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**MEMOTECH**  
**MTX SERIES**



# Memotech MTX SERIES

## MTX-512 Technical Specifications

The MTX 512 is a new departure in micro computer technology. It is designed to be used in businesses, scientific fields, process control, education, home and recreation.

## HARDWARE

### Chassis

Two front-hinged black anodised brushed aluminum extrusions are separated at the rear by a black moulding.

The extrusions act as heatsinks for the voltage regulation circuitry and are secured by two matte black powder coated stamped aluminum endplates.

Dimensions in millimeters: Width 488  
Depth 202 Height 56

Dimensions in inches: Width 19.2  
Depth 7.95 Height 2.2.

Weight: 2.6 Kilograms – 5.8 pounds

### CPU Board

Mounted in the lower chassis, the CPU Board accommodates:

- Zilog Z80A CPU operating at 4MHz
- Main circuit board: Multi-Layer design
- Real Time Clock
- Video Board for television and sound signal encoding
- Video Display Processor with 16K dedicated Video RAM
- Resident User RAM is 64K
- 24K ROM containing:

**MTX Basic**, incorporating sophisticated Logo-type graphic commands

**MTX Noddy**, an easy to learn and simple to use language. With powerful interactive screen manipulation routines.

**Front Panel Display** incorporating: Z80 Register, Memory, and Program display and manipulation routines

### Z80 Assembler

### Z80 Disassembler

**Character Set** Numeric, Upper case, Lower case, and User-definable characters and User-definable sprites. International character sets are included for USA, France, Germany, UK, Spain, and Sweden.

Optional character sets for Denmark and Italy are also available.

ROM may be expanded to 72K via user transparent paging through the cartridge port (standard) or the internal bus, or within the disc based system card cage.

### Expansions

Up to two expansion boards may be added internally. These may be Memory (RAM) boards or the Communication Board.

**Memory** may be increased by the addition of RAM boards in increments of 32K, 64K, 128K, or 256K of memory to a maximum of 512K.

**Communications Board** available as an internal expansion, this board carries two completely independent RS-232C interfaces (running up to 19200 Baud) with full handshaking and modem communication lines. The communications board is required to run the **FDX, HDX, SDX** disc based systems and the MTX Node/Ring Systems.

**Node/Ring System** – Communications software and interfacing which enable the construction of the MTX Ring System. This system is interrupt driven and runs in conjunction with the communications board.

### ROM Expansion

These expansions, either via the disc drive bus or cartridge port will provide:

**MTX PASCAL**

**MTX FORTH**

**Node System Software**

Business, Education, and Games Software



### Displays

Color TV and/or Video Monitor – 40 column 24 line display as standard, with optional color 80 column expansion board. (Disc based system required)

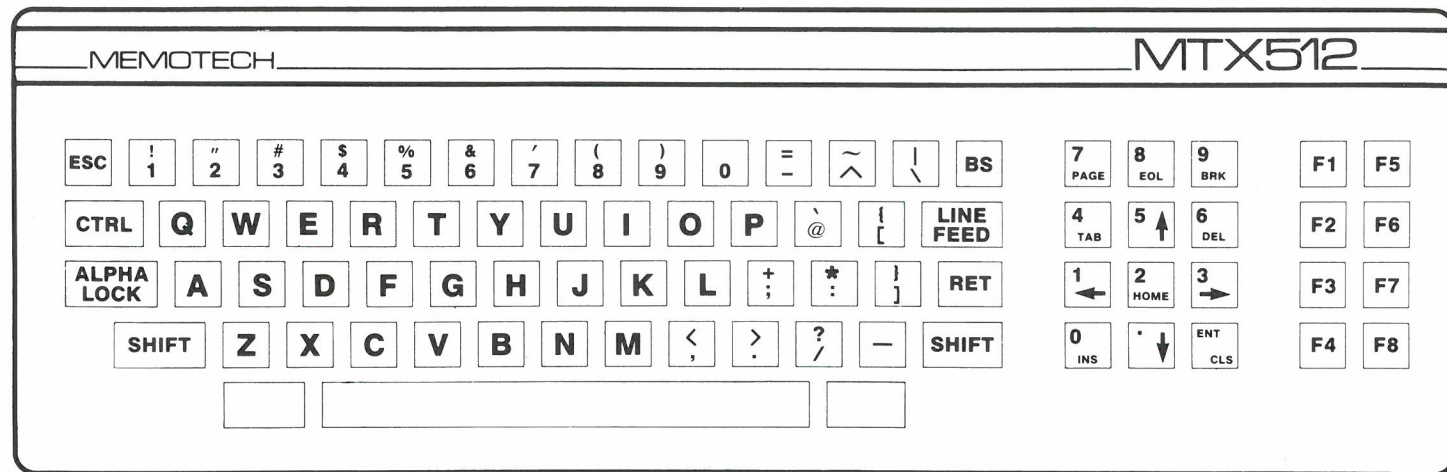
**Facilities** – Full Screen Handling  
Eight Virtual Screens – user definable

