

FULCRUM™
COMPUTER PRODUCTS

1981

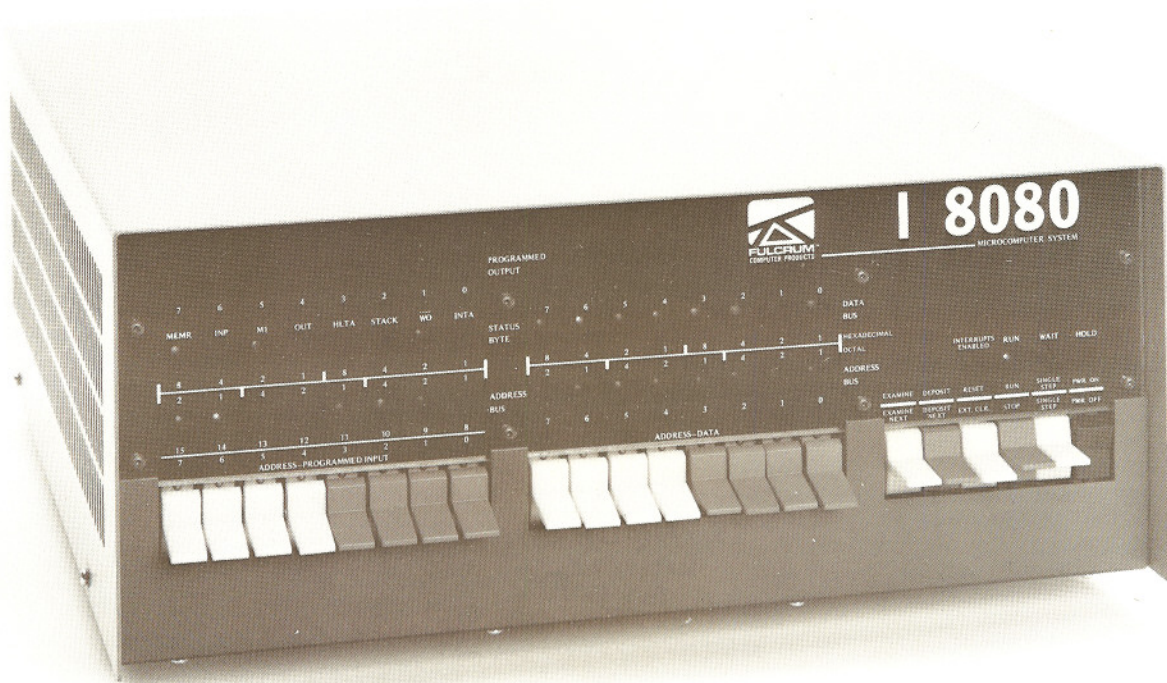
FULCRUM (EUROPE)
VALLEY HOUSE
PURLEIGH
ESSEX, ENGLAND CM3 6QH
TELEPHONE: (0621) 828763



IMSAI COMPATIBLE PRODUCTS

Fulcrum Computer Products are manufactured by WW Component Supply, Inc. in San Jose, CA. The Fulcrum product line includes a complete spectrum of IMSAI compatible S-100 microcomputer, interface, and memory boards, as well as new products for S-100 computers like the VIO-X intelligent video interface and the 488+3 GPIB I/O board.

All Fulcrum products are guaranteed for 6 months against defects in workmanship or failure.



I-8080

The standard microcomputer includes:

- Front panel and control board (CP-A)
- Chassis with 22-slot card cage
- Sturdy, attractive dust cover (DC)
- Microprocessor board (MPU-A)
- 28-ampere power supply (PS-28)
- 10 MHz 20 slot terminated Motherboard (WB20)
- Documentation

Motherboard

Card-to-card spacing on the Mother Board is $\frac{3}{4}$ -inch, except for the first position reserved for the front panel board or any other board in dedicated applications. Eight, ten, twelve and twenty slot terminated Mother Boards are available for the system, good to 10 MHz.

