INTRODUCTION

With the introduction of the P2000C Portable Computer it is now possible to have a complete computer system in one easily movable package; including the keyboard, a monitor and two floppy disk drives.

With the possibility to operate in either 8 or 16 bit modes the P2000C combines the latest in computer design techniques. Flexibility in hardware and software configuration and the availability of extensive system reference documentation have produced a fully open architecture.

The P2000C is intended for business professionals of large and small companies, for small businesses, science and industry and for the dedicated home computer enthusiast.

The main operating system is CP/M* version 2.2 supplied with specially designed Philips utilities for disk handling (format, copy) hard disk backup and system configuration.
An alternative operating system, p-System**, supporting the UCSD PASCAL and FORTRAN-77 programming languages, is also available.

For 16 bit operation the MS-DOS# version 2.11 operating system is used with the 8088 CO-POWER Board.
This is supplied with a range of MS-DOS oriented utilities.

A configuration program, part of the system software, allows users to design their own disk, keyboard, video and printer tables and to integrate any combination of these tables into specific configurations. From the complete internal character set, a set that suits the user's particular needs can easily be configured at any time.

*)   Trademark of Digital Research Inc.
**)   Trademark of Softech Microsystems
#)   Trademark of Microsoft Corp.

SYSTEM CHARACTERISTICS

Main Features

The main features of the P2000C range of 'compact' computers are:

- 8 or 16 bit operation
- limited IBM PC compatibility with 8088 CO-POWER Board fitted
- compact design
- portability
- dual processor Z80A 4 MHz, 64 KB CPU RAM
                             32 KB VIDEO RAM
- built in 9" monochrome (green) CRT antiglare
- 320 or 1280 KB mass storage (two built in 5¼" floppy disks)
- choice of operating systems
- 1 free slot for:
  . 8088 CO-POWER board (16 bit operation or CP/M RAM disk) or
  . 256 KB Memory board (RAM disk) or
  . IEC/IEEE bus interface
- 16 KB ROM comprising:
  . 4 KB Monitor (with built in debugger)
  . 8 KB terminal software
  . 4 KB character generator
- SASI interface (for hard disk)
- connection for external floppy disk drives
- connection for 12" additional monitor (so called slave monitor)
- two graphics presentations:
  . medium resolution (256 x 252 pixels - 4 grey shades)
  . high resolution   (512 x 252 pixels)
- professional keyboard, including:
  . alphanumeric pad (59 keys)
  . function pad   (15 keys)
  . numeric pad   (19 keys)
- data communication interface (75 - 19200 baud)
- large character set - each key freely programmable

Built up on two printed circuits, one being the 'computer' and the other the 'terminal', and integrated with the built in monitor and disk drives, the P2000C comes as a complete system but allows additional units to be connected. Peripheral devices that may be added include:

- printer
- external monitor
- V24 communication device (modem)
- hard disk via SASI
- plotter

Choice of Three Models

Three models of the P2000C are available, ensuring that every customer can find a system that is adequate for his present needs. The important characteristics of the three models are given below.

P2010   2 x Z80A - 4 MHz
           64 KB RAM user memory (plus 256 KB RAM disk - optional)
           32 KB RAM video memory
           2 x 160 KB floppy drives
           1 extension slot (suitable for Memory Extension or
                             IEC/IEEE interface)
           CP/M operating system

           This model will suit users with modest disk capacity requirements.

P2012   2 x Z80A - 4 MHz
           64 KB RAM user memory
                     (plus optional 256 KB RAM disk Memory Extension board or
                      128, 256 or 512 KB RAM disk 8088 CO-POWER board)
           32 KB RAM video memory
           2 x 640 KB floppy drives
           1 extension slot (suitable for Memory Extension, 8088 CO-POWER or
                             IEC/IEEE interface)
           CP/M operating system

           This model offers a bigger floppy storage capacity.
           It can run CP/M or p-System programs although p-System does not
           support 8088 CO-POWER board as RAM disk.

P2009   2 x Z80A - 4 MHz
           64 KB RAM user memory (plus 256 KB RAM disk - optional)
           32 KB RAM video memory
           1 x 640 KB floppy drive
           1 extension slot (suitable for Memory Extension, 8088 CO-POWER or
                             IEC/IEEE interface)
           CP/M operating system

           This model can run CP/M or p-System programs.
           A 10 MByte hard disk can be built-in for applications with larger
           storage capacity requirements.