Screen formats:  
Text; 40 x 24 characters  
Text with Graphics; 32 x 24 Text with  
256 x 192 pixels with 16 colors  
**Graphics Facilities** – Up to 32 independently controlled, user-definable sprites, plus pattern plane and backdrop plane.  
High level sprite-oriented graphic commands





# MTX SOFTWARE



## Keyboard

A 1 millimeter mild steel sheet is secured to the upper chassis and supports 79 keys which are interconnected by an independent printed circuit board and arranged as:

- Standard U.S. QWERTY layout with 57 professional typewriter quality keys, standard pitch and spacing. Keys F and J are recessed for easy fingertip location. Foreign language keyboards are available.
- Twelve dual function keys are arranged as separate numeric keypad with cursor controls and editing functions.
- Eight function keys (programmable in conjunction with Shift to provide 16 user definable functions)
- Two unmarked reset keys, which must be depressed simultaneously to reset the computer
- Auto repeat on all alpha-numeric keys

## Input/Output

Provided as standard:

- Uncommitted Parallel input/output port
- Monitor output – composite video signal (1V peak to peak)
- Parallel printer port (compatible with standard Centronics-type printers)
- Television output
- Hi-Fi output
- Cartridge port
- Cassette port (variable rate up to 2400 Baud)
- Two Joystick ports with industry standard pin outs
- Four channel sound under software control – three independent voices plus pink noise output through TV speaker, or through separate Hi-Fi output.
- Optional: Communications board with two RS 232C interfaces and Disc Drive Bus

## Printers

Standard Centronics-type parallel printers  
RS232C serial printers (requires Communications Board)

## Power Supply

Input: 110 VAC 50/60 Hz (220/240 VAC 50/60 Hz available)  
Output: 22.5 VAC, 1A tapped at 18V and 9V  
Dimensions in millimeters: Width 92 Depth 110 Height 70  
Dimensions in inches: Width 3.62 Depth 4.33 Height 2.76  
Weight: 1.0 Kilogram 2.20 pounds

The PSU is double insulated and has a side mounted rocker switch which is internally illuminated when the unit is on. The main transformer is located between two groups of four anti-vibration, noise absorbing rubber mounts. Extensive strain relief mouldings are incorporated in the PSU casing to support the input and output cables. The output cable terminates in a 240 degree, six pin DIN connector. The PSU is supplied as a sealed unit.



## ■ MTX BASIC

## ■ MTX GRAPHIC COMMANDS

## ■ MTX NODDY

## ■ ASSEMBLER/DISASSEMBLER

## ■ FRONT PANEL DISPLAY

## ■ BASIC EDITOR

SOFTWARE

High Level Facilities

The MTX software can be considered as a group of independent, highly interactive modules.

MTX BASIC

The BASIC language in ROM contains standard commands, and in addition, it is extended with a number of reserved words designed to:

- a) allow easy manipulation of the display,
- b)enable a highly structured form of programming, and
- c)enable assembly language programs to be called and run from within BASIC programs.

Other facilities include reserved word abbreviations, auto scrolling and recovery from assembly program loops.

MTX Graphics Commands

Sophisticated graphics manipulation commands are incorporated, which simplify the type of programming necessary to create serious graphics and effective games applications. These commands do not replace, but are in addition to the normal graphics commands offered by BASIC such as PLOT, CIRCLE, and DRAW.