Heavy power traces handle the large currents that exist in a heavily loaded backplane. High-quality connectors have gold-plated contacts for reliability and long life.

Front Panel

The CP-A Board forms the operator's panel. It includes switches, indicators and logic needed for manual operation. The panel is completely self-contained and plugs directly into the first Mother Board slot. Or it may be connected through an extender board to any available slot in the Mother Board. When the first slot is not used for the front panel, that slot may be used by another board, such as the Parallel I/O Board with its LED indicators visible.

Front panel facilities include:

- 16 address/data switches
- 16 LED address indicators
- 8 LED data bus indicators
- 8 LED programmed output bit indicators
- 6 control function switches
- 8 LED status indicators (including control indicators for INTERRUPT ENABLED, RUN, WAIT and HOLD)

The front panel includes logic that drives the programmed output indicators, and reads the input byte from the high-order address switches. Data bus indicators show data being read or written by the processor.

Indicators are wide-angle LED's behind a contrast-enhancing acrylic panel assembly. Photographically produced panel markings are crisp and explicit and can never wear off. Bit positions are numbered and labeled for both hexadecimal and octal notation. Special labels may be easily inserted to identify special functions for the programmed output LED's.

Switches are high-quality units, with paddle handles color-coded for easy, error-free operation.

Power Supply

The Power Supply (PS-28) is designed for use with pc boards having on-board regulators. Outputs are +10V and $\pm 18V$ at no load, and approximately +7V and $\pm 15.8V$ at full load.

A Power Supply pc board contains rectifiers and 120V ac switching and fusing functions. The board provides terminals for switched ac power, both fused and unfused, for a ventilating fan and auxiliary power outlets on the back panel. When the computer is supplied without the front panel, an ac power switch is mounted on the Power Supply Board.

A custom-built transformer and large, conservatively rated filter capacitors are mounted on the chassis. All connections are made by molex connector.

Processor Board

The Processor Board (MPU-A) contains the Intel 8080A Microprocessor chip, clock crystal oscillator and clock drivers, status signal latches and bidirectional bus drivers, as well as on-board power supply voltage regulators.

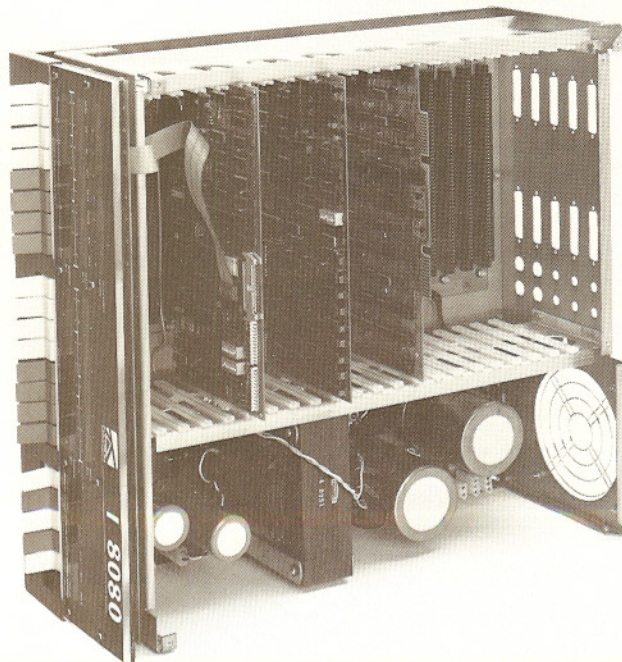
The 2-MHz, 2-phase non-overlapping clock for the processor chip is provided by an 18-MHz crystal and 8224 clock driver. An 8212 chip latches status signals. Two 8216 tri-state, bidirectional bus drivers interface the processor chip with the I-8080 data buses. Other tri-state bus drivers drive address, status and control lines.

The MPU-A board receives $\pm 16V$ and +8V supply voltages and uses on-board regulators to obtain required voltage levels.

