



TORCH UNICORN

TECHNICAL OVERVIEW



UNICORN



1 TORCH UNICORN PRODUCTS- WHAT THEY OFFER

The TORCH UNICORN range gives the enthusiast and the professional user a choice of upgrades which take the BBC Microcomputer to the ultimate height of its capabilities.

In the UNICORN range, TORCH uses the expertise and software technology it developed for its TORCH professional computers to add many of the same capabilities to the BBC Micro.

TORCH chose the BBC Micro as the peripheral controller for its business computers in 1981, when TORCH was developing business software and operating systems for the Acorn Z80 second processor. Having developed the software in early 1982, the delayed availability of the Acorn Z80 second processor resulted in Torch developing its own Z80 board, which is now a major component in both the Business and UNICORN ranges.

The BBC Micro is provided with a wide range of peripheral connections and interfaces, but lacks in itself the computing power and memory space to exploit these features. The addition of a processing element with extra memory to the BBC board solves this problem, and Acorn provide a 2MHz Bus or "TUBER" interface" for this purpose.

The UNICORN range is a major part of TORCH's business. The thousands of TORCH Z80 Disc Packs and second processors now in use ensure that there is a large base of software for the TORCH business machines, and the sophisticated software developed for the TORCH business computers can be used on the UNICORN products.

The major software distributors now supply their CP/M software on TORCH format discs, and there are now several independent hardware manufacturers using TORCH format discs and TORCH Z80 processors in their products under licence from TORCH.

2 THE PRODUCT ARCHITECTURE AND COMPONENTS

A key aspect of the TORCH Architecture is its modularity. To keep the design simple, and to allow for future enhancements, TORCH designers implemented the software

for particular functions with the hardware which handles them. For example, the handling of floppy discs is performed by TORCH software on the BBC board, rather than writing the disc drivers in the second processor. This approach has many advantages:

- 1 A change of second processor does not mean a re-write of the code.
- 2 By using clever "cacheing" techniques, the TORCH software can offer improved disc performance to the second processor.
- 3 A change in disc technology or use of networked discs can be accomplished without changing code in the second processor.
- 4 Operating systems written for the second processor are much easier to implement, because they can handle the disc drives at a high level.

These advantages have been realised many times during the development of TORCH products. TORCH has developed 4 different second processors (3 of which are currently available) without changing the TORCH 6502 operating system firmware (MCP). Operating systems which have been implemented include CP/M, CPN (TORCH's enhanced capability CP/M compatible O.S.), UNIX System III, UCSD p-System, and various stand alone systems including FORTH and C68. Other operating systems such as Tripos and CP/M 68K are being worked on by third party software houses and will be available shortly.

TORCH MCP

The code to handle all the functions available on the BBC micro is contained in the TORCH MCP sideways ROM. MCP contains 16K bytes of 6502 code, which took approximately 6 man years of development. MCP takes its commands from the second processor which is active, or optionally from the network. It contains drivers for floppy discs, various types of hard disc, the drivers to allow the use of Acorn Econet from second processors in a useful way (TORCHNET), a standardised filing system with automatic blocking, de-blocking and allocation, file serving code, protection tables, alternative (TORCH) keyboard code, and many other facilities. Using MCP, a second processor can take full advantage of the BBC board or its peripherals.



Z80 Card

The TORCH Z80 card is attached to the BBC microcomputer interface. It provides 64K RAM and a Z80A for the running of application programs. An 8K or 16K ROM/EPROM on the board provides the Z80 standard operating system CPN and also holds the standard CPN command line interpreter (CCCP) together with the most popular commands.

CPN is an operating system which runs CP/M programs quite normally, but which has many advantages, since it was written specially for the 2 processor environment and the capabilities of the BBC Micro.

CPN Advantages over CP/M:

Providing the device drivers on the 6502 reduces the space needed by the operating system in the Z80 memory. Generally CP/M implementations use 7-10K of Z80 memory. CPN uses just over 1K. This means that user programs have much more free memory.

CPN is provided in ROM. The older CP/M is loaded from system tracks on each disc. CPN is therefore much quicker to load (quarter of a second) and does not waste space on discs for the system tracks. In addition, there is no need to prepare special "System Discs" using CP/M SYSGEN, and the CPN system will load even on a discless workstation.

