to load a file longer that 64K into memory anyway. Actually, you may have a file longer then 256 sectors, but you will not be able to load, save, or verify it with MZOS.

A fact to remember is that MZOS does not necessarily access a file when it accesses the directory. Create, delete, and similar operations only modify the directory, not the actual file. Thus if you accidentally delete a file, you can recover it just by creating it with the same addresses as it had before. If you need to create a bigger file, you can just delete the old one and then recreate it with a greater length and the same starting address.

Another thing to remember is that MZOS maintains no copies of the directory in memory, so you may exchange disks at will. (This is as opposed to, say, CPM.)

MZOS MEMORY LAYOUT

It is important to know the places in memory used by MZOS. There are actually three separate areas to know about. The first, symbolically called MZOS, is the actual operating system and buffer areas. This resides in RAM from 2000-29FF. The top of this area is used for system i/o and is explained later. The second area is called MZIO and is a 1K prom at address C400-C7FF. This is the second 2708 on the prom/ram board. It contains all of the disk i/o routines. The third area, MZTMP, is an approximately 32-byte block starting at DF40, in the ram area of the prom/ram board. This is used for the track table and similar important information.

In addition to the regular area, a 2K area immediately following MZOS (actually 2A00-31FF) is used for some mass transfer commands to achieve a higher speed. Execution of the IN, DT, CF, CD, or CO commands will utilize this area, thus overwriting whatever is there.

Last but not least, there are several entry points to the system which you should know about. These, as well as the disk subroutines, are covered in appendix A.

MZOS CONSOLE COMMANDS

Following is an explanation of MZOS commands and their usage. The following conventions are used in this explanation: When something is enclosed in parentheses, e.g. (address), that argument is optional. Something in angle-brackets, e.g. <address>, means that you should substitute a valid argument; in this example, you should type an address. Also, all arguments are in decimal, with the exception of memory addresses, which are in hex.

LI (<unit>)

This will list the directory on the specified unit, with the current disk as the default. Each file will be listed, followed by the address, length, protect status, type, and start address if the file is type 1. A sample listing is shown in appendix C.

FL (<unit>)

This is similar to the LI command, only the directory is listed in a 'fast' format. Only the file is listed, six-wide across the page. This is useful for seeing just if you have a particular file.

CR <file> <length> (<address>)

The create command allows you to create a file entry in the directory. The file will be created with the specified length. If an address is specified, it will be used, otherwise the first free disk address will be defaulted to.

DE <file>

This will delete a file entry. Remember, the file itself will not be harmed, just the entry in the directory. A protected file cannot be deleted.

RN <old-file> <new-file>

This allows you to change the name of (rename) a file. All the other information (type etc.) will remain the same. Do not rename a file to a name that already exists!

TY <file> <type> (<start addr>)

This sets the type of a file. If type 1 is specified, the start address MUST be specified. No accessing of the file is actually done, just the directory entry.

PR <file>

This protects the file specified. When a file is protected, it cannot be deleted. The file may still be written into, however! This is not a perfect protection, but it does keep you from deleting an important file in a moment of frustration. **IMPORTANT NOTE!** Assembler source (type 8) and BASIC (types 2 and 3) files MAY NOT be protected. If you do, any attempt by XEK or BASIC to look them up will fail.

UP <file>

This will just unprotect a file. No error is caused by unprotecting a file that wasn't protected anyway.

LF <file> <mem addr>
SF <file> <mem addr>
VF <file> <mem addr>

These commands load, save, or verify a file. The load and save commands do so with respect to the memory address specified. Thus 'SF TEST 3000' would save memory into a file called TEST, starting at memory address 3000. Data will be written into the file sequentially until it is full. The LF command works in a similar manner, only data is read from the disk into memory. The VF command does no ram access; it verifies the file by doing an internal check on it. The memory address is necessary, though, so just use 0 as a dummy address,

CF <old-file> <new-file>

This will copy the data from one file to another. In addition, the type and protect information will be copied too. Make sure that the destination file is at least as large as the source file, or you will receive an error.

GO <file>

This will load a type 1 file into memory at its start address and jump to it. Note that this is equivalent to using the LF command followed by a JP command to the start address of the file. Obviously, this only is for type 1 files.

RD <addr> <mem addr> <sectors>
WR <addr> <mem addr> <sectors>
VR <addr> <mem addr> <sectors>

These commands will read, write, or verify data directly on the disk, with no regard for files. These commands are used infrequently, as normally all work is done with files. Using the RD command as an example, take the command RD 4 3000 10. This will read 10 sectors, starting with address 4, and load them into memory beginning at address 3000 (hex). The WR and VR commands work similarly. The VR command, like the VF command, does internal checking only. You may use 0 as a dummy ram address for this command.

IN (<unit>)

This will initialize a fresh diskette. It completely fills the diskette with spaces (ascii 20 hex). This **MUST** be done to **ALL** diskettes before use, as they contain garbage before initialization. This command also writes the sector id's on each of the sectors (These id's are used for error checking). You shouldn't initialize a diskette that contains valid data, of course.

DT (<unit>)

This will test a diskette by writing and then verifying a constantly changing pattern over the entirety of the diskette. This destroys any data that was on the diskette, so use with caution, and NEVER on a diskette after it has valid data written on it.

CD <source> <dest>

This will copy the entirety of the source diskette onto the destination diskette. No file-oriented access is used, just direct read and write. The resulting diskette is an exact duplicate of the source diskette.

CO (<unit>)

This compacts the data on the disk by moving all files toward the beginning of the disk. This can become necessary when you have several files, and you delete one or more out of the middle. See also a note in the usage section of this manual referring to this command.

JP <mem adr>

This just transfers control to the specified address in memory. It is used, for example, to start a program that is already in memory.

DD (<unit>)

This sets the default unit to the one specified. If no unit is specified, then unit 1 is used. All disk accesses, when no unit is specified, use the default unit.

; <text>

Typing a semicolon (;) as the first character of a line will cause the line to be ignored. Only thirty characters may be typed, though, or you will receive an error.

<file>

Typing a file name alone is exactly like typing GO followed by the file name. Thus BASIC and GO BASIC are identical commands.

USAGE NOTES ON MZOS

The following is a collection of things to know while using MZOS.

When typing a command, it may be aborted at any time by typing control-C. To erase the last character typed, hit Backspace, Underscore, or DEL.