For industrial and scientific measurements, control and testing; it is possible to fit the IEC/IEEE bus interface to all models. This will occupy the extension slot and preclude the use of the Memory Extension or 8088 CO-POWER board.

System Software

The popular CP/M 2.2 operating system, as supplied with the basic machine, includes a variety of CP/M standard programming and specially designed P2000C operating utilities. If the 8088 CO-POWER Board is fitted the MS-DOS version 2.11 operating system can also be used.
This is described in more detail further on.

- CONFIG. Designed for easy and flexible system configuration.
  For more demanding applications, the software can be custom configured by defining new keyboard, disk, printer and screen tables.
  Printer and Communications interface can be set to support transmission speeds from 75 to 19200 baud.

- UTIL.# This program is used to format floppy and hard disks and to copy disks. Disk formats from other P2000 computers are also copyable to enable data transfer.

- BACKUP.# Used to backup and restore hard disks on 5¼" floppies.

- other programs available run with CP/M to support MS-DOS

- PIP and STAT. CP/M standard utilities for file and disk organisation.

- LOAD, SYSGEN, ED, ASM, XSUB, SUBMIT, DUMP, DDT. CP/M standard programming utilities.

  # = CP/M system only

User memory layout: 1 KB BIOS
                      4 KB CP/M BDOS
                     59 KB TPA

A wide range of software is available for the CP/M operating system. This includes application program like:

- spreadsheet packages
- database managers
- word processors
- business graphics
- languages
- utilities and tools
- financial packages
- custom designed programs
- data communications packages
    ° asynchronous e.g., TTY or VT-100
    ° synchronous e.g., 2780/3780 or 3270 series

Documentation

For technical information on the CP/M Operating System the:

   CP/M Reference Manual (order number - 5103 993 11921) is available.

Even more information on the hardware itself can be obtained from the:

    System Reference and Service Manual (P2599).

This manual includes more on the BIOS, peripherals, circuit diagrams and descriptions and the spare part catalogue. It also describes the maintenance program and contains the Maintenance Disk.

The P2000C is delivered complete with the CP/M User's Guide, which explains the essentials of using CP/M, and the Hardware Operator Manual.

An MS-DOS User's Guide will also be available.
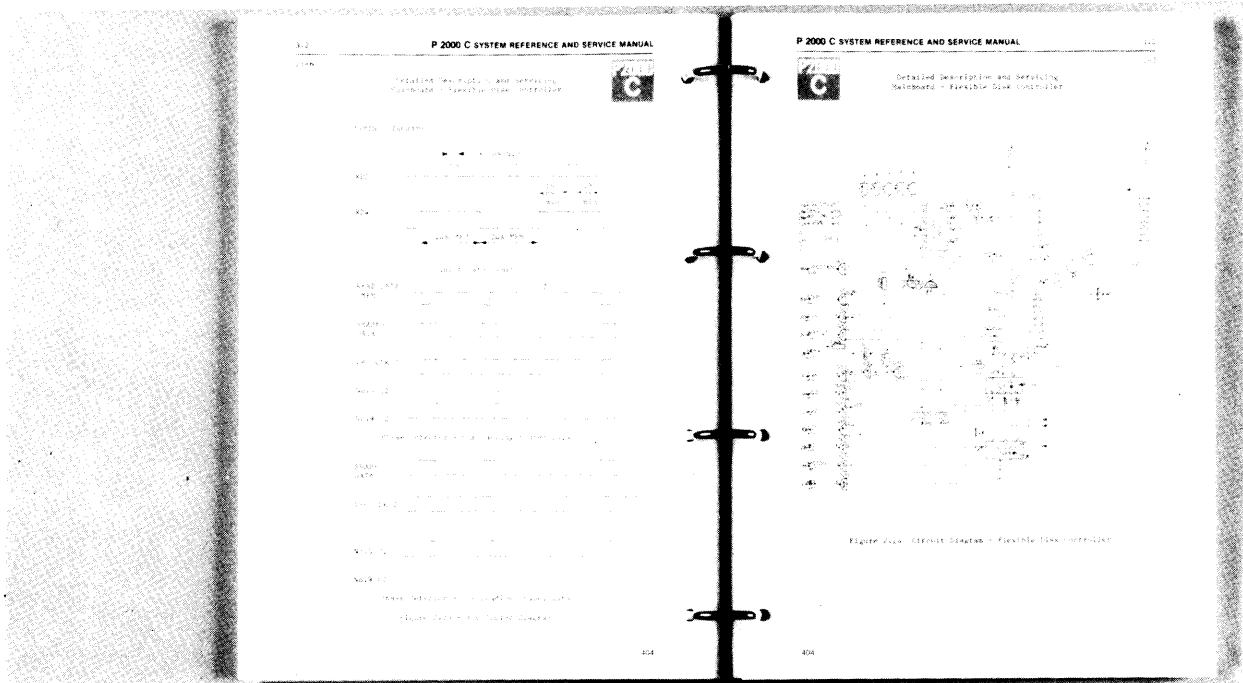
System Architecture