The CPN command interpreter provides commands such as FORMAT, COPY, DUPLICATE, INPUT, and PRINT. With CP/M, special programs such as FORM, PIP, and DISKCOPY have to be used, taking up space on the disc, taking much longer to load, and often requiring disc changes.

The BBC Micro has many special features such as colour, ROM BASIC, *FX calls and soft keys. Normal CP/M does not make these features available. TORCH CPN provides built-in commands (in ROM) such as MODE, FOREGROUND, KEY, VDU, *FX, BASIC etc., to use these capabilities.

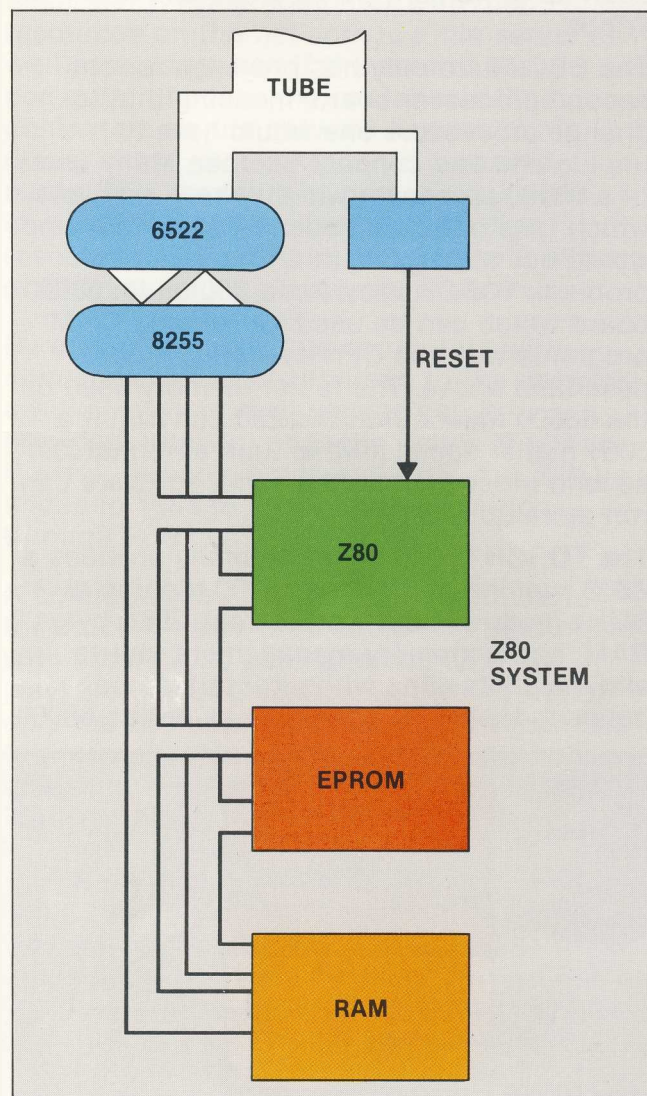
CPN uses the networking features in TORCH MCP to allow discless workstations on a network or the sharing of floppy or hard discs, without having to change CP/M programs at all. Normal CP/M does not support networking.

TORCH CPN can read BBC DFS, UNIX, CP/M or p-System files. CP/M does not provide these facilities.

The interface from the Acorn TUBE Bus to the Z80 card is through twin parallel 8 bit

channels. The Z80 sends commands and data to the 6502 through one, and the 6502 responds through the other. Using this interface it is possible to pass data at the maximum speed the processors can handle it. (80K bytes per second for the Z80 card, and up to 160K bytes per second on the 68000 card)

The full 64K of RAM is normally used, with the 8K ROM being "paged" out, but when code in the ROM is required, it can be copied from ROM to RAM or executed in the ROM directly.



68000 Card

For those applications which need more processing power and memory than can be provided by a Z80 second processor, TORCH has developed its 68000 board. The 68000 is recognised as one of the most powerful microprocessors available. Internally it uses sixteen 32 bit registers for data and addresses, while externally it uses a 16 bit



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wide databus. (A Z80 uses 8 and 16 bit registers internally and has an 8 bit databus, the 8088 uses 8 and 16 bit registers and has an 8 bit databus). The TORCH 68000 board runs at 8MHz (2 million instructions per second) and normally has 256K bytes RAM.