MTX NODDY

In many situations all that is required to reach an answer to a problem is to ask a series of questions where the next question depends on the previous answer. This method is used successfully in medical diagnosis. NODDY provides a very simple method of programming the computer to display information or ask questions and then move on to another display, depending on the previous response. Complete screens may be named and constructed and later called from within BASIC programs. On exit from NODDY to BASIC all NODDY screens/programs are saved intact. Coupled with the MTX ring facility, NODDY can provide an interactive two-way system, with applications in business, education and process control.

ASSEMBLER/DISASSEMBLER

An assembler/disassembler is included to enable fast and efficient development of machine code programs. The source code and object code occupy the same space in memory, allowing very compact storage of large assembly language programs. Machine code programs may be included within a BASIC program and are assembled as the BASIC program is run, allowing interaction of BASIC and machine code at a high level and avoiding the need to define fixed areas in which the machine code must reside, i.e. in REM statements or above RAMTOP.

FRONT PANEL DISPLAY

The Front Panel Display is an interactive program which displays and allows manipulation of the contents of the computer's memory and registers. It is very useful for debugging and testing machine code programs, and the display of the internal interactions of the computer while a simple program is running is an effective way of becoming familiar with assembly language instructions.

BASIC Editor

All BASIC commands can be entered by typing them in full at the keyboard. In addition reserved words may be abbreviated by typing the first letter or start of the word followed immediately by a full stop, e.g. P. is equivalent to PRINT and E. is equivalent to EDIT. Reserved words must be preceded by a non alphabetic character, and followed by character other than an alpha-numeric character. This condition on reserved words allows less restriction on the names of variables, e.g. 'TO' and 'STOP' are reserved words, but 'TOM' and 'STOPPARD' are legal variables.

If the abbreviated form of a reserved word is used, it is unnecessary to follow with a non alpha-numeric character, e.g.

if x = 5 t.g.500 is equivalent to

IF X = 5 THEN GOTO 500

BASIC lines can be entered in upper and lower case, and extra spaces are removed (subject to the reserved word condition), but when they are reprinted on the display most characters are converted to upper case. The only exceptions are after REM, or strings within inverted commas, e.g.

let a\$ = 'goto asd': rem example will be reprinted as:

LET A\$ = 'goto asd': REM example

APPLICATIONS

The MTX ROM contains the essential routines to allow a user to easily exploit the hardware facilities which are available. Some of the features are demonstrated by the following examples of uses in business, education and games.

BUSINESS

The high quality keyboard and disc operating system allow the MTX user access to the wide range of business software available under CP/M. Where necessary, the Color 80 column board can be used together with a mono or color monitor to provide a powerful business computer comparable with larger, more expensive systems.

EDUCATION

The MTX 512 is effective both in the classroom through CAI, using the Node/Ring system, and in the laboratory when utilizing the extensive I/O and system monitor facilities.

GAMES and GRAPHICS

As well as the normal BASIC graphics commands, LOGO-type commands are provided to enable the definition and animation of characters and sprites. A sprite can be thought of as a user definable character which can be moved around in front of the normal graphics display using comprehensive and powerful commands.

COMMAND WORDS

MTX BASIC

BAUD	STOP	FKEY	PLOT	SPRITE
CLOCK	VERIFY	THEN	CODE	CTLSPR
INK	CIRCLE	CONT	OFF	NODE
PAPER	ELSE	CLEAR	TO	GENPAT
EDIT	STEP	DATA	REM	PHI
GOTO	CSR	FOR	CLS	VIEW
IF	DIM	INPUT	ASSEM	RESTORE
LET	GOSUB	LIST	AUTO	ROM
LPRINT	LLIST	LOAD	VS	EDITOR
NEXT	NEW	PRINT	CRVS	DSI
NODDY	ON	OUT	ATTR	ANGLE
PLOD	PANEL	POKE	COLOUR	SBUF
PAUSE	RETURN	READ	ADJSPR	ARC
RAND	SAVE	SOUND	MVSPR	LINE
RUN	DRAW			