During execution of a command like DT or IN, you may abort execution by typing control-C.

You should not have any type 1 files with a filename less that three characters long. If you do, you will have to use the GO command to run it.

The DT command will run until it finds an error or you stop it.

The IN command takes around a minute and a half, or about two and a half if you have the read-after-write check enabled.

NEVER NEVER NEVER NEVER interrupt the execution of the CO command, unless you don't mind your diskette being totally destroyed. Compaction normally takes well under five minutes, but depending on the degree of disaster your diskette is in, it could take ten or twenty minutes to compact it. DON'T PANIC! A relatively messy disk could require over a million read/writes, and interrupting it in midstream is guaranteed to leave the disk in a totally unknown state. So unless the disk starts smoking or making really terrible sounds, just leave it alone.

In a multiple-unit system, the particular drive which you wish to reference is indicated by adding a ,1 ,2 ,3 or ,4 to either a filename or disk address. Thus referencing the file TEST on unit 2 would look like TEST,2; a reference to sector 24 on unit 3 would be 24,3. This is true of ANY file reference, in any command; or of the disk address in the RD, WR and VR commands.

MZOS will digest lower case letters as well as upper case, since it just translates everything to upper case anyway.

To repeat something said elsewhere, all disk accesses, where an explicit unit isn't specified, reference the disk specified in the last DD command. If no such command has been issued, then unit 1 is used.

If you have a printer interfaced with your system, you should know that error messages will only print on the console, not the printer, even if the printer is enabled. This prevents getting error messages in the middle of a good printout.

Needless to say, this operating system is completely compatable with the North Star DOS. It is specifically designed so that any software that runs on the North Star system will run on MZOS.

ERRORS AND MISTRAKES

A reasonably comprehensive set of error messages are provided with MZOS. Following is a list of these errors and why you might get them.

Huh?

This means that you typed something that MZOS can't possibly understand. Usually this is from misspelling a command, or typing an invalid filename as an implied GO.

% Syntax error

This indicates that you typed a valid command, but invalid arguments. Examples: TY FILE 1 without a start address, or LF FILE QWERT where QWERT is obviously not a hex address.

% File error

This is caused by an invalid file reference. It can be caused by creating a file that already exists, referencing one that doesn't, trying to GO a non-type-1 file, and so forth.

% Disk overflow

You tried to create a file that would extend beyond the boundries of the disk (that is, past sector 1231).

% Write protected

You either tried to write on a protected disk, or tried to delete a file that is protected.

% Disk offline

This can be caused by trying to access the disk when either there is no diskette in the drive, the drive is not up to speed, or the controller just isn't installed in the computer.

% Illegal argument

An attempt was made to read, write, or verify beyond the boundries of the disk. This is similar to the overflow error, only this refers to access attempts, rather that file creation.

% CRC error at sector xxxx,n

Bad data was encountered on the disk in unit n, at sector xxxx. This is usually caused by a faulty diskette, or access to an uninitialized diskette.

% Sector id error at sector xxxx,n

This means that the sector read was not the one wanted. The most common cause of this is a glitch in the stepper motor, or possibly a bad diskette.

FAMOUS LAST WORDS

MZOS has been thoroughly tested, and should hopefully serve you well on your system. In the event you have any trouble, though, or need help in figuring out how it works, feel free to contact us for assistance. We would also appreciate any comments, suggestions, or improvements to this manual, or additions to or ideas for MZOS, that you might think up.

APPENDIX A: MZOS ENTRY POINTS

Assuming you have some familiarity with assembly language, this should help you understand interfacing to MZOS. Although MZOS is actually a Z-80 program, these explanations will use 8080 code whenever possible as it seems to be more popular.

MZOS 2028

The MZOS entry point is where you jump to start MZOS. The monitor 'J' command will jump here very nicely. At the end of some other program, putting a JMP 2028H will return control to MZOS.

MBOOT C400

This is where to jump to in order to boot up MZOS. The monitor 'E' command can be used to initially do so.

DCOM C402 or 2022

This is the nitty-gritty disk i/o routine. All disk access can be done here. Basically, what you do is set up the registers for what you want to do, then call here. (The difference is that 2022 will do the read-after-write check, and it will return to MZOS after printing any error, whereas C402 does not, and returns as explained below. The registers should be set up as follows:

A	number of sectors to access
B	command - see below
C	unit - 1, 2, 3, or 4
DE	ram address to read into or write from
HL	disk address (sector) to begin access at

Commands are:		
	0	write from memory to disk
	1	read from disk to memory
	2	verify CRC internally on disk
	3	seek (go to) sector specified only
	4	recalibrate drive (go to sector 0)

The last two, seek and recalibrate, are mainly for test purposes. The recalibrate is used to insure proper positioning of the head, in case (for example) the track table is accidentally destroyed, or the stepper motor doesn't.

On return, if the carry flag is cleared, then all is well; otherwise, the flag will be set, and the error code will be in A' (A prime). The error codes are as follows:

0 - no error	1 - CRC error	2 - sector id error
3 - write protected	4 - disk offline	5 - illegal argument

Calling address C404 will print the error associated with the error code.

DLOOK 201C

This is used to lookup a file in the directory. Looking up a blank entry will locate a free space, for creating a new file. When this is called, A should contain the unit number, and HL should point to (contain the address of) a string of characters representing the file name, followed by either a return (0D hex) or a blank (20 hex).

When this routine returns, if the CY flag is set, then the file you looked up does not exist. In this case, HL contains the first free address on the disk. If CY isn't set, then the file was successfully found. In this case, HL points to the eighth byte of a copy of the entry. This copy is actually within the directory buffer of MZOS. See the file structure section of this manual for the structure of the entry.

DWRIT 201F

This will write a directory entry back to the disk. It is important that NO DISK ACCESS OCCUR between DLOOK and DWRIT. Now, the procedure for reading a file would be to use DLOOK to lookup the file; assuming it is really there, incrementing HL will make it point to the starting disk address of the file; then use DCOM to actually read the file. To write a new file to disk, you would first lookup the file, to make sure that it doesn't already exist. This will fail, assuming the name isn't there yet. Next, lookup a blank name. In the event this fails (it shouldn't), the disk you're using doesn't have a directory on it, or is full. Anyway, now HL points to the eighth byte of a blank entry. Now you should copy in the file name, disk address (from your first lookup), length, type, and start address (if needed). This done, call DWRIT to update the directory.