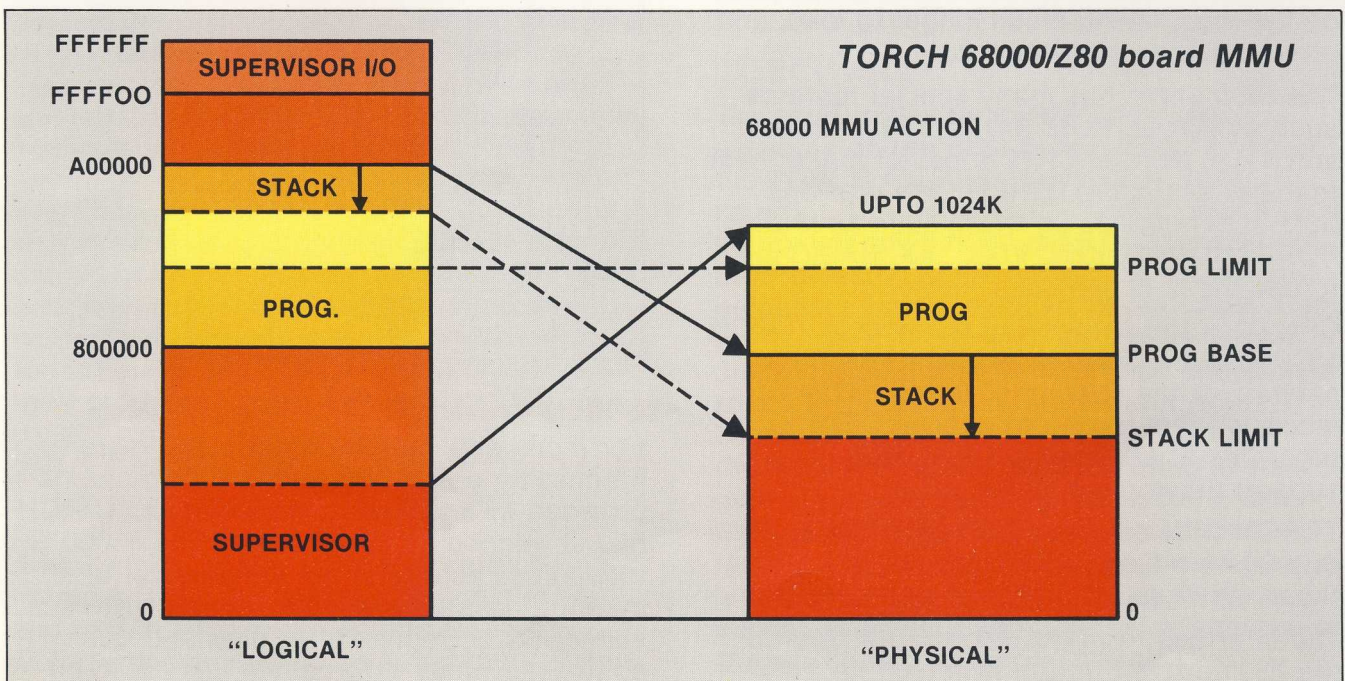
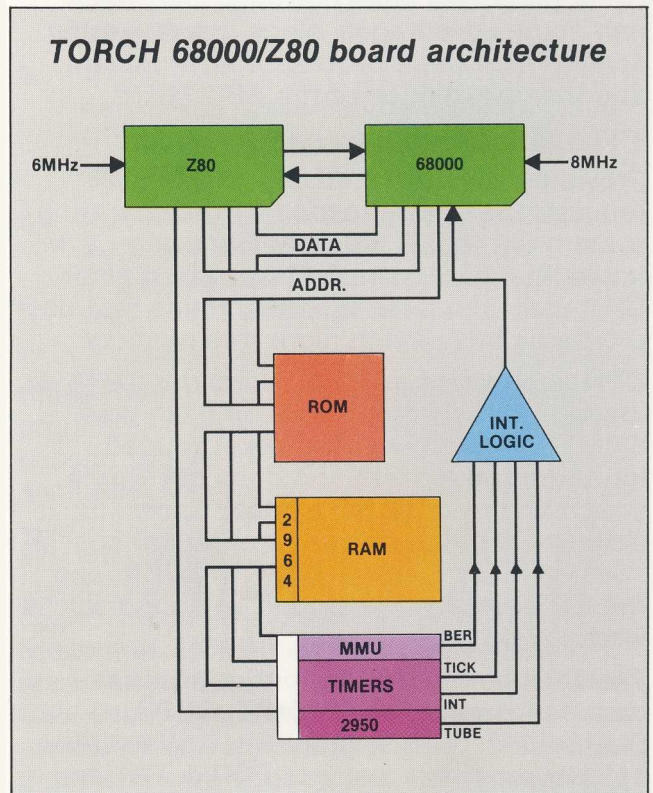
TORCH has identified Unix as the most important operating system for 16 and 32 bit microcomputers in the 1980's, and Unix System III is the operating system provided by TORCH for its 68000 board. Software houses are currently working on other operating systems for the TORCH 68000 such as CP/M 68K, UCSD p-System, and Tripos.