The board edge connector has 100 pins on 0.125-inch centers, with 50 pins on each side. Except for gold-plated contact fingers, circuit traces are tin-lead plated for easier, more reliable solder connections.

The board includes a power-on reset circuit, plus pull-up resistors so that without the front panel, power-on reset will start the program at location zero.

Multiple microprocessor boards are able to share memory and run identical or different programs in parallel.



S-100 Systems

OUTSTANDING HARDWARE FEATURES

Front Panel

- Handsome and functional, with sharp, readable legends behind acrylic panel
- All indicators long-life LED's . . . panel filter enhances contrast
- Eight extra LED's programmed as an output port
- Easy-to-use paddle handle switches
- Easily customized for private labeling

Mechanical

- Sturdy card-cage construction . . . holds up to 22 cards
- Straight-through backplane design . . . no special-purpose slots
- Short backplane sections available
- Flat cable interconnections throughout
- Absolute minimum of point-to-point wiring . . . no point-to-point wiring to front panel permits easy panel removal
- Rack-mount cabinet available
- Pc boards double-sided with plated-through holes and solder mask
- Pc boards of glass-fiber reinforced epoxy laminate
- Pc board contact fingers gold-plated over nickel

Electrical

- Front panel circuits make one-shot timing links non-critical
- Latest LSI and MSI components . . . minimizes package count
- Heavy-current tri-state bus drivers

Power Supply

- Heavy-duty supply . . . 28 amperes for system expansion
- Power regulated on-board by IC devices with thermal current limits
- Generous ceramic disk power decoupling capacitors . . . dipped tantalum capacitors for board decoupling
- Completely connectorized

Cabinet

Custom aluminum and steel case with acrylic front panel

Dimensions: 19½ in. wide, 17 in. deep, 7 in. high (rack mount option available)

Front Panel Switches: Paddle handle

Power

Requirements: 120V, 50-60 Hz, single phase, less than 50 Watts (basic system)

Maximum Power Capability: Up to 500 Watts in a large system

Interconnections

Back panel accommodates ten EIA-type 25-pin connectors. Opening and cable clamp furnished for flat cables to exit from cabinet. Flat cables used throughout.

MPU-A Processor 8080A

Memory (directly addressable): 65,536 words

Word Size: One byte (8 bits)

Register Instruction Cycle Time: 2 microseconds

Basic Machine Cycle Time:

0.5 microsecond

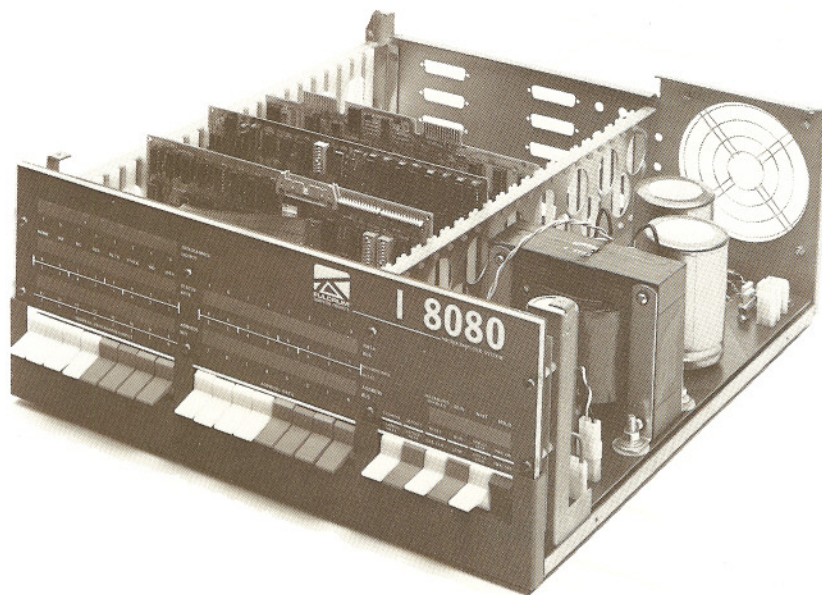
Number of Input/Output Ports: 256

Machine Instruction Set: 78 basic instructions, 174 including variants

Nested Subroutine Calls: Number limited only by memory size

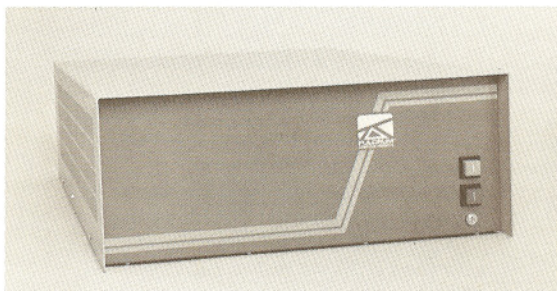
Interrupts: Eight hardware levels (with optional PIC-8 board)

Registers: Six plus stack pointer, program counter, accumulator and status register

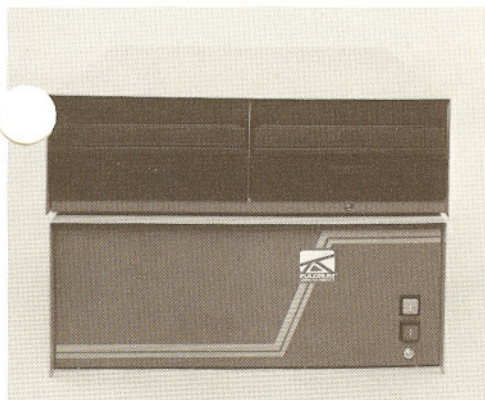


I-8015/25/30/35 Computer Systems

The I-8015 series is a stand alone business and industrial micro-computer using the S-100 bus. It includes the basic I-8080 chassis with a 10 slot terminated motherboard, 28 amp power supply, and various front panel configurations. It normally uses the MPU-B 8085 3 MHz processor card and the RAM III 64K dynamic memory with either the DIO-C or D.

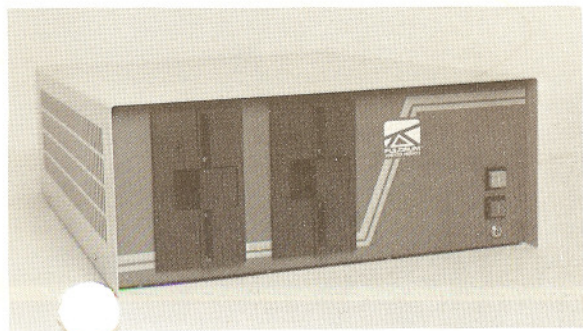


The I-8015 has a blank steel front panel with reset, interrupt, and power switches.



The I-8025 is an I-8015 with DIO-C/PDS II and the DS-8 disk drive system.

The I-8030 is an I-8015 with 5" BALL CRT mounted in the front panel for output and a VIO interface.



The I-8035 is an I-8015 with two 5 1/4" disk drives mounted in the front panel and a DIO-D/PDS-II controller set.

Multifunctional 8085 Processor Board

The MPU-B contains an 8085 microprocessor and a serial I/O interface. Some features are included or excluded from system memory under software control—three 16-bit programmable timers, 256 bytes of RAM, a 2K firmware monitor program which permits bootstrap loading from the floppy disks, and 26 other commands for stand-alone operation.

Performing 50% faster than the 8080, the 8085 microprocessor maintains or improves bus timing margins, thereby reducing critical timing requirements of RAM and other interfaces. A four-level maskable priority interrupt system, plus the regular 8085 system interrupt, enables the MPU-B to be used in sophisticated interrupt-driven systems without additional interrupt controllers. The I/O and timers included on the MPU-B can be used with the interrupts.