DLIST 2025

This will print the directory of the unit specified in A. The list is exactly the same as the LI command.

RWCHK 202B

This is not an entry point, but rather a flag. If this byte is 1, then a verify will be done after a write. This will slow down write operations considerably, but may be desired if you don't trust your diskette.

PRMPT 206B

This location contains the character used as a prompt. Currently it is set to a number sign (#, 23 hex), but you may change it if you like.

APPENDIX B: CONSOLE I/O

Here we will discuss the console i/o provided with your system, and how you may change it if necessary.

First, there are four entry points in MZOS which reference console i/o. They are as follows.

INCH 2010

This will input a single character from the console.

OUTCH 200D

This will output a single character.

OUTPR 200A

This will output a character to the printer.

CHKCH 2016

This does three things. First, it checks whether a character has been typed. If not, it returns immediately with the Z flag cleared. If a character has been typed, it sees if it was a control-C. If this is the case, then it returns, with Z set. Finally, if a character was typed, and it was a space, then another character is waited for. This allows you to momentarily suspend output by hitting the space bar. After another character is typed, this routine returns, with the Z flag set if that character was a control-C.

TINIT 2013

This is used to initialize the i/o system, if needed. It is currently set up to initialize the Bitstreamer board, but may be able to be replaced with RET instruction.

So. Those are the entry points. The actual routines, though, are located in a 64-byte block from 2900-29FF. A listing is provided of the routines as provided, in case your system is different.

Checking with the listing, notice that there are addresses assigned to each routine. They are spaced far enough apart that you should be able to fit in any of your own routines without moving any other routine. This means that you shouldn't have to patch the jump table (entry points) at all.

Notice that the OUTCH routine does more than just output a character to the console. Since the character to be printed is passed in the B register, the A register is used as a channel number. In the configuration provided, channel 1 is used to send output to the printer, and any other channel sends output through the monitor.

Also, notice that the input routine converts the characters 5F (underscore) and 7F (DEL) to 08 (backspace).

At this point it might be wise to point out that normal console i/o takes place through the prom monitor. PTCN (C098) is used for output, and CNTLC (C0DC) is used for input.

As for rules of use, they are as follows. (Except as specified, no registers may be changed.)

INCH	returns the character typed in A.
OUTCH	prints character in B; returns with it in A also.
OUTPR	exactly as OUTCH, but character is sent to printer.
CHKCH	may use A only; character returned is indeterminate.
TINIT	currently uses A only, but may use all registers.

In the event you change the i/o routines, the procedure for updating the disk is as follows. First, you should assemble your i/o routines to run at 2900 (hex). You can overlay them directly on MZOS, providing you do no i/o while the routines are being loaded. Once overlaid, they are immediately effective, so you can check them to make certain they work. Once that's done, you can resave MZOS on disk simply by typing SF MZOS 2000.

```
2900                    0001 * MZOS STANDARD I/O SYSTEM
2900                    0002 * NEALE BRASSELL [15-DEC-78]
2900                    0003 *
2900                    0004 IOLOC  EQU   2900H
2900                    0005 MZOS   EQU   2028H
2900                    0006 *
2900                    0007 *
2900                    0008 * THIS DOES AN INIT, THEN JUMPS TO MZOS
2900                    0009 *
2900                    0010        ORG   IOLOC
2900                    0011 *
2900 CD 10 29           0012 REENT  CALL  INI8
2903 C3 28 20           0013        JMP   MZOS
2906                    0014 *
2906                    0015 *
2906                    0016 * THIS IS THE INIT ROUTINE
2906                    0017 *
2906                    0018        ORG   IOLOC+16
2910                    0019 *
2910 AF                 0020 INI8   XRA   A
2911 D3 03              0021        OUT   3
2913 D3 03              0022        OUT   3
2915 D3 03              0023        OUT   3
2917 3E 40              0024        MVI   A,40H
2919 D3 03              0025        OUT   3
291B 3E CE              0026        MVI   A,0CEH
291D D3 03              0027        OUT   3
291F 3E 27              0028        MVI   A,27H
2921 D3 03              0029        OUT   3
2923 C9                 0030        RET
2924                    0031 *
2924                    0032 *
2924                    0033 * THIS CHECKS FOR <©C>, AND SUSPENDS OUTPUT ON <SPACE>
2924                    0034 *
2924                    0035        ORG   IOLOC+64
2940                    0036 *
2940 CD DC C0           0037 CHK8   CALL  0C0DCH
2943 FE 03              0038        CPI   3
2945 C8                 0039        RZ
2946 FE 20              0040        CPI   32
2948 C0                 0041        RNZ
2949 CD 60 29           0042        CALL  IN8
294C FE 03              0043        CPI   3
294E C9                 0044        RET
294F                    0045 *
294F                    0046 *
294F                    0047 * THIS IS THE CONSOLE INPUT ROUTINE
294F                    0048 *
294F                    0049        ORG   IOLOC+96
2960                    0050 *
2960 CD DC C0           0051 IN8    CALL  0C0DCH
2963 CA 60 29           0052        JZ    IN8
2966 FE 5F              0053        CPI   5FH
2968 CC 71 29           0054        CZ    MAKE8
```

```
296B FE 7F              0055        CPI   7FH
296D CC 71 29           0056        CZ    MAKE8
2970 C9                 0057        RET
2971 3E 08              0058 MAKE8  MVI   A,8
2973 C9                 0059        RET
2974                    0060 *
2974                    0061 *
2974                    0062 * CONSOLE OUTPUT - IF A=1 THEN THE PRINTER IS USED
2974                    0063 *
2974                    0064        ORG   IOLOC+144
2990                    0065 *
2990 FE 01              0066 OUT8   CPI   1
2992 CA C0 29           0067        JZ    OUTPR
2995 78                 0068        MOV   A,B
2996 C3 98 C0           0069        JMP   0C098H
2999                    0070 *
2999                    0071 *
2999                    0072 * PRINTER OUTPUT - JUST USES CONSOLE
2999                    0073 *
2999                    0074        ORG   IOLOC+192
29C0                    0075 *
29C0 78                 0076 OUTPR  MOV   A,B
29C1 C3 98 C0           0077        JMP   0C098H
29C4                    0078 *

SYMBOL TABLE

CHK8  2940    IN8   2960    INI8  2910    IOLOC 2900    MAKE8 2971
MZOS  2028    OUT8  2990    OUTPR 29C0    REENT 2900
```

APPENDIX C: SAMPLE DIRECTORY LISTING

Here is a sample listing, as produced by the LI command.

```
MZOS        4   10 P 00          BASIC      14   45   01 2A00
DEX        59   23 P 01 2A00     TESTFL     82    4   02
IOSYS      86   90   08          DATAFILE  176  250   03
INXFILE   426   50   03
```

Here is an analysis of the above listing.

