THE HENELEC DISK SYSTEMS

The Henelec disk system is designed to provide an economical answer to bulk storage on microcomputer systems. The disk controller card, measuring 11 x 11 cms was commissioned by Henry's Radio and is wholly UK designed. Further, it was designed to be totally bus independent. Although designed with the Nascom range of microcomputers in mind, the Henelec disk controller card and its attendant software (with minor modifications) can be used with any other 8080, 8085 or Z80 based computer system provided that an uncommitted peripheral input/output device, such as the Z80 PIO is available. The disk controller card is compatible with normal TTL levels, and as such could be used with processors other than the Z80 8080 series, although the controlling software would have to be rewritten. There are no plans to offer this facility at present.

The format used in the Henelec disk system is IBM compatible 'double sided/single density' using Pertek 250 series 5.25" drives using two sides each of 35 tracks, each track consisting of 18 (128 byte) sectors. The hardware is internally decoded for use with the double sided drives, the two sides being selected in sequence, such that the drive behaves as a single sided drive of 70 tracks. The hardware and software may be upgraded for use with 8" drives. Although the Henelec system uses Pertek drives, most other standard drives of other manufacture can be used. The single density disk format was chosen as by far the most commercial software is available in this format. Single density has become an 'industry software standard', unfortunately no such standard exists for double density format systems. Although at first thought to be attractive, double density format was finally disregarded on three grounds. Cost, lack of software standards, and despite the rapidly improving technology, undispelled doubts about the overall data integrity of double density systems. The Henelec system is designed to be attractive to the home user because of its comparatively low cost, and to the industrial and business user because of its adherence to already accepted software standards. It is important to note that both the hardware and software parameters for the Henelec System were deliberately chosen to be compatible with 'SD Systems' CP/M formats. SD Systems would appear to have most commercial CP/M software available.

The Henelec system can be considered in three parts: the drives, the controller card and its assocciated software, and the disk control software. A 26 way ribbon cable is required between the computer PIO and the FDC card; +5 and +12 volt supplies are also required by the FDC card. The 36 way ribbon cable between the FDC card and the drives may be up to 3 metres in length, allowing the drives to be run remotely from the computer. In its simplest form, the FDC card may be mounted in a convenient location within the computer case or frame and draw its power from the computer power supplies. Alternatively the card may be mounted in the drive case if the distance between the computer and drive case is kept to a minimum (cable not to exceed 1 metre). The Henelec system is available in two distinct versions.

The 'Floppy Tape Recorder'

The 'Floppy tape recorder' software is designed to be used with Nascom microcomputers and uses the drives, the controller card (with its software) and a simple 'Disk Operating System' called D-DOS which runs under NAS-SYS. Its purpose is to replace the existing Read Write cassette tape commands available from the monitor, and Read and Write data to the disk instead. This gives an approximate 100 times increase in speed (compared with a Nascom 2 running at 1200 BAUD). D-DOS does not contain any disk management routines, and the user is intended to organise the disks in much the same way he would previously have done using cassette tape. D-DOS is primarily aimed at the machine code programmer, and provides the base for a more elaborate DOS which the user may wish to write. A fully commented listing is supplied which describes how the disk routines are accessed and how error conditions are handled.

The FDC software is located at B000H and the D-DOS at B400H, the total software being 2K long. This location was chosen as this is space set aside for enhancemets to the Nascom operating system. The original memory map of the Nascom is not altered in any way, and all the features of the Nascom remain unchanged.

D-DOS supports four commands:

R llll aa tt ss dd
: Read, starting at address <llll>, <aa> sectors, starting at <tt> track <ss> sector, from <dd> drive.

W ffff tttt tt ss dd
: Write, starting from address <ffff> to address <tttt>, to disk starting at <tt> track <ss> sector on drive <dd>.

N
: Return to NAS-SYS.

F
: Format a disk.

The commands are fully validated and in the event of an error, prompt the user for the correct entry. After a Write command, D-DOS returns the number of sectors saved, and the start address of the next free track and sector. This information simplifies the task of keeping track of the data stored on the disk.

Full documentation and listings of D-DOS is supplied, and D-DOS is supplied in 1 2708 EPROM.

Full CP/M system

Being a Z80 based system, the Nascom lends itself to CP/M. CP/M is a 'de facto' industrial and business system monitor. In many ways this monitor is not as good as the Nascom monitors, but what it loses in its operational effectiveness is more than made up by its disk management routines. Quantities of professional software are available to run under CP/M, and much 'off the shelf' business software is also available.