MTX OPERANDS	MTX FUNCTIONS	MTX STRINGS
+	AND	CHR\$
<=	INP	LEFT\$
-	ABS	ASC
<>	EXP	RND
*	SGN	NOT
/	TAN	COS
^	VAL	INT
=	PI	PEEK
>	OR	SQR
<	ATN	USR
>=	LN	LEN
	SIN	MOD

MTX Graphics Commands

CLS

Clears the graphics (and text) screen

CSR x,y

Cursor Positioning  
x,y must be in the range 0 to 255. This function does not change the cursor state but moves the stored print position to x,y

CRVS n,t,x,y,w,h,s,

Creates a Virtual Screen  
n is the screen number in the range 0 to 7  
t is the screen type. Currently two screen types are defined:  
0 = text screen, 1 = graphic screen  
x is the x origin i.e. the horizontal distance, in character blocks, from the top left-hand corner of the screen  
y is the y origin i.e. the vertical distance, in character blocks, from the top left-hand corner of the screen  
w is the number of characters on a line. This can be greater or less than the screen width  
h is the number of lines of width w  
s is the distance, in characters, from the start of one line to the start of the next. If 0 is input, s defaults to the screen width.  
The virtual screen default for color is white ink on black paper.

VS n

Calls a Virtual Screen  
Switches to virtual screen n; n must be in the range 0 to 7

PAPER n

Selects paper color

INK n

Selects ink color  
n must be in the range 0 to 15 for all color commands

COLOR p,n

Specific color definition  
n defines the color  
p is the control parameter  
p = 0 Print paper  
p = 1 Print ink  
p = 2 Non-print (i.e. plot) paper  
p = 3 Non-print (i.e. plot) ink  
p = 4 Defines border color

- Two sets of colors can be defined
- The print colors refer to the colors used when characters are printed
  - The non-print colors (i.e. plot colors) refer to two things:
    - The colors used when plotting points, and
    - The colors used on the screen when spaces are printed implicitly, i.e. during CLS, insert line and erase to end of line

ATTR p,state

Character Attributes  
state 0 switches off ATTR  
state 1 switches on ATTR  
p is the control parameter  
p = 0 Inverse print attribute  
p = 1 Overprint attribute  
p = 2 Unplot attribute  
p = 3 Overplot attribute

PLOT x,y

Plots a pixel and also sets stored plot position co-ordinates

LINE x,y, x',y'

Draws a line from x,y, to x',y' and does not change stored plot position co-ordinates

CIRCLE x,y,r

Draws a circle with center x,y, radius r, and does not change stored plot position co-ordinates

ANGLE x

x in radians  
Sets absolute angle to x radians. The angle is orientated using standard polar co-ordinates

PHI x

x in radians  
Adds an angle of x radians to the current angle

DRAW x

Draws a line of length x from the current stored plot position along a previously defined angle, and updates the stored plot position

ARC x,theta

Draws an arc of length x while turning through an angle theta. The start position is the stored plot position and initial orientation is the current angle. Updates stored plot position and current angle.

SPRITES

Up to 32 sprites, numbered 1 to 32

CTLSPR p,x

p is a control parameter controlling either speed, distance moved, number of sprites, number of circling sprites, plot sprite number, number of moving sprites or magnitude/size of sprites.  
x must lie within the range of p

SPRITE n,pat,xp,yp,xs,ys,col

n is the sprite number  
pat is the pattern number  
xp is the x axis position of the center of the sprite  
yp is the y axis position of the center of the sprite  
xs is the sprite speed in the x axis direction  
ys is the sprite speed in the y axis direction  
col is the sprite color  
Sprite co-ordinates are absolute and ignore virtual screen origins