MZOS is a file, starting at address (sector) 4 and taking 10 sectors. It is protected, so it cannot be deleted.

BASIC is a 45-sector machine code file, starting at address 14. It's ram starting address is 2A00. It could be executed by typing 'GO BASIC', or just 'BASIC'.

DEX is a machine code file, similar to BASIC. It is protected, though. Its starting ram address is also 2A00.

TESTFL is a BASIC program (type 2), which can be loaded and executed with BASIC.

IOSYS is a XEK source file (type 08).

DATAFILE is a rather large BASIC data file (type 3). It is accessed with READ and WRITE statements in BASIC.

INXFILE is a BASIC data file, like DATAFILE.

MZOS Utilities

by Vector Graphic Inc.

There are two utility and three printer driver programs provided on your system disk as received from Vector Graphic. They are NS2MZ, TITLE, DIAB, CENT, and TTY. Here we will provide you with source listings and instructions for their use.

First for the printer drivers. DIAB is the routine for a Diablo printer. It assumes that you are using ports 2 and 3 for the printer, and that the printer is the version that runs at 1200 baud, with handshaking logic.

CENT is for a Centronics printer, such as 781, 702, etc. with parallel handshaking logic. Port 1 is used for this printer.

TTY is for most serial printers, such as a TTYs, Decwriters, TI810s, and so forth. It also assumes ports 2 and 3 are being used.

For all three routines, they may be invoked by simply typing the name of the one you want, either DIAB, CENT, or TTY. If you want to save MZOS with one of these routines incorporated into it, you would just type SF MZOS 2000 after loading the driver. Example:

```
#DIAB
#SF MZOS 2000
```

The system on the diskette now has the driver incorporated in it.

Notice (in the source listings) that the various routines are spaced over the entire 2900-29FF block allocated to them. This is so that you can change the drivers without changing the jump table in MZOS. The current assignments are as follows:

REENTRY	2900	jump back to MZOS
TINIT	2910	initialize
CCCHK	2940	control-C check
INCH	2960	input character
OUTCH	2990	output character
OUTPR	29C0	output character to printer

The reentry spot is so that this can be executed as a program, allowing you to type 'DIAB' instead of 'LF DIAB 2900'.

There are a couple of features included in the input and output routines to complement the printer. First, when you type a control-P, the input routines toggles the printer flag, then discards the character. This way, even if your program doesn't allow control characters, typing control-P will still work. What toggling the printer flag actually does is to allow output to go to both the console and the printer. Typing control-P a second time will turn the printer off, etc. Second, typing control-L will send a formfeed to the printer, and discard the character. This should be done before you print something the first time, as it also sets the line counter. The output is paged; every 56 lines, it skips to the top of the next page. Checking the listings provided should help you understand how the system works.

Also, the input routine converts the Underscore character (5F) and the DEL character (7F) to Backspace (08). This is so that any one of them will work properly to erase the last character typed.

The utilities provides are NS2MZ and TITLE.

The first utility is the NS2MZ program, which, as its name implies, transfers files from North Star disk to MZOS. It is a simple program, as you can see from the listing. To use it, first initialize a disk with MZOS. Then load the NS2MZ program into memory, anywhere EXCEPT from 2000 to 3400. The program is relocatable, so it doesn't matter; we recommend that you load it at 4000. Next, boot your North Star DOS. Insert the disk you want to copy into drive 1 (North Star), and the disk you just initialized into drive 1 (Micropolis). Now JP to whatever address you loaded the program at. It will copy the entire disk, exactly as it is, onto the Micropolis disk. Now insert a system disk into the Miropolis drive and boot MZOS. Type LF MZOS 3000 (load MZOS into memory), then insert the new diskette; type SF DOS 3000 (which saves it onto the disk) followed by RN DOS MZOS (which renames the DOS to MZOS). You now have your North Star diskette on Micropolis disk. This procedure may be repeated for each disk you wish to copy. Note, though, that the disk is copied onto another disk exactly, so you may only copy disks one-to-one. Since the Micropolis disks hold more, you may want to merge several disks together manually after you've copied them.

The other utility, TITLE, titles the disk. The title is 10 characters long maximum, and is printed when you boot the disk. That is, only disks with MZOS on them can be titled. To run the program, just type TITLE. The program will print > indicating it is reading in the first sector of MZOS, then print : indicating that it is waiting for the title. At this point, type the desired title. Type carefully, since it is absolutely unforgiving of errors. After you've typed the title, hit CR. The program will print < indicating it is writing the data back out to disk, then it will return to MZOS.

