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D-DOS is a simple disk operating system for use with Nascom 1 or Nascom 2 fitted with either NAS-SYS 1 or NAS-SYS 3 monitors. The author claims no originality in the software, nor makes any claims that the software is in any way 'clever'. Simply, D-DOS is intended as a guide to the machine code programmer into the use of the Henelec Floppy Disk Controller software. D-DOS can not be described as the final and definitive Nascom DOS, but is provided in the hope that other more proficient programmers may wish to write far more comprehensive versions. It is further hoped that any more comprehensive Disk Operating Systems will be made available to other users either through the auspices of the INMC or at reasonable prices through Nascom dealers.

D-DOS is normally supplied in 2 2708 EPROMs and is located between B000H and B7FFH. Alternatively, a tape version of D-DOS designed to run in RAM, may be supplied which is located between 8800H and 8FFFH, for use in cases where the EPROM locations at B000H - B7FFH are already allocated to other firmware (the Bits and PCs Programmer's Aid for instance). Both EPROM and tape versions of D-DOS are identical, save that the tape version is assembled to execute from 8800H.

D-DOS provides 4 commands:

- 1) Read from disk
- 2) Write to disk
- 3) Format disk
- 4) Return to NAS-SYS

All inputs for the read and write commands are fully validated, being checked for both the number of arguments supplied and as to the validity of the arguments. In the event of an error, prompts are supplied to remind the user of the correct order for inputs. As D-DOS has no internal directory or write protect it is up to the user to ensure that the commands given do not overwrite data which may still be required. The Format command reminds the user that its use will destroy the current contents of the disk to be formatted. Note that the current contents of memory from 1000H to 1D00H will also be corrupted when using the Format routine. The Format command specifically asks the user to continue, use of any key other than 'Y' will abort the Format routine without overwriting the disk contents or corrupting memory.

With the standard drives and FDC software, the format is single density, double sided. Each side of the disk has 35 tracks each of eighteen sectors. Each sector contains 128 bytes. This gives a total storage capacity of approximately 161K bytes. Although each side of the disk contains 35 tracks, the FDC software is such that this is treated as a contiguous data area containing a total of 70 tracks, the changeover from side to side is accomplished automatically by the FDC software and is totally transparent to the user. To all intents and purposes the disk may be treated as a single sided disk of 70 tracks.

Fitting D-DOS

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D-DOS is normally supplied in two EPROMs, one marked 'D-DOS-1' and the other marked 'D-DOS-2'. The '-1' EPROM is intended to run in an EPROM socket decoded for memory location B000H, and the '-2' EPROM is intended to run in an EPROM socket decoded for memory location B400H. The exact fitting will depend on the system in use, and it is best to refer to the Nascom manuals for guidance on decoding the memory locations. The tape version may be loaded from tape (normally supplied at 1200 BAUD Nascom 2 format) direct to memory locations 8800H - 8FFFH, by using Nascom command 'R'..

Executing D-DOS

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D-DOS is executed by typing 'E B000' terminated with a 'newline' for the EPROM version. If NAS-SYS 3 is in use, then command 'Y' may be used as this executes an automatic jump to B000H. When the tape version is in use, type 'E 8800' terminated with a 'newline'. On executing D-DOS, the drives will start and the default drive (drive 0) indicator will light. A second or so later the caption 'D-DOS Version 1.1' will be displayed followed by a 'blinking cursor' on the next available new line. D-DOS is now in the command mode ready to accept commands. Note that the disk drive motors will turn off 5 seconds after the cessation of read/write activity, and will restart in response to D-DOS commands.

The Write Command

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The Write command writes an area of memory determined by the input arguments to the disk starting at a specified track, sector and drive number.

There are two forms of input for the Write command:

(F m To Tr Sc Dr)

<ssss> <eeee+1> <tt> <ss> <dd>

and

<ssss> <eeee+1> <tt> <ss> <dd>

In the first form, the user types 'W' and enters 'newline', the D-DOS responds with the prompt '(From To Tr Sc Dr)'. The user may then respond with <ssss> which is the start address of the data to be saved, <eeee+1> which is the last address to be saved + 1, starting at <tt> track number, <ss> sector number and <dd> drive number. Each argument should be in HEXadecimal and separated by or more spaces. Having entered the arguments the user should type 'newline'. Note that the track number should be within the range 0 - 45H, the sector number within the range 1 - 12H and the drive number within the range 0 - 2H. Note particularly that the sector range is 1 to 12H and not 0 - 11H as would be the more usual HEXadecimal convention, this is so the sector numbering conforms to 'standard' IBM disk formatting conventions. In

the event of an input error the message 'Error. Start again.' is displayed. The user should then restart by re-entering both the command letter and the arguments. An error will occur if too few or too many arguments are entered, or if the arguments contain a non HEX character.