The memory map of the Nascom is not suitable for CP/M as it stands, as CP/M requires that locations 0H to 4000H (minimum) be available as program space. The Nascom monitor, video and workspace currently occupy the bottom 4K of memory. This problem is easily overcome in a Nascom 2 by using a new 'MD' PROM. Using CP/M with Nascom 1 requires minor hardware modifications to be made (these can be incorporated on the buffer board), details are included, but components are not supplied as part of the Henelec systems. In either case after conversion, it is a simple matter to switch the Nascom back to 'normal'. The memory map chosen for Nascom using CPM is as follows:

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FFFF    Top of RAM               ) Space allowed
FC00    Workspace (redundant)    ) for a possible
F800    Video RAM                ) 80 x 25 video.
F400    FDC EPROM
F000    CBIOS-S (simple boot, see SYS.COM)
  :
  :     Transient RAM
  :
0000
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This allows a 60K CP/M to be implemented.

Those familiar with CP/M will know that normally only 0.5K is allowed within CP/M 1.4 for the CBIOS, but Nascom with its memory mapped video and software controlled keyboard requires considerably more memory space than this, if the full versatility of the Nascom is to be retained. Therefore, unlike normal CP/M systems, the Henelec CP/M based system uses two CBIOSes. There is a simple 'boot loader' in EPROM at location F000H which loads in the CP/M system and gives simple CBIOS control. Items such as the list device, punch and reader, I/O byte, etc, are not supported. The CP/M may optionally load a special 1.5K disk based self locating CBIOS called SYS.COM which gives full CBIOS support.

SYS.COM

If only NAS-SYS were rewritten to run under CP/M, and then existing programs further adapted to run under the modified NAS-SYS, true CP/M compatibility would be lost, as the NAS-SYS monitor is 'peculiar' to the Nascom, and programs written to run under the 'CP/M NAS-SYS' would only be compatible with other Nascoms running 'CP/M NAS-SYS'. To this end SYS.COM has been specially written for the Henelec system by Richard Beal, the author of B-BUG, NASBUG T4 and the NAS-SYS monitors. SYS.COM is a fully fledged CBIOS, supporting peripheral devices such as serial printers with handshake, Centronics parallel printer interfaces, tape punch and reader, etc. Full NAS-SYS 3 type repeat keyboard support is incorporated, and also the NAS-SYS screen editing features (although at present not many CP/M programs support this). SYS.COM is fully transparent to the user and to the CP/M, so that full compatibility with other CP/M based software is ensured. 2.5K has been allowed for SYS.COM, of which approximately 1.5K has been used. This allows the user to utilize the remaining permanent space for such items as special purpose print handlers for the LST device, etc. A commented source listing is supplied with the CP/M, and a disk of the source suitable for the MACRO-80 assembler will be made available to those wishing to tailor the SYS.COM to a specific application. Because SYS.COM is allowed an additional 2K (plus the existing 0.5K within CP/M), the maximum size CP/M which can be implemented when SYS.COM is in use, is 58K.

As an aid to screen editing a disk based version of the Nascom text editor, NASPEN, will be available soon. This new enhanced version of NASPEN with full disk support, can be used in place of ED.COM (which is normally supplied as part of the CP/M package) and is fully compatible with ED.COM files.

The CP/M 1.4 package is supplied in its standard form from Digital Research and includes the cold start loader and CBIOS jump table. The CP/M is supplied complete with the Digital Research documentation. The CP/M disk also contains SYS.COM and a disk formating routine, FORMAT1.COM. FORMAT1.COM replaces the format routines supplied with the CP/M as this format routine is more applicable to our form of FDC control.

The Drives

The drives are supplied in a dual drive stand-alone steel case, finished in black and mushroom 'hammer finish' paint. Where one drive is supplied, the position for the second drive is blanked off with a matching cover plate. The case contains its own regulated +12 and +5 volt mains power supply adequate for two drives. Connections to the drives is made using a standard 34 way ribbon cable and plug which enters through a slot at the back of the case, allowing simple and tidy 'daisy chaining' of the drives.

Drive specifications

Mains input	220-250 V AC 45 W (running) 15 W (standby)
Disk drive	Pertek 250 series
Disk size	5.25"
Data rate	125K bits/sec
Unformatted capacity	218K bytes
Formatted capacity	161.28K bytes
Format	Single density double sided IBM format 2 sides, each of 35 tracks each of 18 sectors 128 bytes/sector
Drive start up time	0.5 second
Inter track settling	10 mS
Head load time	50 mS
Material & finish	Two piece steel construction, black and mushroom hammer finish paint