MVSPR p,n,d

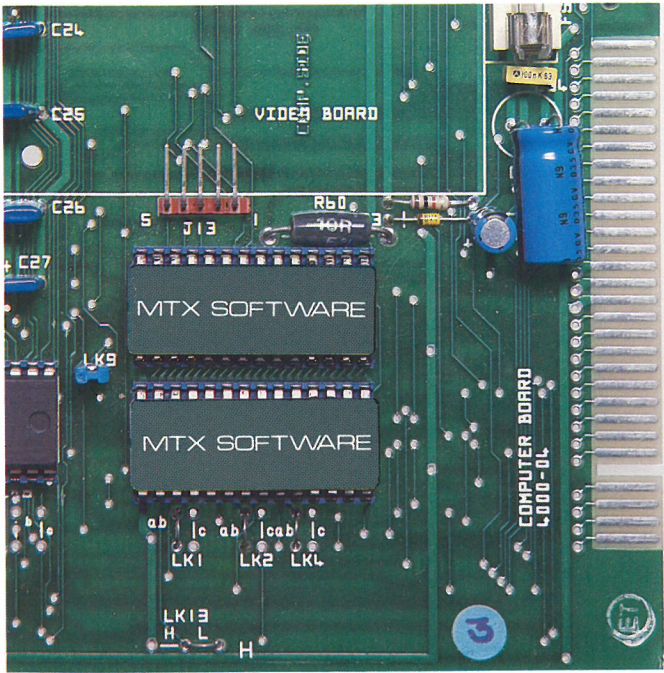
Moves a sprite  
p is the control parameter  
bit 0 means move sprite  
bit 1 means rotate sprite  
bit 2 means redirect sprite  
bit 3 means plot a point at sprite center  
p is a complete parameter made up of bits as above  
i.e. 10 (binary 1010) rotates sprite and plots a point at sprite center (bit 1 plus bit 3)  
n is the sprite number  
d is the sprite direction



**ADJSPR p,n,v**  
Alters previously defined sprite  
p is the control parameter  
p = 0 Pattern change  
p = 1 Color change  
p = 2 Redefines x position  
p = 3 Redefines y position  
p = 4 Redefines x speed  
p = 5 Redefines y speed  
n is the sprite number  
v must lie within the range of p

**VIEW direction, distance**  
Controls the position of the display over the larger virtual graphics screen, which is 4095 x 4095 pixels

**GENPAT p,ch,8 bytes**  
Generates a sprite pattern  
p is the control parameter  
p = 0 Bytes are input in ASCII code  
p = 1 User defined graphics  
p = 2 User defined graphics color  
p = 3 Defines 8 x 8 sprite pattern  
p = 4 Defines top left quadrant of 16 x 16 sprite  
p = 5 Defines bottom left quadrant of 16 x 16 sprite  
p = 6 Defines top right quadrant of 16 x 16 sprite  
p = 7 Defines bottom right quadrant of 16 x 16 sprite  
ch must lie within the range of p



MTX Graphics Functions

**SPK**  
Peeks the character at current cursor location

**GR\$ x,y,b**  
Reads bits directly off the screen  
x,y are co-ordinates on the virtual graphics screen (4095 x 4095)  
b is the number of vertical bits read in a downward direction

**DSI**  
Direct screen input  
Allows the user to roam about freely within the screen, ending when carriage return is pressed. Control W tabs back, Control A switches the cursor on, Control \_ (underline) switches the cursor off, Control D changes paper color, Control F changes ink color, ESC I inserts, ESC J deletes, ESC K duplicates a line.

**FRONT PANEL DISPLAY Commands**  
B followed by Y (i.e. BASIC, then Y/N) returns user to BASIC  
C clears the List screen  
D displays memory in hexadecimal  
G (go) runs a block of code defined by the user  
I cycles the display between ASCII characters or machine code values currently in memory  
L lists memory contents from a given hex address  
L. lists memory contents from current Program Counter address  
M moves a block of memory to a given address  
R alters contents of a given Register  
S single steps through code from current Program Counter address  
T as above but treats Calls as one instruction  
X displays alternate Register set  
= moves Register cursor  
- moves memory display cursor backwards  
<enter> moves memory display cursor forwards  
↑ moves display up  
↓ moves display down  
<brk> stops a program and displays register contents

**MTX ASSEMBLER Commands**  
The assembler is invoked by typing ASSEMBLE line number e.g. ASSEMBLE 100 or ASS. 100 This tells the computer to insert a CODE line at BASIC line 100 . . . the word ASSEMBLE will appear at the bottom of the screen.  
To insert code type <return>. The instruction occupying the location of the current BASIC line will be displayed. This can be overwritten, or retained by pressing <return>. To exit press the CLS key followed by <return>.  
E (line number) allows you to edit the line number entered  
L (line number) lists from the line number entered  
T. moves to top of code  
T. <return> followed by L. lists from top of code. Pressing <page> will temporarily halt listing  
P. prints to printer  
B returns to BASIC and assembles the code



FDX,  
HDX,  
SDX.