The P2000C consists of the following main units:

- power supply unit and distribution board
- mainboard
- terminalboard
- 9" monitor
- one or two 5¼" flexible disk drives (160 KB or 640 KB)
- keyboard

With the exception of the keyboard, all units are contained within the main casing.

The system architecture is shown in figure 1.
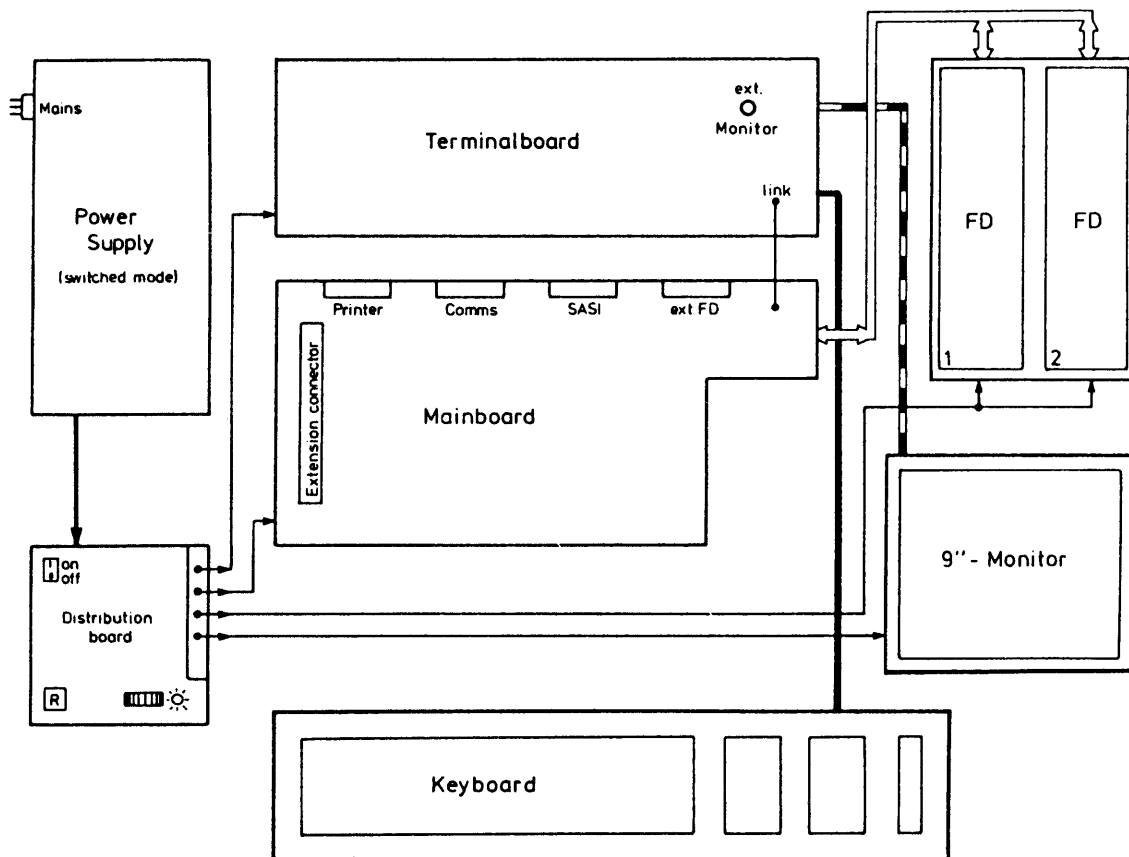
Figure 1. P2000C - System Architecture

Mainboard
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The P2000C Mainboard, which can be used with an external terminal in lieu of
the built in terminalboard, is built around the Z80A processor. It operates at
4MHz when working with RAM and is switched to 2 MHz when working with
additional ROM.
For enhanced data transfer rates, an Intel 8257 Direct Memory Access controller
is used.