The BBC Micro only has provision for one second processor board, meaning that to change processors one would have to unplug one and connect another. Many users of a 68000 processor will still have software which runs on a Z80 under CP/M or CPN and would not want to do this. To avoid this problem, TORCH provides a Z80 on its 68000 board which can be used for running CP/M programs with the CPN operating system described above. The faster memory used on the 68000 means that the Z80 can run at a 50% higher speed (6MHz) than a normal Z80 second processor, so the same software can run more quickly.

The TORCH 68000 board normally provides a Z80B running at 6MHz, a 68000 running at 8MHz (both without wait states), 256K bytes RAM, and a memory management unit to allow multi-tasking without interference between tasks. By altering links on the 68000

board and changing the 64K bit RAM chips to 256K bit units, the board can be expanded to 1Mb RAM. 1Mb RAM would be more suitable for multi-user or multi-tasking applications, reducing the disc traffic significantly.

The interface between the 68000 or Z80 and the 6502 TUBE interface is through a single chip (2950) which is equivalent to the two twin 8 bit ports used on the Z80 board. Bytes can be transferred through this interface at up to 160K bytes per second.





Twin Disc Pack

In designing its twin disc pack, TORCH determined that quality and reliability was of paramount importance, since the drives would be used as a base for future upgrades through the Unicorn range. The disc drives used are high quality slimline units with long-life heads and direct drive motors. Experience gained during the shipment of over ten thousand drives has shown them to be highly reliable.

The disc pack itself is constructed from steel with a baked on plastic coating. The metal case acts as a shield, and is strong enough to support other equipment. Several University users have bolted the cases to benches for use in public areas.

Although the BBC Microcomputer power supply can theoretically power two disc drives as well as the micro itself, the TORCH Z80 Disc Pack includes a high power switch mode power supply. This supply can either be used to power just the discs, or can power the BBC micro as well. The power supply has ample reserves of power to cope with other peripherals that may be added later.

Hard Disc Interface

For the TORCH Unicorn Hard Disc Pack, and 68000 Hard Disc Pack, a reliable hard disc interface which could handle high speed high capacity hard discs was required.

The TORCH hard disc interface is on two boards, a SASI interface card which generates the standard Bus used on most disc controllers, and a hard disc controller with on-board buffering.

The TORCH MCP 6502 operating system detects the presence of the SASI board on power-up or reset, and performs tests to check the hard disc controller. The controller is then used to read a sector from the hard disc which contains information on the structure of the disc and the configuration of the system.

TORCHNET

The BBC Micro used as a peripheral controller for Unicorn upgrades will often be fitted with Acorn Econet circuitry. All BBC boards fitted to TORCH professional computers are equipped with this circuitry.

The basic Econet network allows computer; to pass to each other packets of information across a 5 core cable, which can be up to 1000m long, and can have 254 computers connected. The Acorn Econet system requires a file server on the network to hold common files, and the file structure on this server is Acorn's own.

TORCH has implemented its own high level protocols on top of the Econet packets to provide a much more flexible system, which can be used from **any** operating system.