MTX DISC SYSTEMS



MTX SERIES DISC BASED SYSTEMS

The MTX computers support a range of mass memory storage devices using one of two types of disc systems. These are the

FDX Floppy Disc System

and the

HDX Winchester Disc System

Both of these systems require the Communications Board expansion within the MTX computer. Both systems have the following features:

A 19 inch wide chassis comprised of four black anodised brushed aluminum extrusions, containing a card cage which accommodates:

- Computer expansion board
- Color 80 column board
- Four Silicon Disc memory boards
- Floppy disc controller board

An integral power supply which also powers the MTX computer. Inputs 110/115 VAC 50/60Hz. (Optional 240/220 VAC 50/60 Hz) Parallel port for Bus expansion

Two slots are provided on the front face for horizontally mounted five and a quarter inch disc drives

Optional battery backup facility

Digital Research Inc. CP/M 2.2 operating system license is stand-

ard with every **FDX** or **HDX** system.

Color 80 Column Board

Mounted in the **FDX** or **HDX** systems, the board permits the use of color programs requiring an 80 column screen running under CP/M 2.2, such as Color Wordstar, Color SuperCalc, etc.

80 Column Board – Input and Output

RGB monitor output with selectable positive/negative sync. Monochrome composite video output, 1V peak to peak, negative sync.

Light pen input

Single channel sound

SCREEN DISPLAY FORMATS

Text 80 columns x 24 lines

Graphics Mode 160 x 96

Two 96 element character sets with true lower case descenders

4K ROM based graphics characters

Teletext compatibility

High speed glitch-free screen update (average 25,000 baud)

Color 80 column board provides a complete emulation of a CP/M terminal via ROM software, and features:

Full cursor control

Vector plot, point plot

Powerful editing facilities with screen dump

Complete attribute control for color and monochrome displays

Color	Monochrome
-------	------------

- |         |            |
|---------|------------|
| White   | Flash      |
| Red     | Underline  |
| Green   | Background |
| Blue    | Bright Up  |
| Yellow  | Reverse    |
| Magenta |            |
| Cyan    |            |

FLOPPY DISC CONTROLLER BOARD

This board uses the full Western Digital 1791 chip set and supports most CP/M floppy drives, types 0 to 13, which range from single sided single density five and a quarter inch floppies to double sided double density eight inch floppies, using SASI (Shugart) standard interfaces. Any combination of four SASI compatible drives can be controlled. The WD 1791 controller set together with a bipolar DMA controller provides a high speed processor interface minimizing latency and facilitating rapid data transfer especially on high capacity discs. Variable and fixed write precompensation is software selectable. Bus extenders permit the connection of external floppy drives.