Intelligent Video I/O

The VIO-X is an intelligent port mapped S-100 video I/O board featuring an 8085 processor, 8275 CRT controller, and two pages of 2114 static RAM. The board features a keyboard port, light pen input, and audio output port. It includes complete firmware, composite and non-composite video output and full escape command instruction set. Video attributes include:

- FLASH
- INVERSE
- PROTECT
- UNDERLINE
- DIM

Memory Mapped Video Interface (VIO-F)

Character and line insert/delete allows fast program correction and text editing with the VIO-F. Inverse video and programable field allows highlighting or enlarging graphic information display for viewing at long distances. With EPROM, the user can control the font, and use special characters of the users own design, foreign alphabets, pictures, and forms. There are up to 256 characters, both upper and lower case.

64K Memory (RAM-III)

The RAM III board is a dynamic random access memory. This family of add-in RAM boards is specifically designed for compatibility with the special features of all I-8080/8085 computers designed with the S-100 bus. All RAM III boards come factory assembled to assure user reliability. RAM III are designated: and RAM III-64. The numbers designate the amount of memory in kilobytes. Thus, RAM III-64 offers 64K bytes of memory.

All of the RAM III boards have an access time of 375 nanoseconds and a cycle time of 500 nanoseconds. Each board contains an independent refresh element which does not interfere with normal CPU functions. Refresh will continue even when the CPU is halted. Power requirements are +8 volts at 360 milliamperes, +16 volts at 250 milliamperes and -16 volts nominal at 10 milliamps. All boards are fully burned in and tested at the factory under strict quality control.

Since all I8080/8085 computers use a 16 bit (64K) address bus, the total memory capacity is limited to 64K. The full 64K can be used in a number of flexible modes by installing one 64K RAM-III board. The RAM-III is also compatible with many 8086/8088 processor boards because of the extended address board select capability.

Disk Controller

The DIO-C/D-PDS-II disk controller board set is a high quality non-LSI design for 8" or 5 1/4" disk drives. They work with most standard models of disk drive. CP/M® 2.2 is available as an operating system for these controllers, and they will also work with IMSAI's IMDOS 2.0× software.

With CP/M® 2.2 the DIO-C will support standard single density 128 byte sector formats as well as 256 and 1024 byte sector double density, allowing over 600K bytes of data storage on a single sided 8" diskette.

Desktop Computer

The VDP-40 is a complete desktop S-100 computer with MPU-B processor, 64K RAM III, VIO-F video interface, IKB-1 keyboard, 10 slot motherboard, 9" BALL CRT, DIO-D/PDS II disk controller, power supply, and two 5 1/4" disk drives with CP/M® 2.2.

Interfaces

Serial I/O Interface

The SIO 2-2 Serial I/O Interface board contains two identical ports, each permitting the computer to communicate with most peripheral devices through an RS232 or current loop interface. The two ports are independent. Each may operate through either the current loop or RS232 mode, and will operate in full-duplex or half-duplex with all control signals.

You can run synchronous or asynchronous lines, full- or half-duplex, at any baud rate up to 9600 baud (asynchronous) or 56,000 baud (synchronous). Baud rates up to 9600 (asynchronous) or 38,400 (synchronous) are selected by jumpers on the board. Asynchronous baud rates are 75, 110, 150, 300, 600, 1200, 2400, 4800 and 9600. Synchronous rates are 1200, 2400, 4800, 9600, 19,200 and 38,400. Other rates are made possible using the SIOC board which mounts directly on the SIO board.

Control lines for each input include DSR, DTR, RTS, CTS and Carrier Detect. RS232 receivers and drivers are also provided for clocks in synchronous operations. Jumpers permit using the board as either the receiving (terminal) end of a communication line or the originating (computer) end.

Each interface is structured around an Intel 8251 USART chip. This chip allows extensive program control of I/O functions including control line and sync character selection, and error-condition sensing and recovery. The board generates interrupts for received characters, transmitter buffer empty, transmitter empty or sync character.

The board may be jumper-adapted to respond either to I/O instructions from the I-8080 system or to memory reference instructions for memory-mapped I/O.

Parallel I/O Board

Use the Parallel I/O board as a custom TTL-level interface to peripheral devices.