Following are the source listings for all five of these programs.

```
0000                    0001 *
0000                    0002 * NORTH STAR TO MZOS DISK COPY PROGRAM
0000                    0003 * NEALE BRASSELL [26-JUN-78]
0000                    0004 *
0000                    0005 * THIS PROGRAM IS 100% RELOCATABLE.
0000                    0006 *
0000                    0007 MZ      EQU   0C402H        ;MZOS DCOM ROUTINE
0000                    0008 NS      EQU   02022H        ;NORTH STAR DCOM ROUTINE
0000                    0009 *
0000                    0010 DJNZ    EQU   10H
0000                    0011 *
0000 3E 0A              0012 NS2MZ   MVI   A,10          ;10 SECTORS AT A TIME
0002 06 23              0013         MVI   B,35          ;35 SUCH TRANSFERS
0004 0E 01              0014         MVI   C,1           ;WE'LL USE DISK 1
0006 11 00 2A           0015         LXI   D,2A00H       ;TYPICAL BUFFER SPOT
0009 21 00 00           0016         LXI   H,0           ;START FROM THE BEGINNING
000C C5                 0017 N2M     PUSH  B             ;SAVE COUNTER
000D 06 01              0018         MVI   B,1           ;READ FROM NS
000F F5                 0019         PUSH  PSW
0010 D5                 0020         PUSH  D
0011 E5                 0021         PUSH  H
0012 CD 22 20           0022         CALL  NS            ;<< DO IT >>
0015 E1                 0023         POP   H
0016 D1                 0024         POP   D
0017 F1                 0025         POP   PSW
0018 06 00              0026         MVI   B,0           ;WRITE TO MZ
001A CD 02 C4           0027         CALL  MZ            ;<< DO IT >>
001D D5                 0028         PUSH  D             ;SAVE DE
001E 11 0A 00           0029         LXI   D,10          ;TEN SECTORS DONE
0021 19                 0030         DAD   D             ;REFLECT THIS
0022 D1                 0031         POP   D             ;RESTORE DE
0023 C1                 0032         POP   B             ;GET COUNTER
0024 10                 0033         DB    DJNZ          ;USE NEAT Z-80 CODE
0025 E6                 0034         DB    N2M-$-1       ;TO EFFECT A LOOP
0026 C9                 0035         RET                 ;HOPEFULLY RETURN TO WHOEVER
0027                    0036 *

SYMBOL TABLE

DJNZ  0010    MZ    C402    N2M   000C    NS    2022    NS2MZ 0000
```

```
0000                    0001 * LITTLE PROGRAM TO TITLE A DISK
0000                    0002 * NEALE BRASSELL [12-JUL-78]
0000                    0003 *
0000 AF                 0004 TITLE  XRA   A
0001 06 3E              0005        MVI   B,'>'
0003 CD 0D 20           0006        CALL  0200DH        ;OUTPUT NOTE
0006 3E 0A              0007        MVI   A,10
0008 01 01 01           0008        LXI   B,101H
000B 11 00 2B           0009        LXI   D,2B00H
000E 21 04 00           0010        LXI   H,4
0011 CD 22 20           0011        CALL  02022H        ;READ IN MZOS
0014 06 3A              0012        MVI   B,':'
0016 CD 0D 20           0013        CALL  0200DH        ;PROMPT
0019 21 00 2B           0014        LXI   H,2B00H
001C 06 09              0015        MVI   B,9
001E CD 10 20           0016 LOOP   CALL  2010H         ;GET CHARACTER
0021 47                 0017        MOV   B,A
0022 CD 0D 20           0018        CALL  0200DH
0025 FE 0D              0019        CPI   13
0027 28                 0020        DB    28H           ;IF <CR>, END
0028 04                 0021        DB    CR-$-1
0029 77                 0022        MOV   M,A
002A 23                 0023        INX   H
002B 10                 0024        DB    16            ;CONTINUE
002C F1                 0025        DB    LOOP-$-1
002D 2B                 0026 CR     DCX   H
002E 3E 80              0027        MVI   A,128
0030 B6                 0028        ORA   M
0031 77                 0029        MOV   M,A
0032 06 3C              0030        MVI   B,'<'
0034 AF                 0031        XRA   A
0035 CD 0D 20           0032        CALL  0200DH
0038 3E 0A              0033        MVI   A,10
003A 01 01 00           0034        LXI   B,1
003D 11 00 2B           0035        LXI   D,2B00H
0040 21 04 00           0036        LXI   H,4
0043 CD 22 20           0037        CALL  2022H         ;WRITE MZOS BACK
0046 C3 28 20           0038        JMP   2028H

SYMBOL TABLE

CR    002D    LOOP  001E    TITLE 0000
```

```
2900                    0001 * MZOS DIABLO I/O SYSTEM
2900                    0002 * NEALE BRASSELL / R.S. HARP  [15-DEC-78]
2900                    0003 *
2900                    0004 IOLOC  EQU   2900H
2900                    0005 MZOS   EQU   2028H
2900                    0006 *
2900                    0007 *
2900                    0008 * THIS DOES AN INIT, THEN JUMPS TO MZOS
2900                    0009 *
2900                    0010        ORG   IOLOC
2900                    0011 *
2900 CD 10 29           0012 REENT  CALL  INI8
2903 C3 28 20           0013        JMP   MZOS
2906                    0014 *
2906                    0015 *
2906                    0016 * THIS IS THE INIT ROUTINE
2906                    0017 *
2906                    0018        ORG   IOLOC+16
2910                    0019 *
2910 AF                 0020 INI8   XRA   A
2911 D3 03              0021        OUT   3
2913 D3 03              0022        OUT   3
2915 D3 03              0023        OUT   3
2917 3E 40              0024        MVI   A,40H
2919 D3 03              0025        OUT   3
291B 3E CE              0026        MVI   A,0CEH
291D D3 03              0027        OUT   3
291F 3E 27              0028        MVI   A,27H
2921 D3 03              0029        OUT   3
2923 C9                 0030        RET
2924                    0031 *
2924                    0032 *
2924                    0033 * THIS CHECKS FOR <©C>, AND SUSPENDS OUTPUT ON <SPACE>
2924                    0034 *
2924                    0035        ORG   IOLOC+64
2940                    0036 *
2940 3A FD 29           0037 BUFT   LDA   CCBUF
2943 F5                 0038        PUSH  PSW
2944 AF                 0039        XRA   A
2945 32 FD 29           0040        STA   CCBUF