Essentially, every computer with disc resources on the network is a file server as well as a computer. If the user of the computer chooses, he can allow other computers on the network access to his discs, either exclusively or in a shared mode. This means that one can have two computers on a net sharing their disc resources without having to dedicate either of them to running a special program.

By adding professional computers with communications capabilities to the network a full electronic mail service can be provided, interworking with Telex, MailPlus, Prestel, Telecom Gold, and PSS. X25 will be added in 1984 to allow inter-net bridges through PSS.

A common low cost network configuration for Unicorn users is to equip one BBC micrc with a hard disc pack and Z80 card and (say) 3 other BBC Micros on the net with only the Z80 card. Each user could then use for example 4Mb of their own on the hard disc, and share a further 4Mb for common files.

Where there is a cluster of Unix systems using the 68000 Hard Disc Pack, it is wasteful of disc space to keep copies of all utilities and manuals on every user's hard disc. It is therefore common to network the systems, and spread the shared utilities round the network. The network is fast enough to prevent any significant performance degradation.

All TORCH Unicorn products are supplied with the MCP 6502 operating system which handles the network protocols and disc sharing. TORCHNET uses the same basic packet protocols as Econet, so Acorn Econet systems and TORCH systems can be operated simultaneously on the same physical network.

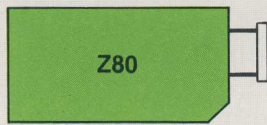


Individual Product Structure

The following diagrams show how each Unicorn product is composed of standard modules.

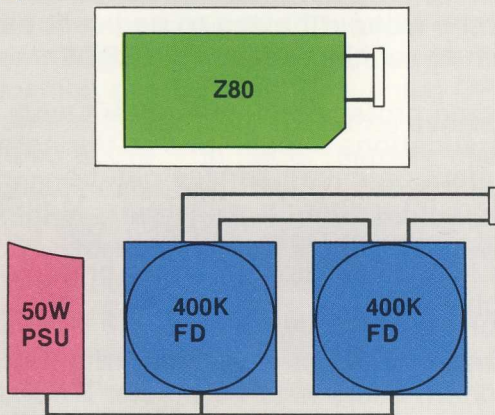
1

ZEP100 Z80 Extension Processor



2

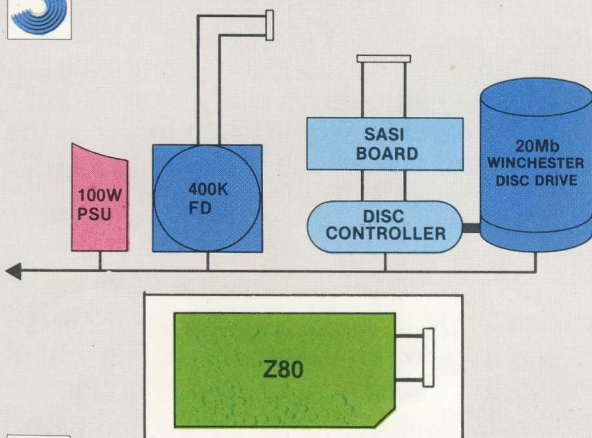
ZDP240 Z80 Disc Pack



Consists of ZEP100 + 2
400K Floppy Disc Drives FD = Disc Drive

3

HDP240 20Mb Hard Disc Pack



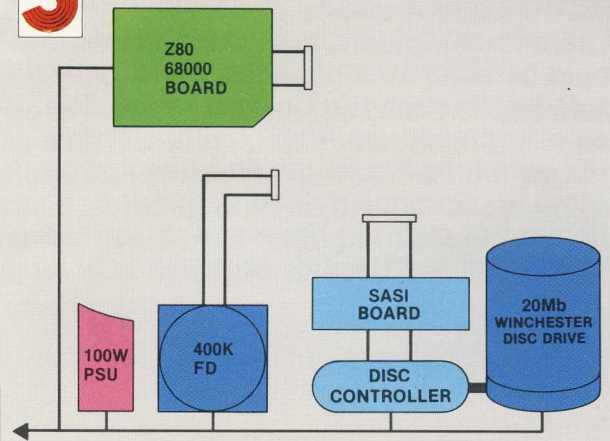
4

HDPZ80 Z80 20Mb Hard Disc Pack

Consists of HDP240 + ZEP100

5

HDP68K 68000 20Mb Hard Disc Pack



3 OPERATING SYSTEMS

TORCH offers 2 primary operating systems, CPN for the Z80 and UNIX III for the 68000. In addition, several other operating systems are available or being implemented by independent suppliers. These operating systems are supported on the BBC micro by the TORCH MCP operating system, which also supports TORCHNET.