CP/M DRIVES SUPPORTED

Controller: SM2 FDCX1

Number of Drives: 4

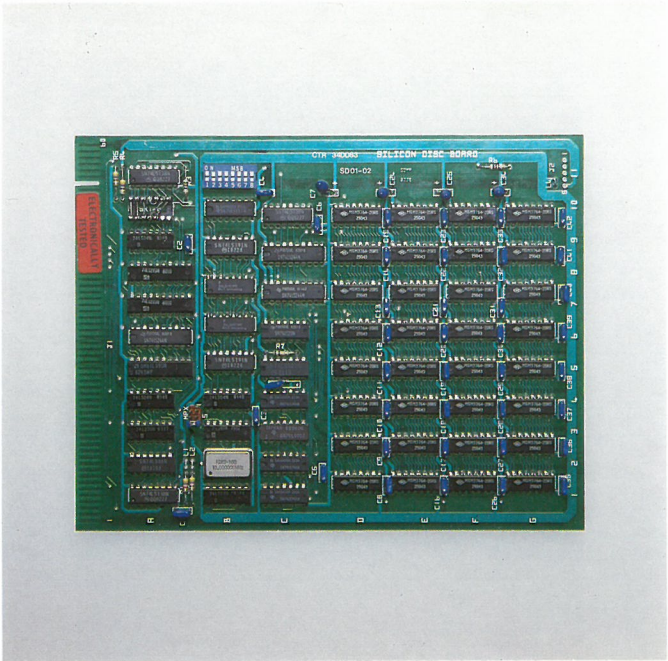
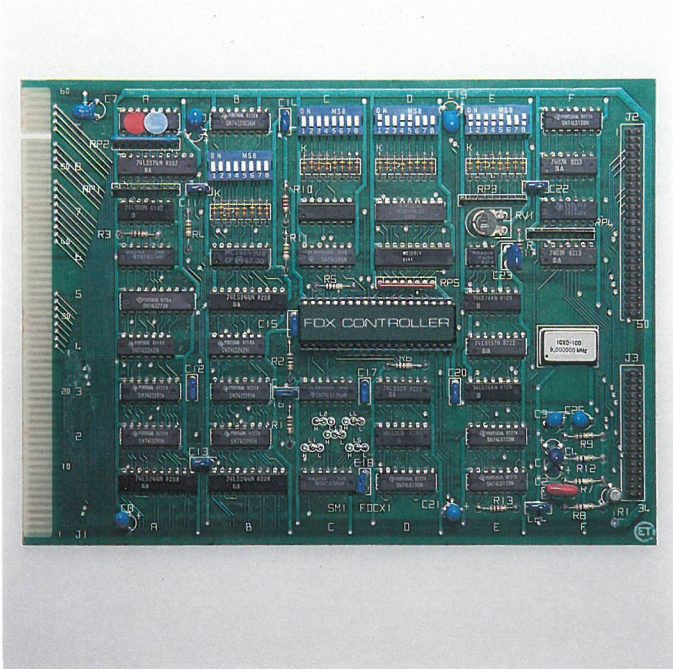
Prom Size: 4K Bytes

Config Codes Supported: 0,1,2,3,4,5,6,7,10,11,12,13,

Physical Disc Format Table

Config. Code		Drive Hardware	Physical Format
00 5"	*S,*T	16 x 128B S/D	s.p.t. 40Tk
01 5"	D/S,*T	16 x 128B S/D	s.p.t. 50,S1
02 5"	*S,*T	16 x 256B D/D	s.p.t. 40Tk
03 5"	D/S,*T	16 x 256B D/D	s.p.t. 50,S1
04 5"	*S,D/T	16 x 128B S/D	s.p.t. 40Tk
05 5"	D/S,D/T	16 x 128B S/D	s.p.t. 50,S1
06 5"	*S,D/T	16 x 256B D/D	s.p.t. 40Tk
07 5"	D/S,D/T	16 x 256B D/D	s.p.t. 50,S1
10 8"	*S IBM	3740 26 x 128B S/D	sectors per tract 77Tk
11 8"	D/S only IBM	3740 both sides 77 Tk	
12 8"	*S IBM System	34 26 x 128B S/D TkO, 26 x 256B D/D Tk 1 ..76	
13 8"	D/S only IBM	34 26 x 128 S/D Tk, SO; 26 x 256B D/D all other Tks	

\*S means double or single sided – \*T means Double or Single Tract Density



SILICON DISC

These are a quarter or one megabyte fast access RAM boards which are full emulators of CP/M drives 0 to 13. Four Silicon Discs may be mounted within the HDX or FDX chassis, providing from one to four megabytes per card frame. However, the Silicon Disc controllers can supervise four logical drives, of up to eight megabytes each giving a maximum silicon storage of 32 megabytes. This is in addition to the 4 five and a quarter and/or eight inch conventional floppy disc drives handled by the floppy disc controller board. Numerous advantages include:

Speed – up to five times faster than a Winchester disc, and fifty times faster than a floppy disc.

A dramatic increase in efficiency of proven eight bit CP/M software to 16/32 bit software levels, obviating the need for complex and costly memory management techniques

Permits single floppy disc CP/M system which is ideal for database manipulation, word processing and compilation.

Greatly reduces disc wear and prolongs life to mechanical disc drives, enhancing reliability especially in disc intensive transactions.