Initial program loading is carried out from the IPL ROM, mounted on the
mainboard, which in turn reads the operating system from the designated 'A'
drive. In the event of the system being unable to read in the operating system,
a built in DEBUGGER is available which allows short checks to be performed on
memory, ports, floppy disk, hard disk, video, keyboard and printer.

The random access memory consists of a 64 KB array of HM 4864-2 memories.
Memory management is used to control switching between internal ROM and ex-
ternal RAM and for switching over between internal RAM and the IPL ROM. For
external RAM access, the memory management is handled by external hardware.

In addition to the interface to the terminalboard, the mainboard also handles
the interfaces to a printer, a communications device, external floppy drives
(two additional drives may be connected) and the SASI interface to a maximum of
7 devices (8 bit parallel bus).

Two 4 channel Z80A CTCs, (Z8430A), are used as baudrate generators and as in-
terrupt controllers for the system timer and non-Z80 devices.

The P2000C has three fully duplexed serial channels.
Terminal and communication interfaces are controlled by a Z80A SIO (Z8440).
The printer interface is controlled by an Intel 8251A USART.

A free slot is available which allows the addition of either the 8088 CO-POWER
board, the IEC/IEEE bus interface or the memory extension board.
An important use of the memory extension and the 8088 CO-POWER board in the
CP/M environment is as RAM floppy, giving fast access to a mass storage medium.

Terminalboard

The P2000C Terminalboard, ·which can be used as an external terminal, is built around the second Z80A processor.
It carries out the following functions:

- control of the monochrome monitor
- scanning of the keyboard
- control of the beeper

Terminalboard memory consists of 32 KB of RAM (in two banks of 16 KB) and 8 KB ROM.
RAM Bank0 is used as video refresh memory, and is 2, 4 or 8 KB (selectable).
The remaining RAM is used by the CPU (buffer, downloaded IPL, stack etc.).
RAM Bank1 is used either as attribute memory or as graphic memory.

P2000C image representation may be:

- alphanumeric with 5 attributes
- medium resolution graphics (4 grey shades) with alphanumeric representation
- high resolution graphics with alphanumeric representation

Attributes (normal alphanumeric representation only) are:

- underlined
- blinking
- inverted
- bright 0
- bright 1 .. bright 0 and bright 1 are decoded
                to give 4 brightness levels

Screen size may be:

- 24 lines by 80 characters (CP/M) or
- 25 lines by 80 characters (MS-DOS)

Note: 25 line MS-DOS requires version 1.3 or later of the terminal ROM.

The character generator ROM contains dot information for 256 characters, including all ASCII characters and mosaic graphics.

If RAM Bank1 is used as graphic memory, there are two possible methods:

- HIGH   resolution graphics with 512 x 252 dots
- MEDIUM resolution graphics with 256 x 252 dots

The V24/Internal interface (the interface with the Mainboard) is controlled by a USART 8251A. The internal link is at TTL level; the V24 connnection (when the Terminalboard is used as a stand-alone terminal) is buffered by open collector drivers.

The CRT Controller is an MC 6845, which generates all the signals required for controlling a monitor. The video refresh addresses given by the CRTC are only used to control the alphanumeric characters and attributes.

The lightpen circuit of the CRTC is used in the P2000C for interrogating the keyboard scan logic, reducing the number of connections between the keyboard and the terminalboard to six.

The Terminalboard also includes a Z80A CTC, (Z8430A), used for USART CLOCK, transmit and receive functions and keyboard handling.

Keyboard

The keyboard has been specially designed for the P2000C, with particular
attention having been paid to the ergonomic requirements of the professional
user. It is a low profile unit with sculptured keys on the typewriter section
and has separate function and numeric pads. An LED is incorporated in the
'shift lock' key to indicate that the keyboard is in the shift lock mode.
The keyboard is separate from the main unit and connected by a coiled cable. It
contains only the keyswitch matrix and a few TTL packages.