TORCH MCP 6502 Operating System

The TORCH MCP (Master Control Program) resides in a 16K sideways ROM on the BBC Micro board. When it is running it uses 6502 RAM up to 2F00H.

However it is possible to prevent it from claiming **any** memory if required.

MCP takes commands from whichever second processor which is fitted, and executes them. It also responds to commands sent across the network from other MCP systems as they arrive. It is possible to adjust the priority it gives to each command source.

The operations MCP performs range from simple character I/O under control of the second processor, to complex multi sector disc transfers with read ahead and write behind. Additional user defined commands can be added to MCP, and 6502 routines can be downloaded for execution if required.

If a TORCH keyboard is fitted, MCP loads the appropriate alternative keyboard drivers and performs translations so that the BBC INKEY (-ve) operations still work even though the matrix positions are different.

Although MCP provides general disc access routines (e.g. read sector) it also provides a standardised file structure for transfer of files between operating systems and use by various electronic mail services



TORCH CPN Z80 Operating System

CPN is loaded from ROM into the Z80 RAM on reset. It provides a complete emulation of CP/M in just over 1K bytes, and provides many extra features as well. Since CPN is loaded from ROM, there is no need for the wasteful system tracks which are required on CP/M discs. CPN also makes more efficient use of disc space, allowing 256 files in a directory (CP/M normally has 64) and saving on disc space usage by allocating in 256 byte granules (CP/M normally uses 4096 granules).

CP/M BDOS, BIOS and zero page entry points are supported, with the version number being returned as CP/M 2.2. Disc allocation vectors and allocation maps are also supported. CPN also supports many 'CP/M' programs which actually disobey the CP/M specification. CPN runs CP/M software better than Digital Research's own CP/M products such as CP/NET and MP/M.

Extra BDOS calls are provided to handle the network facilities of CPN, and to allow the systems programmer to write portable programs.

The TPA (Transient Program Area) available under CPN is nearly 63K.

CCCP is the TORCH equivalent of CCP (CP/M's console command processor). CCCP has many of the common commands built into it and is resident in the CPN ROM

| Some CCCP commands: | CP/M equivalent: |
|---|--|
| To copy an entire disc DUP | DISKCOPY (needs program) |
| To copy a file COPY ABC TO DEF | PIP A:ABC = DEF(OG) (requires PIP program) |
| To print a file "LETTER.LET" PRINT LETTER.LET | PIP LST: = LETTER.LET (requires PIP program) |
| To read protect a file PROTECT RAYDATA [R] | STAT RAYDATA \$R/O (requires STAT program) |
| To display time TIME | not available |
| To set up soft keys KEY 4 String a KEY 5 String b | not available |
| To call for help HELP | not available |

UCSD p-System

The UCSD p-System is a popular portable operating system which is based around Pascal. It has been implemented on the IBM

PC, Apple II, and SAGE Micros as well as on the TORCH.

The UCSD p-System was implemented on the TORCH Z80 by Microtraffic Systems Limited in 1983. Microtraffic are now implementing the p-System on the TORCH 68000. Programs from the Z80 p-System will run without change on the 68000 version.

UNIX System III

UNIX will be the most important supermicro operating system in the 1980's. Most advanced software now being developed is written in C, and will run under UNIX. UNIX is also becoming very important in Universities and Colleges because it can be used on so many different computers, and is an ideal software development environment.

TORCH's implementation of UNIX is genuine UNIX System III with the Berkley enhancements. The porting of the UNIX operating system was carried out by UniSoft Inc., ROOT Computers Ltd., and TORCH.