With the second form of the 'W' command the arguments are entered directly after the 'W' terminated with a 'newline'. No prompts are given. The form of the arguments is as above. If an input error is detected the message 'Error. (From To Tr Sc Dr)' is displayed, and data should be re-entered as in the first example. In the event of a further error, the message 'Error. Start again.' is displayed and the user should start from the beginning by re-entering both the command letter and the arguments.

When the inputs are entered correctly the data will be written to disk (see Error Handling for details of Write errors). When the write is complete D-DOS will display the following message:

```
Sectors saved xx
Next file at (Tr Sc Dr) tt ss dd
```

This indicates to the user the length of the file saved (xx) and the next track and sector available for subsequent write operations. The drive number returned may be ignored for most purposes as this simply acts as confirmation that the data was written to the drive intended. It is suggested that the user make note of the returned parameters and 'logs' them on a disk map (see appendix 1 for an example), as the length of the file will be required for the Read command, and the track and sector will be required for the next write operation. Having completed a write operation the program returns to the D-DOS command mode.

The Read Command =====

The Read command reads a specified number of sectors to memory starting at a specified address from a specified disk track, sector and drive, determined by the input arguments. There are two forms of input for the Read command:

```
R
(To Sctrs Tr Sc Dr)
<ssss> <nn> <tt> <ss> <dd>
```

and

```
R <ssss> <nn> <tt> <ss> <dd>
```

In the first form, the user types 'R' and enters 'newline', the D-DOS responds with the prompt '(To Sctrs Tr Sc Dr)'. The user may then respond with <ssss> which is the start address of the memory area to be written to, <nn> which is the number of sectors to be read, starting at <tt> track number, <ss> sector number and <dd> drive number. Each argument should be in HEXadecimal and separated by one or more spaces. Having entered the arguments the user should type 'newline'. Note that the track number should be within the range 0 - 45H, the sector number

within the range 1 - 12H and the drive number within the range 0 - 2H. In the event of an input error the message 'Error. Start again.' is displayed. The user should then restart by re-entering both the command letter and the arguments. An error will occur if too few or too many arguments are entered, or if the arguments contain a non HEX character.

With the second form of the 'R' command the arguments are entered directly after the 'R' terminated with a 'newline'. No prompts are given. The form of the arguments is as above. If an input error is detected the message 'Error. (To Sctrs Tr Sc Dr)' is displayed, and data should be re-entered as in the first example. In the event of a further error, the message 'Error. Start again.' is displayed and the user should start from the beginning by re-entering both the command letter and the arguments.

When the inputs are entered correctly the data will be read from the disk (see Error Handling for details of Read errors). When the read is complete D-DOS will display the following message:
Complete
and then returns to the D-DOS command mode.

The Format command =====

The Format command is provided to format a disk correctly. This is necessary, as each sector of the disk is prefixed with data to tell the disk system which track and sector the head is currently reading from or writing to. The format command works by setting up an 'image' of a disk track in RAM (thereby overwriting the current contents of RAM between 1000H and 1D00H), and writing the whole image to a complete track of the disk. A special command within the FDC controller is provided for this purpose. Note that a disk cannot be used without having been previously formatted. But once having formatted a disk, a disk will not usually require reformatting unless a 'system crash' corrupted the format or unless the total contents of the disk are to be erased. The Format command issues a warning that the total contents of the disk will be erased and issues a prompt whilst waiting for the user to reply. Typing 'Y' will cause the formatting routine to proceed, any other key will abort the routine and neither the contents of RAM or the disk will be affected. When the format routine has finished, D-DOS displays the message 'Format complete'. In the event of a formatting error, D-DOS displays the message 'Format error', no error code is returned. In both cases D-DOS returns to the command mode.