For transportation the keyboard fits inside the facia of the main unit and is
secured by the carrying strap. The keyboard connecting cable is stowed, with
the mains cable, in a compartment at the back of the unit.

Although the keyboard is obtainable in various language versions, the
electronics of each is identical and only the key-tops differ. The adaption of
the basic keyboard to meet national requirements is carried out by the use of
the Keyboard and Video tables. This is detailed in the CP/M Configuration
Program (part of the System Software).

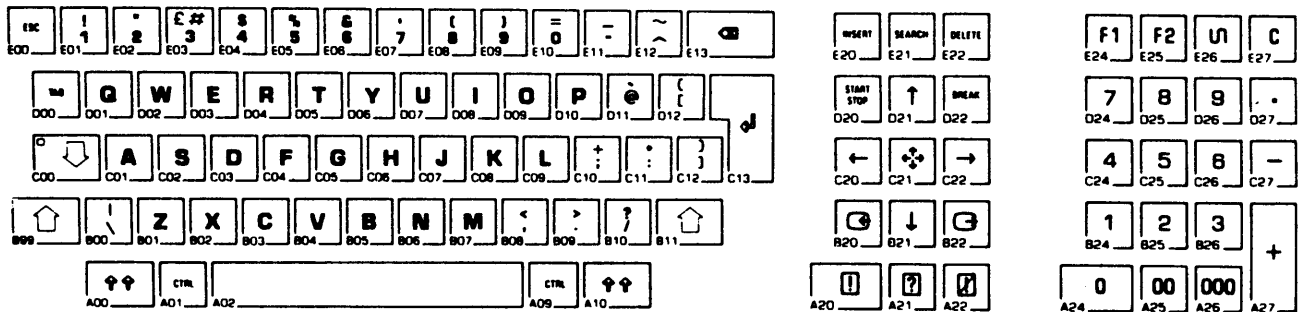Figure 2 shows a typical (United Kingdom) keyboard layout.

Figure 2 P2000C Keyboard - United Kingdom Version

Monitor

The P2000C incorporates a 9" monochrome (green) monitor, with an antiglare screen. The monitor produces a distortion free display from edge to edge that is 'easy on the eyes'. The brightness is adjustable from the front panel to suit the display to ambient lighting conditions.

An external 12" monitor can be connected.
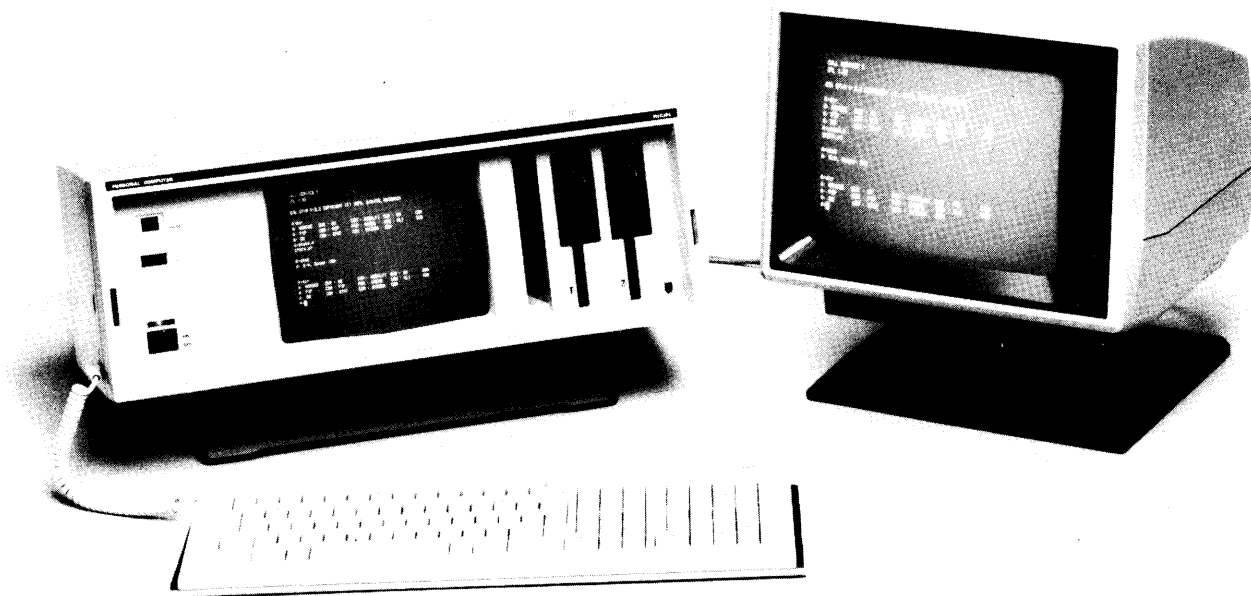
Disk Drives