2948 F1                 0041        POP   PSW
2949 CD 50 29           0042        CALL  CMPR
294C C8                 0043        RZ
294D CD DC C0           0044 CHK8   CALL  0C0DCH
2950 FE 03              0045 CMPR   CPI   3
2952 C8                 0046        RZ
2953 FE 20              0047        CPI   32
2955 C0                 0048        RNZ
2956 CD 60 29           0049        CALL  IN8
2959 FE 03              0050        CPI   3
295B C9                 0051        RET
295C                    0052 *
295C                    0053 *
295C                    0054 * CONSOLE INPUT - <©P> & <©L> ARE HANDLED SPECIALLY
```

```
295C                    0055 *
295C                    0056        ORG   IOLOC+96
2960                    0057 *
2960 CD DC C0           0058 IN8    CALL  0C0DCH        ;GET CHARACTER
2963 CA 60 29           0059        JZ    IN8
2966 FE 5F              0060        CPI   5FH
2968 CC 89 29           0061        CZ    MAKE8
296B FE 7F              0062        CPI   7FH
296D CC 89 29           0063        CZ    MAKE8         ;CONVERT DEL & USCORE TO BS
2970 FE 10              0064        CPI   16            ;SEE IF ©P
2972 CA 7F 29           0065        JZ    CTLP
2975 FE 0C              0066        CPI   12            ;SEE IF ©L
2977 C0                 0067        RNZ                 ;RETURN IF NOT
2978 47                 0068        MOV   B,A
2979 CD C0 29           0069        CALL  OUTPR         ;SEND FORMFEED
297C C3 60 29           0070        JMP   IN8           ;DISCARD CHARACTER
297F 3A FE 29           0071 CTLP   LDA   OUTFL
2982 2F                 0072        CMA
2983 32 FE 29           0073        STA   OUTFL         ;©P COMPLIMENTS PRINTER FLAG
2986 C3 60 29           0074        JMP   IN8           ;AND DISCARD CHARACTER
2989 3E 08              0075 MAKE8  MVI   A,8
298B C9                 0076        RET
298C                    0077 *
298C                    0078 *
298C                    0079 * OUTPUT CHARACTER - IF A=1, THEN USE DIABLO
298C                    0080 *
298C                    0081        ORG   IOLOC+144
2990                    0082 *
2990 FE 01              0083 OUT8   CPI   1
2992 CA C0 29           0084        JZ    OUTPR         ;IF A=1 THEN USE PRINTER
2995 78                 0085        MOV   A,B
2996 CD 98 C0           0086        CALL  0C098H        ;SEND CHARACTER TO CONSOLE
2999 3A FE 29           0087        LDA   OUTFL
299C B7                 0088        ORA   A             ;CHECK PRINTER FLAG
299D 78                 0089        MOV   A,B
299E C8                 0090        RZ                  ;RETURN IF NOT SET
299F C3 C0 29           0091        JMP   OUTPR         ;SEND TO PRINTER IF SET
29A2                    0092 *
29A2 32 FF 29           0093 PRCNT  STA   LNCNT
29A5 78                 0094        MOV   A,B
29A6 C0                 0095        RNZ
29A7 C5                 0096        PUSH  B
29A8 06 0C              0097        MVI   B,12
29AA CD C0 29           0098        CALL  OUTPR
29AD C1                 0099        POP   B
29AE 78                 0100        MOV   A,B
29AF C9                 0101        RET
29B0                    0102 *
29B0                    0103 *
29B0                    0104 * DIABLO PRINTER OUTPUT ROUTINE
29B0                    0105 *
29B0                    0106        ORG   IOLOC+192
29C0                    0107 *
29C0 DB 03              0108 OUTPR  IN    3
29C2 E6 01              0109        ANI   1
29C4 CA C0 29           0110        JZ    OUTPR         ;WAIT FOR READY FROM USART
```

```
29C7 78                 0111          MOV   A,B
29C8 D3 02              0112          OUT   2             ;SEND CHARACTER
29CA FE 0A              0113          CPI   10            ;SEE IF LINEFEED
29CC CA D9 29           0114          JZ    ITALF
29CF FE 0C              0115          CPI   12            ;SEE IF FORMFEED
29D1 C0                 0116          RNZ                 ;RETURN IF NOT
29D2 3E 38              0117          MVI   A,56
29D4 32 FF 29           0118          STA   LNCNT         ;RESET PAGE COUNTER ON FORMFEED
29D7 78                 0119          MOV   A,B
29D8 C9                 0120          RET
29D9 C5                 0121 ITALF    PUSH  B
29DA 06 03              0122          MVI   B,3           ;SEND ETX AFTER LF
29DC CD C0 29           0123          CALL  OUTPR
29DF DB 03              0124 WTACK    IN    3
29E1 E6 02              0125          ANI   2
29E3 CA DF 29           0126          JZ    WTACK         ;WAIT FOR ACKNOWLEDGE
29E6 DB 02              0127          IN    2
29E8 E6 7F              0128          ANI   7FH
29EA FE 06              0129          CPI   06
29EC CA F5 29           0130          JZ    IACK
29EF 32 FD 29           0131          STA   CCBUF
29F2 C3 DF 29           0132          JMP   WTACK
29F5 C1                 0133 IACK     POP   B
29F6 3A FF 29           0134          LDA   LNCNT
29F9 3D                 0135          DCR   A             ;ADJUST LINE COUNTER
29FA C3 A2 29           0136          JMP   PRCNT
29FD                    0137 *
29FD                    0138          ORG   IOLOC+253
29FD                    0139 *
29FD 00                 0140 CCBUF    DB    0             ;CHAR FROM DIABLO
29FE 00                 0141 OUTFL    DB    0             ;PRINTER FLAG
29FF 38                 0142 LNCNT    DB    56            ;LINE COUNTER
2A00                    0143 *

SYMBOL TABLE

BUFT  2940    CCBUF 29FD    CHK8  294D    CMPR  2950    CTLP  297F
IACK  29F5    IN8   2960    INI8  2910    IOLOC 2900    ITALF 29D9
LNCNT 29FF    MAKE8 2989    MZOS  2028    OUT8  2990    OUTFL 29FE
OUTPR 29C0    PRCNT 29A2    REENT 2900    WTACK 29DF
```

```
2900                    0001 * MZOS CENTRONICS I/O SYSTEM
2900                    0002 * NEALE BRASSELL [15-DEC-78]
2900                    0003 *
2900                    0004 IOLOC  EQU   2900H
2900                    0005 MZOS   EQU   2028H
2900                    0006 *
2900                    0007 *
2900                    0008 * THIS DOES AN INIT, THEN JUMPS TO MZOS
2900                    0009 *