Floppy Disk Controller Card

The FDC card is based on the Western Digital WD1771 floppy disk controller chip. The 1771 is controlled by signals from the peripheral input/output device fitted to the computer bus. 16 bi-directional lines are used in total, 8 for data transfer and 8 for control signals. Floppy disk timing is derived from an on board 8 MHz crystal controlled oscillator which is divided to the appropriate frequencies. Input and output to the drives is fully buffered. Decoding is provided for up to three drives, and a further decode is provided for side select. These decodes can be gated together if required to provide single sided decoding for up to six drives. A hardware 'time out' of approximately 5 seconds is provided to obtain optimum drive and media life. Provision is made on the printed circuit board for the inclusion of a separate 'data sync' separator for use with 8" disk systems. Connections to the FDC input is made through a standard 26 way 0.1" pitch connector, and output to the drives is through a similar 34 way connector. Power supplies of +5 and +12 volts are required, and are terminated on pins on the printed circuit card. No -5 volt power supply is required, as this is generated internally. This feature has been provided as -5 volts is not normally available from the disk drive supplies, and this provision allows the card to be mounted in the drive case if required.

The double sided, plated through hole printed circuit card is 11 x 11 cms square with four mounting holes, making it ideal for mounting with the computer case or frame. Alternatively, the card may be mounted on a prototyping card (which could also incorporate any neccessary PIO and decoding) in the event that the user wished to mount the card on the computer bus

Specifications

Controller chip	WD1771
Input/output	16 bi-directional lines total 8 for data, 8 for control All lines present no more than 2 LS TTL loads
Internal clock	8 MHz, divided to 2MHz for 8" drives divided to 1MHz for 5.25" drives
Max. number of drives	3, with side select decode
Time out	5 seconds after cessation of R/W activity
Head load timer	50 mS
Chip complement	1 LSI NMOS 2 MSI TTL 5 SSI TTL
Power requirement	+5 volt at 80mA +12 volt at 2mA
Pcb size	11 x 11 cms (mounting holes on 10.2 cm ctrs)
Pcb type	Fibre glass, double sided, plate through hole with solder mask
FDC software	0.75K written in 8080 code. Suitable for Z80, 8080 and 8085, with processor cycle times of 500nS to 250nS (2 - 4 MHz)
Software locations	D000H (D-DOS) F400H (CP/M)

Sundries

An 'MD' PROM called 'N2MD/CPM' has been prepared for the Nascom 2 to enable maximum advantage to be taken of the CP/M memory layout within the Nascom memory map. This is decoded as follows:

0000) Existing NAS-SYS
0800) Existing Video
E800) Alternative CP/M video
F000) CP/M cold start
F800) CP/M video
C000
D000
E000) Coupled with E800, F000 and F800, restores Nascom Basic

This layout was chosen, as it allows the Nascom to be converted from CP/M back to its 'normal' form by simply substituting the 'MD' link plug, without changing the new 'MD' PROM. Decoding for the Nascom 1 is derived from the memory board decoding, and is a little more complicated.

Cables for the Henelec system are provided, the 26 way ribbon cable is 1 metre long, terminated in 26 way connectors suitable for the Nascom 2 and FDC card. Cables for Nascom 1, and cables of different lengths are available to order. The 34 way ribbon cable connecting the FDC to the drives is terminated with a 34 way 0.1" plug suitable for the FDC card at one end and, normally, two drive connectors, 15 cms apart are provided at the other end. The drive cable is normally 2 metres long. Different cable lengths and plug configurations can be supplied to order.

Full documentation for constructing and commissioning the Henelec disk systems is provided.

The Simple DOS Kit

The simple DOS kit consists of:

1 Drive in double case and power supply
1 D-DOS EPROM and documentation
1 FDC card, EPROM and documentation
1 PIO to FDC connecting cable
1 FDC to drive connecting cable
One additional drive may be fitted in the case, and one further drive may be accomodated as required.

The CP/M Kit

The CP/M kit consists of:

1 Drive in double case and power supply
1 CP/M 1.4 disk with SYS.COM, FORMAT1.COM, CBIOS-S EPROM and documentation
1 FDC card, EPROM and documentation
1 N2MD/CPM RAM decoder PROM and 'MD' link plug
1 PIO to FDC connecting cable
1 FDC to drive connecting cable
One additional drive may be fitted in the case, and one further drive may be accomodated as required.

Prices

1 Double sided disk drive fitted in dual case with power supply	305.00
FDC card, EPROM (state D-DOS or CP/M) and documentation	75.00
D-DOS EPROM and documentation	12.50
CP/M 1.4 with SYS.COM, FORMAT1.COM, CBIOS-S EPROM and documentation . . .	78.00
N2MD/CPM PROM	5.00
PIO to FDC cable	4.50
FDC to drive cable	13.95
Double sided Pertek drive on its own .	205.00

Special prices for complete built systems.

Single drive D-DOS version	380.00
Single drive CP/M version	450.00
Double drive CP/M version	650.00

Prices are subject to change without notice and are quoted exclusive of VAT at the ruling rate.

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