The running of UNIX on TORCH systems offers several significant advantages over normal systems. The inbuilt networking features of TORCH systems can be exploited by UNIX to allow the sharing of data or the use of electronic mail or printer server facilities elsewhere on a network. The provision of a Z80 and CPN on TORCH UNIX systems means that investment in older software need not be written off, since it can still be run on the Z80. Files can be transferred between the operating systems with ease, since they share the same physical hardware, and disc access is controlled through MCP.

The TORCH UNIX System III is comprehensive and complete. It is delivered on 24 floppy discs, which contain over 200 programs and utilities, and there is a full set of supporting documentation including the 3 standard Unix manuals, and descriptions of TORCH specific enhancements.

The complete UNIX pack contains a C compiler and editor, the "vi" screen editor, and the "csh" C-shell.

Languages available include Fortran 77 and Pascal. Application software is available from Pipeline Ltd., a subsidiary of Tamsys which is specialising in Unix application software.



4 SOFTWARE

For a full description of the large range of software available for TORCH Unicorn systems and TORCH professional computers, please see the TORCH Software Catalogue which is available from TORCH dealers or direct from TORCH.

TORCH System Software

Each TORCH system is supplied with a disc containing utility software. Examples of use are contained in the manuals. Programs supplied with UNICORN systems include:

POKEDISC Disc sector editor for investigation/recovery of discs

MAPDISC Displays how space is allocated on discs

FONT Allows the customisation of character fonts

MUSIC Plays tunes from text file description

COPIER Copies/Formats non standard discs (e.g. 40 track)

TORCHBUG Simple Z80 patcher/debugger

Hard Disc systems are supplied with Hard Disc backup and restore utilities, and a program to allow re-formatting of the hard disc if this is ever necessary.

TORCH Perfect Software Suite

TORCH supply a comprehensive software package with each Unicorn System. It forms the basis of a business system, and is also applicable in other fields such as research or engineering. The package has been tailored to run on TORCH Unicorn systems, and is supplied with lessons, tutorials, and comprehensive manuals.

Perfect Writer is the word processor. It is ideal for the editing of programs or text and is particularly useful for longer documents, since it automatically creates an index and a table of contents if required. Perfect Writer allows the editing of up to 7 files simultaneously, and two of these can be displayed at once using the unique split screen display.

Perfect Speller is the spelling checker associated with Perfect Writer. New words can easily be added if they are not already in Perfect Speller's 12,000 word dictionary.

Perfect Calc is a superb spreadsheet. It can handle linked spreadsheets, and its output can be fed into Perfect Writer for consolidation into a report.

Perfect Filer is a simple database which will handle most database applications. It is easy to prepare special reports and lists. Perfect Filer can be used in conjunction with Perfect Writer for mailshots and will automatically print labels from specified addresses stored in its database.

Development Software

TORCH realises the importance of software development tools on its computers. There are many languages available for CP/M systems, all of which will run on TORCH CPN, but in order to make the special facilities of the TORCH available to programmers, TORCH has arranged with suppliers of the languages to add special library routines to their products wherever possible.

TORCH would recommend ProPascal, Aztec C or BBCBASIC (Z80) for software development on Z80 systems, and C for software development under Unix.

Some of the languages available (* = special TORCH routines):

| | | |
|-------------|------------|-----------|
| COBOL | APL(*) | BCPL(*) |
| LISP | PROLOG | PASCAL(*) |
| BBCBASIC(*) | FORTRAN(*) | BASIC(*) |
| FORTH(*) | PILOT | |

For further details of these languages see the TORCH Software Catalogue.

Application Software

A wide range of application software is available for the TORCH Unicorn range:

Accounts, Modelling, Design, Costing, Viewdata, Farming, Building, Stock Control, Graphics, Electronics, Statistics, Terminal Emulations, Mathematics, Databases, Solicitors, Planning, etc. etc.

For more details please see the TORCH Software Catalogue.

General Policy

It is TORCH policy to ensure that the UNICORN range remains the best supported upgrade path for the BBC Micro. TORCH invests considerable time and money in encouraging third party software developers, and assists with the marketing of new software products.



TORCH COMPUTERS

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CP/M is a registered trademark of Digital Research.

Unix is a registered trademark of Bell Laboratories.

UCSD-p system is a registered trademark of University of California San Diego.