2900                    0010        ORG   IOLOC
2900                    0011 *
2900 CD 10 29           0012 REENT  CALL  INI8
2903 C3 28 20           0013        JMP   MZOS
2906                    0014 *
2906                    0015 *
2906                    0016 * THIS IS THE INIT ROUTINE
2906                    0017 *
2906                    0018        ORG   IOLOC+16
2910                    0019 *
2910 AF                 0020 INI8   XRA   A
2911 D3 03              0021        OUT   3
2913 D3 03              0022        OUT   3
2915 D3 03              0023        OUT   3
2917 3E 40              0024        MVI   A,40H
2919 D3 03              0025        OUT   3
291B 3E CE              0026        MVI   A,0CEH
291D D3 03              0027        OUT   3
291F 3E 27              0028        MVI   A,27H
2921 D3 03              0029        OUT   3
2923 C9                 0030        RET
2924                    0031 *
2924                    0032 *
2924                    0033 * THIS CHECKS FOR <©C>, AND SUSPENDS OUTPUT ON <SPACE>
2924                    0034 *
2924                    0035        ORG   IOLOC+64
2940                    0036 *
2940 CD DC C0           0037 CHK8   CALL  0C0DCH
2943 FE 03              0038        CPI   3
2945 C8                 0039        RZ
2946 FE 20              0040        CPI   32
2948 C0                 0041        RNZ
2949 CD 60 29           0042        CALL  IN8
294C FE 03              0043        CPI   3
294E C9                 0044        RET
294F                    0045 *
294F                    0046 *
294F                    0047 * CONSOLE INPUT - <©P> & <©L> ARE HANDLED SPECIALLY
294F                    0048 *
294F                    0049        ORG   IOLOC+96
2960                    0050 *
2960 CD DC C0           0051 IN8    CALL  0C0DCH        ;GET CHARACTER
2963 CA 60 29           0052        JZ    IN8
2966 FE 5F              0053        CPI   5FH
2968 CC 89 29           0054        CZ    MAKE8
```

```
296B FE 7F              0055          CPI   7FH
296D CC 89 29           0056          CZ    MAKE8          ;CONV DEL & USCORE TO BS
2970 FE 10              0057          CPI   16             ;SEE IF ©P
2972 CA 7F 29           0058          JZ    CTLP
2975 FE 0C              0059          CPI   12             ;SEE IF ©L
2977 C0                 0060          RNZ                  ;RETURN IF NOT
2978 47                 0061          MOV   B,A
2979 CD C0 29           0062          CALL  OUTPR          ;SEND FORMFEED
297C C3 60 29           0063          JMP   IN8            ;DISCARD CHARACTER
297F 3A FE 29           0064 CTLP     LDA   OUTFL
2982 2F                 0065          CMA
2983 32 FE 29           0066          STA   OUTFL          ;©P COMPLIMENTS OUTPUT FLAG
2986 C3 60 29           0067          JMP   IN8            ;AND DISCARD CHARACTER
2989 3E 08              0068 MAKE8    MVI   A,8
298B C9                 0069          RET
298C                    0070 *
298C                    0071 *
298C                    0072 * OUTPUT CHARACTER - IF A=1, THEN USE CENTRONICS
298C                    0073 *
298C                    0074          ORG   IOLOC+144
2990                    0075 *
2990 FE 01              0076 OUT8     CPI   1
2992 CA C0 29           0077          JZ    OUTPR          ;IF A=1 THEN USE PRINTER
2995 78                 0078          MOV   A,B
2996 CD 98 C0           0079          CALL  0C098H         ;SEND CHARACTER TO CONSOLE
2999 3A FE 29           0080          LDA   OUTFL
299C B7                 0081          ORA   A              ;CHECK PRINTER FLAG
299D 78                 0082          MOV   A,B
299E C8                 0083          RZ                   ;RETURN IF NOT SET
299F C3 C0 29           0084          JMP   OUTPR          ;SEND TO PRINTER IF SET
29A2                    0085 *
29A2                    0086 *
29A2                    0087 * CENTRONICS PRINTER OUTPUT ROUTINE
29A2                    0088 *
29A2                    0089          ORG   IOLOC+192
29C0                    0090 *
29C0 DB 01              0091 OUTPR    IN    1
29C2 E6 01              0092          ANI   1
29C4 C2 C0 29           0093          JNZ   OUTPR          ;WAIT TILL NOT BUSY
29C7 78                 0094          MOV   A,B
29C8 F6 80              0095          ORI   128            ;SET STROBE
29CA D3 01              0096          OUT   1
29CC E6 7F              0097          ANI   127            ;CLEAR STROBE
29CE D3 01              0098          OUT   1
29D0 F6 80              0099          ORI   128            ;SET STROBE (NOW WE'VE PULSED IT)
29D2 D3 01              0100          OUT   1
29D4 78                 0101          MOV   A,B
29D5 FE 0A              0102          CPI   10             ;SEE IF LINEFEED
29D7 CA E4 29           0103          JZ    ITALF
29DA FE 0C              0104          CPI   12             ;SEE IF FORMFEED
29DC C0                 0105          RNZ                  ;RETURN IF NOT
29DD 3E 38              0106          MVI   A,56
29DF 32 FF 29           0107          STA   LNCNT          ;RESET PAGE COUNTER ON FORMFEED
29E2 78                 0108          MOV   A,B
29E3 C9                 0109          RET
29E4 3A FF 29           0110 ITALF    LDA   LNCNT          ;ON LINEFEED, ADJUST LINE COUNTER
```

```
29E7 3D                 0111        DCR   A
29E8 32 FF 29           0112        STA   LNCNT
29EB 78                 0113        MOV   A,B
29EC C0                 0114        RNZ                ;RETURN IF LESS THAN A PAGE
29ED C5                 0115        PUSH  B
29EE 06 0C              0116        MVI   B,12
29F0 CD C0 29           0117        CALL  OUTPR        ;IF FULL PAGE, SEND FORMFEED
29F3 C1                 0118        POP   B
29F4 78                 0119        MOV   A,B
29F5 C9                 0120        RET                ;AND RETURN
29F6                    0121 *
29F6                    0122        ORG   IOLOC+254
29FE                    0123 *
29FE 00                 0124 OUTFL  DB    0            ;PRINTER FLAG
29FF 38                 0125 LNCNT  DB    56           ;LINE COUNTER
2A00                    0126 *
```