The Flexible Disk Drives fitted to the P2000C are 5¼" slim line drives.
The two versions that will be available are:

- 160K Single Sided, single track density (48 tpi)
- 640K Double Sided, double track density (96 tpi)

Two additional (external) drives can be connected.

IEC/IEEE Bus Interface P2091

The P2091 IEC/IEEE bus interface represents a version of the Standard Digital Interface for Programmable Instrumentation according to the IEEE Std 488-1975, and deals with the interconnection of programmable electronic measuring devices under control of the P2000C.

The main properties of the P2000C IEC/IEEE bus interface are as follows:

Completely complies with IEEE 488 and IEC 625 standards.

Connection of up to 15 devices (in addition to the P2000C).

A maximum overall distance between P2000C and the furthest device of 20m.

Byte serial, bit parallel, data transfer.

Multiplexing of addresses, commands and data.

8 data bus lines.

8 control bus lines - (3 for bus transfer, 5 for bus management).

Standard codes for addresses and commands (ASCII or ISO 7 bit code).

Transparent data transfer.

Asynchronous communication (handshake).

The IEC/IEEE bus interface allows the P2000C to be incorporated into a system in the following roles:

- system controller
- controller
- non-controlling device
- analyser/bus controller

Important features of the IEC/IEEE bus interface are:

- able to pass/receive control
- supports serial polling
- supports interrupts on IFC, EOI and SRQ
- supports secondary addressing
- incorporates programmable terminator handling

Physical aspects include:

- individually programmable bus lines
- hardware interrupt

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IECBASIC

The IEC/IEEE bus interface is supplied with an extended IEC/IEEE MBASIC. This makes it easy for the industrial or scientific user to write the programs he needs without having to master Assembly programming or the technical details of IEC/IEEE hardware.

The features of IEC/IEEE extended BASIC are:

- The IEC/IEEE bus statements are fully integrated
  into the Standard Microsoft BASIC Interpreter, so
  low level language need not be used at all.

- Easy-to-program macro statements are used.

- The P2000C IEC/IEEE software distinguishes between
  system controller, controller and non-controller.

- IEC/IEEE addressing is both primary and secondary.

- Polling and service request facilities work with
  P2000C as controller or device.

- Specific instrumentation functions are available
  like CLEAR, TRIGGER, LOCAL LOCKOUT, LOCAL, REMOTE -
  all either general or addressed.

- Transfer control.

- Variable input/output formats
                        (block/record separators).

- BASIC interrupt subroutines
                        (on IFC, SRQ, EOI GOSUB).

Memory Extension P2092 (for P2010 and P2012)

The P2092 Memory Extension option provides the user with an additional 256 KB of RAM, which may be 'used as RAM Floppy (or cache-memory).

The board occupies the extension socket on the mainboard.
In the Cache Mode, the user has 15 additional banks of memory available, each covering 16 KB. Each bank can be individually addressed.

The Cache Memory can be visualised in the following way:

> For each of the 15 memory banks, the lower addresses (from 0000H to 3FFFH) are common, allowing data to be effectively 'carried over' to different programs. This area is used as the directory area when the RAM Floppy is implemented.

> For each of the 15 memory banks, the upper addresses (from C000H to FFFFH) are part of the main memory, allowing data to be 'carried over' to and from main memory routines.

> For each of the 15 memory banks, the addresses from 8000H to BFFFH do not exist and any attempted access to these addresses while in the Cache Mode will give undefined results.