Using D-DOS =====

At the machine code level of a Nascom, D-DOS is used exactly as the 'W' and 'R' command, except that the additional track, sector and drive information must be supplied. When using D-DOS with other utility programs, it is normal to return to the machine level prior to a read or write operation, the inconvenience of this is far outweighed by the increased read/write speed which may be achieved.

D-DOS with ZEAP 2.0

When writing a source file from ZEAP 2.0, type 'N' to return to NAS-SYS, then execute D-DOS. Use the 'W' command to write from the start of the source file (normally 2000H, unless you changed it) to the location indicated by the 'Free' indicator on the header display of ZEAP displayed on the screen. If, for instance, the 'Free' indicator read 4A56H then the 'W' command would appear thus:

```
W 2000 4A56 tt ss dd
```

where tt, ss and dd is the track, sector and drive data. To read a source file, execute ZEAP, then type 'N' to return to NAS-SYS. Execute D-DOS and use the 'R' command to read the source file back into the ZEAP source buffer starting at 2000H (unless you changed it). Warm start ZEAP.

D-DOS with NASPEN

To write a NASPEN source file using D-DOS. Type 'N' to return to NAS-SYS, and using the 'M' command examine memory locations 101AH and 101BH, this is the pointer to the end of text. Remember that the data is stored low byte first, so that for instance:

```
M 101A
  101A 3E
  101B 2F.
```

is address 2F3EH. Use the D-DOS 'W' command to write from the start of the NASPEN buffer, 100FH, to the address given by the end of text pointer. In the above instance, the command would appear:

```
W 100F 2F3E tt ss dd
```

where tt, ss and dd are the track sector and drive details. To read back the file, simply use the D-DOS 'R' command to read the data back starting at 100FH. Then warm start NASPEN.

D-DOS and 8K BASIC

Using D-DOS with 8K BASIC is similar to use with NASPEN. The end of text pointer in BASIC is at 10D6H and 10D7H which gives the end of the BASIC file. Use the D-DOS 'W' command to write a file from 10D6H to the address given by the memory contents of the locations 10D6H and 10D7H. To read a file back into BASIC, cold start BASIC, return to monitor and use the 'R' command to read the file starting at 10D6H. Warm start BASIC.

Error handling

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Error handling is automatic, and due to the self checking nature of the read/write process errors are few and far between. However, due to mechanical tolerances read/write errors occasionally occur between one drive and another, errors can occur because of extreme changes in temperature, or, of course, worn out disks. After 'system crash' the format data on the disks could give rise to misreads. Any errors reported during a write operation will be caused by the failure to read the format data on a sector header.

The FDC software incorporates 'retry' routines which direct the disk drive to try and reread a faulty track five times. If the faulty track has not been read correctly after five tries, then the disk drive head is 'homed' and then a further five tries are made. If this still fails then the FDC software directs the D-DOS to stop and report

When an error is detected, the D-DOS put out a message:

Disk error <nn> at <aaaa> <tt> <ss> <dd>

The error message gives the error number which may best be interpreted by reference to the WD1771 FDC controller chip data. Usually the error number is of no relevance, being only significant when used in debugging the users own software. <aaaa> <tt> <ss> <dd> are the address in RAM that was currently being read from/written to, and <tt> <ss> <dd> are the relevant track, sector and drive numbers. Where a mechanical error is suspected, then removing the disk and replacing it will usually allow the process to continue. After an error report, D-DOS returns to its command mode, so that the previous command must be repeated.

Continual reports of errors at the same track and sector number suggest damaged media or corrupt formatting. The only way to deal with this is to save all readable data on the disk by reading it into RAM and then writing it to another disk. Having saved the data, the suspect disk should be reformatted, and then the suspect track and sector reread to RAM. If there are no error reports, then check that the data read back is 128 bytes of E5H. If errors are still reported, then the disk is damaged and should be destroyed.

It is good practice after formatting a disk to read its total contents to RAM. This can only be achieved in 32K blocks, but provided no read errors are reported, the disk can be assumed to be in good order. It is not unknown for manufacturers' 'certified' disks to still contain 'duff sectors'.

One error will always be reported:

Disk error 1F at aaaa 46 01 dd

This is where the disk has been completely filled, and the error report is that the FDC has failed to find sector 01 of track 71, which, of course, is one track more than the capacity of the system. An error will also be returned if no disk is in the disk drive or that the drive door is not closed. Other errors will occur if a disk is inserted upside down, or the write protect notch on the disk has been covered.