The board provides four 8-bit input ports, and four 8-bit output ports. Each input and output port has its own latch and hand-shaking logic for conventional parallel transfer.

Hand-shaking logic on any I/O port will generate an interrupt, with the priority level of the interrupt selected on the board. (Note that the processor will not respond to the interrupt unless the computer contains the PIC-8 Priority Interrupt board.)

The ports are addressed by four sequential addresses jumper-selected to be in the 256 I/O address space. You may also address the board with memory-mapped I/O, using normal memory read or write instructions to transfer data through the I/O ports.

The Parallel I/O board includes a set of eight LED's for each output port (32 total). You'll find this useful for debugging, monitoring system activity, or replacing the front panel in dedicated applications. Mount a photographic mask, with appropriate legends, over the LED's to form a readable display. The front panel can still be used during development by plugging it into another slot.

The board includes an IC regulator for the +5V supply, with tantalum capacitor filters on either side of the regulator. There is ample ceramic disk capacitor bypassing throughout the board.

You can take +5V power (up to 300 mA total) from the +5V and ground pins on the I/O port connectors of a fully utilized board. For each unused port, an additional 100 mA may be drawn from the board. If, for example, you are using four output ports and only two input ports, 500 mA is available from the board.

IEEE-488 & 3P

The 488+3 is designed to be plugged into one slot of a standard IEEE-696 (S-100) cardcage. It consists of two major functional blocks:

- IEEE-488 Interface
- Three parallel ports

The IEEE-488 portion of the board is designed to perform the interface function between an IEEE 488-1975/78 General Purpose interface Bus (GPIB) and the CPU. It communicates with the CPU via an input/output-mapped 8-bit data bus and provides a 16-bit bus to interface with the GPIB via buffer devices. IEEE 488-1975/78 standard protocol is handled automatically in Talker, Listener, and Bus or System Controller operational modes. Its specific IEEE-488 features are:

- Handles all IEEE 488-1975/78 functions
- Talker and listener functions (T, TE, L, LE)
- Automatic source and acceptor handshakes (SH, AH)
- Controller with pass control capabilities (C)
- System controller capabilities
- Device clear and trigger functions (DC, DT)
- Service request functions (SR)
- Parallel and serial poll facilities (PP, SP)
- Remote/local with local lockout (RL)
- Single or dual addressing modes
- Secondary addressing capabilities

The three parallel input/output ports portion of the board is designed to perform as a general purpose programmable I/O device. It has 24 I/O pins which may be individually programmed in two groups of twelve and used in three major modes of operation.

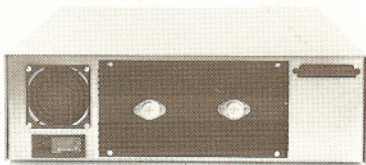
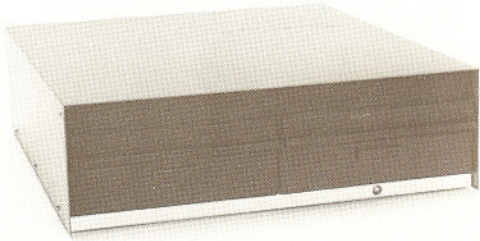
The 488+3's flexibility is enhanced by jumpers which allow the user to select input/output port addresses, interrupt priorities, etc.

The software I/O driver routines supplied with the 488+3 facilitate its use. These programs are callable subroutines for performing message handling. The manner in which they have been written allows them to be easily incorporated into a software program.