SYMBOL TABLE

CHK8	2940	CTLP	297F	IN8	2960	INI8	2910
IOLOC	2900	ITALF	29E4	LNCNT	29FF	MAKE8	2989
MZOS	2028	OUT8	2990	OUTFL	29FE	OUTPR	29C0
REENT	2900						

```
2900                    0001 * MZOS SERIAL I/O SYSTEM
2900                    0002 * NEALE BRASSELL [15-DEC-78]
2900                    0003 *
2900                    0004 IOLOC  EQU  2900H
2900                    0005 MZOS   EQU  2028H
2900                    0006 *
2900                    0007 *
2900                    0008 * THIS DOES AN INIT, THEN JUMPS TO MZOS
2900                    0009 *
2900                    0010        ORG  IOLOC
2900                    0011 *
2900 CD 10 29           0012 REENT  CALL INI8
2903 C3 28 20           0013        JMP  MZOS
2906                    0014 *
2906                    0015 *
2906                    0016 * THIS IS THE INIT ROUTINE
2906                    0017 *
2906                    0018        ORG  IOLOC+16
2910                    0019 *
2910 AF                 0020 INI8   XRA  A
2911 D3 03              0021        OUT  3
2913 D3 03              0022        OUT  3
2915 D3 03              0023        OUT  3
2917 3E 40              0024        MVI  A,40H
2919 D3 03              0025        OUT  3
291B 3E CE              0026        MVI  A,0CEH
291D D3 03              0027        OUT  3
291F 3E 27              0028        MVI  A,27H
2921 D3 03              0029        OUT  3
2923 C9                 0030        RET
2924                    0031 *
2924                    0032 *
2924                    0033 * THIS CHECKS FOR <©C>, AND SUSPENDS OUTPUT ON <SPACE>
2924                    0034 *
2924                    0035        ORG  IOLOC+64
2940                    0036 *
2940 CD DC C0           0037 CHK8   CALL 0C0DCH
2943 FE 03              0038 CMPR   CPI  3
2945 C8                 0039        RZ
2946 FE 20              0040        CPI  32
2948 C0                 0041        RNZ
2949 CD 60 29           0042        CALL IN8
294C FE 03              0043        CPI  3
294E C9                 0044        RET
294F                    0045 *
294F                    0046 *
294F                    0047 * CONSOLE INPUT - <©P> & <©L> ARE HANDLED SPECIALLY
294F                    0048 *
294F                    0049        ORG  IOLOC+96
2960                    0050 *
2960 CD DC C0           0051 IN8    CALL 0C0DCH        ;GET CHARACTER
2963 CA 60 29           0052        JZ   IN8
2966 FE 5F              0053        CPI  5FH
2968 CC 89 29           0054        CZ   MAKE8
```

```
296B FE 7F              0055         CPI   7FH
296D CC 89 29           0056         CZ    MAKE8          ;CONVERT DEL & USCORE TO BS
2970 FE 10              0057         CPI   16             ;SEE IF ©P
2972 CA 7F 29           0058         JZ    CTLP
2975 FE 0C              0059         CPI   12             ;SEE IF ©L
2977 C0                 0060         RNZ                  ;RETURN IF NOT
2978 47                 0061         MOV   B,A
2979 CD C0 29           0062         CALL  OUTPR          ;SEND FORMFEED
297C C3 60 29           0063         JMP   IN8            ;DISCARD CHARACTER
297F 3A FE 29           0064 CTLP    LDA   OUTFL
2982 2F                 0065         CMA
2983 32 FE 29           0066         STA   OUTFL          ;©P COMPLIMENTS PRINTER FLAG
2986 C3 60 29           0067         JMP   IN8            ;AND DISCARD CHARACTER
2989 3E 08              0068 MAKE8   MVI   A,8
298B C9                 0069         RET
298C                    0070 *
298C                    0071 *
298C                    0072 * OUTPUT CHARACTER - IF A=1, THEN USE PRINTER
298C                    0073 *
298C                    0074         ORG   IOLOC+144
2990                    0075 *
2990 FE 01              0076 OUT8    CPI   1
2992 CA C0 29           0077         JZ    OUTPR          ;IF A=1 THEN USE PRINTER
2995 78                 0078         MOV   A,B
2996 CD 98 C0           0079         CALL  0C098H         ;SEND CHARACTER TO CONSOLE
2999 3A FE 29           0080         LDA   OUTFL
299C B7                 0081         ORA   A              ;CHECK PRINTER FLAG
299D 78                 0082         MOV   A,B
299E C8                 0083         RZ                   ;RETURN IF NOT SET
299F C3 C0 29           0084         JMP   OUTPR          ;SEND TO PRINTER IF SET
29A2                    0085 *
29A2                    0086 *
29A2                    0087 * SERIAL PRINTER OUTPUT ROUTINE
29A2                    0088 * (TTY, DECWRITER, TI810, ETC.)
29A2                    0089 *
29A2                    0090         ORG   IOLOC+192
29C0                    0091 *
29C0 DB 03              0092 OUTPR   IN    3
29C2 E6 01              0093         ANI   1
29C4 CA C0 29           0094         JZ    OUTPR          ;WAIT FOR READY FROM USART
29C7 78                 0095         MOV   A,B
29C8 D3 02              0096         OUT   2              ;SEND CHARACTER
29CA FE 0A              0097         CPI   10             ;SEE IF LINEFEED
29CC CA D9 29           0098         JZ    ITALF
29CF FE 0C              0099         CPI   12             ;SEE IF FORMFEED
29D1 C0                 0100         RNZ                  ;RETURN IF NOT
29D2 3E 38              0101         MVI   A,56
29D4 32 FF 29           0102         STA   LNCNT          ;RESET PAGE COUNTER ON FORMFEED
29D7 78                 0103         MOV   A,B
29D8 C9                 0104         RET
29D9 3A FF 29           0105 ITALF   LDA   LNCNT
29DC 3D                 0106         DCR   A              ;ADJUST LINE COUNTER
29DD 32 FF 29           0107         STA   LNCNT
29E0 78                 0108         MOV   A,B
29E1 C0                 0109         RNZ
29E2 C5                 0110         PUSH  B
```

```
29E3 06 0C              0111          MVI   B,12
29E5 CD C0 29           0112          CALL  OUTPR
29E8 C1                 0113          POP   B
29E9 78                 0114          MOV   A,B
29EA C9                 0115          RET
29EB                    0116 *
29EB                    0117          ORG   IOLOC+254
29FE                    0118 *
29FE 00                 0119 OUTFL    DB    0          ;PRINTER FLAG
29FF 38                 0120 LNCNT    DB    56         ;LINE COUNTER
2A00                    0121 *
```

SYMBOL TABLE

```
CHK8   2940    CMPR   2943    CTLP   297F    IN8    2960    INI8   2910
IOLOC  2900    ITALF  29D9    LNCNT  29FF    MAKE8  2989    MZOS   2028
OUT8   2990    OUTFL  29FE    OUTPR  29C0    REENT  2900
```