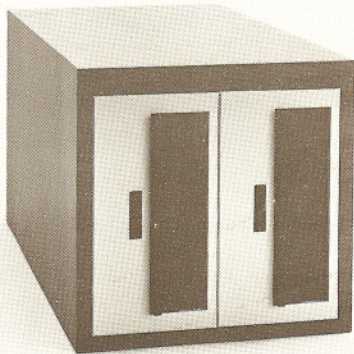
Peripherals

Disk Drive Systems

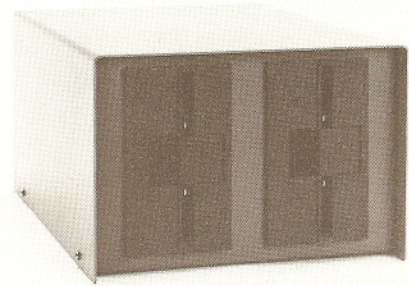
Both 8" and 5¼" dual disk drive cabinets are available with or without power supplies and disk drives.



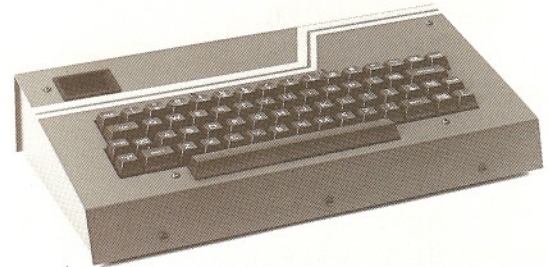
The dual 8" enclosure will hold two Shugart 801/851R drives in a horizontal configuration. The power supply features full regulation, external heat sink and 3 amp continuous rating on both the +24 VDC and the +5VDC outputs. The steel blue and grey cabinet has a 4" fan, multi-tap power connector/fuse holder, and a "Blue Ribbon" style 50 pin data connector.



A formica covered wood enclosure for Shugart 800/801 standard (not rackmount) drives is also available. It uses the same power supply as the steel 8" enclosure.



The 5¼" MDX dual drive cabinet will mount two Shugart SA-400's or two Micropolis drives. It includes a 5" fan, & 5VDC @ 3 amp and 12 VDC @ 3.4 amp power supplies. The steel cabinet is dual tone blue and grey to match the I-8080 series enclosures.



Keyboard (IKB-1)

The programmable keyboard console utilizes an 8035 control processor and a high quality keyboard array, fully debounced (to ensure that a character is printed only once each time a key is engaged). Keys are arranged in a standard tiered, typewriter layout, for operator convenience. In addition, each key stroke is registered regardless of the number of keys pressed simultaneously (N-Key Rollover). Continuous depression of a key will invoke an auto repeat function, causing a character to output continuously until the key is released. Any one key may be redefined to generate any eight bit-code under key-entry control. The user designates upper/lower case or upper case only operations.

Software

CP/M® 2.2

Digital Research's CP/M is available for the DIO disk controller on 8" and 5¼ inch formats. This operating system, unlike IMDOS allows interchange with other users and the use of thousands of standard programs and dozens of languages. Use of CP/M allows over 600,000 bytes (characters) of storage on a single sided 8" diskette and 1.2 megabytes on double sided diskettes using 1024 byte sectors. The DIO-C supports all of the features of CP/M 2.2 and provides 128, 256, and 1024 byte sector formats. With the optimized BIOS the effective load time from the diskette is significantly reduced. Multiple controllers may be supported as the DIO may be switched on or off by software command.

MP/M®

Digital Research's operating system MP/M supports hard disk, real time clock, and multi-processing operations. Contact our sales department for details. Available approximately 9/81.

EDSK

A direct disk editor for the DIO-C which allows sector data editing and recovery, sector moves, and IBM EBCDIC to ASCII translation.

EXOR

EXOR is a disk exerciser program for the DIO-C which aids the alignment of Shugart SA-800 type drives and PERSCI 277 drives. Features allow head positioning to a specific track and automatic cycling.

SDCOPY

SDCOPY allows copying and verifying from one single density disk to another using only two drives and the DIO-C. This is normally not possible as CP/M 2.2 requires a double density system disk in drive A.

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VALLEY HOUSE
PURLEIGH
ESSEX, ENGLAND CM3 6QH
TELEPHONE: (0621) 828763



1771 Junction Avenue
San Jose, California 95112

BULK RATE
US POSTAGE
PAID
PERMIT 4130
SAN JOSE, CA 95101