> For each of the 15 memory blocks the 16 KB between 4000H and 7FFFH are available to the user. These areas are used to store files when the RAM Floppy is implemented.
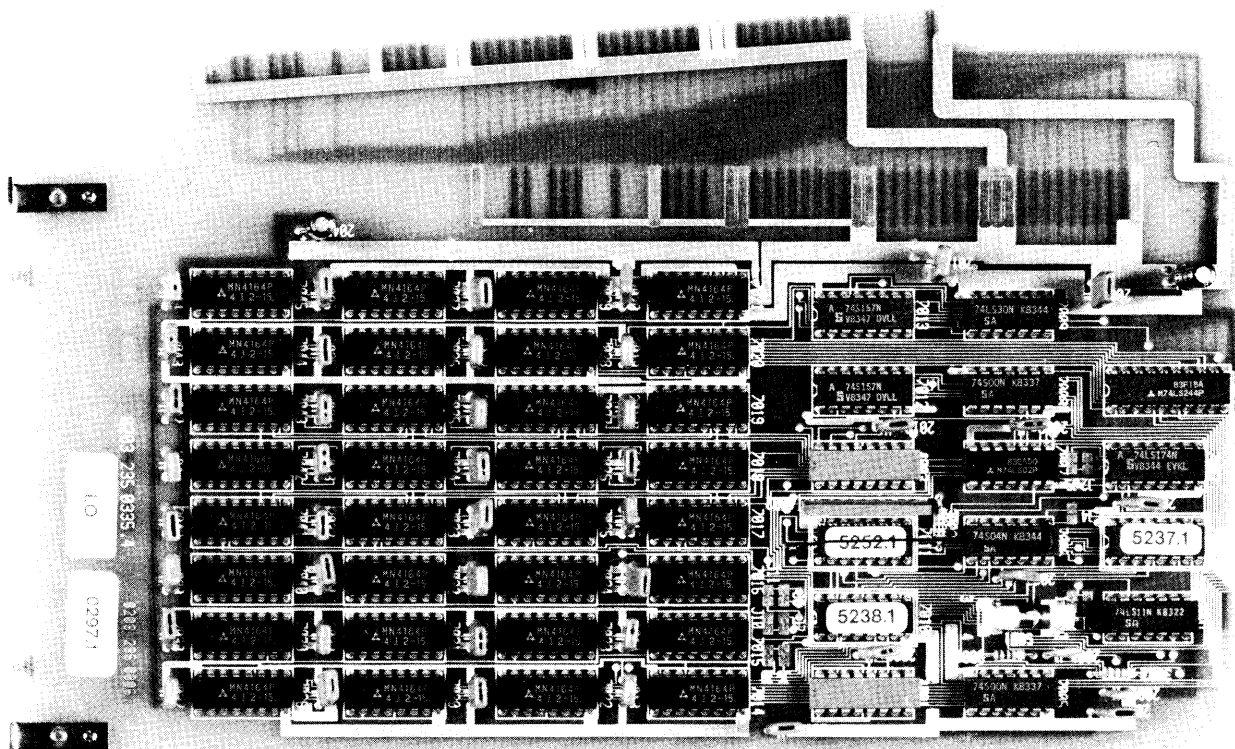
Conversion to a mixed 8 and 16 bit computer is possible with the incorporation of the 8088 CO-POWER Board and the associated software. The enhanced machine is capable of running the MS-DOS operating system on an 8088 processor simultaneously with the CP/M-80 operating system on the original Z80 processor. Machine resources are shared and CP/M use is restricted (see 8088 CO-POWER description).

The 8088 CO-POWER Board contains memory that can be accessed as main memory by the MS-DOS operating system or as RAM disk by the CP/M (in the same way as the Memory Extension Board P2092).

The MS-DOS implementation has been made as compatible as possible with the IBM PC-DOS 2, although it has not been possible to make video access compatible for programs that bypass the operating system and make direct use of the video memory in the IBM PC.

The 8088 CO-POWER Board is fitted to the extension slot of the P2000C mainboard. It contains an 8088 processor and has facilities for adding an optional 8087 maths processor.

RAM memory is dependent on the number and type of RAM chips fitted. Using 64 KB or 256 KB chips, the total available RAM may be:

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    - 128 KB            (2 banks of  64 KB chips)
    - 256 KB or 512 KB  (1 or 2 banks of 256 KB chips)
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TESTING

A test program is supplied with the 8088 CO-POWER Board (TEST88) which is used to exercise the memory and 8088 CPU to confirm that the board is operating correctly. This program is run from the CP/M environment.

LOADING MS-DOS

The 8088 CO-POWER Board is run under the MS-DOS version 2.11 Operating System. This is loaded via the CP/M program MSBOOT. This program performs some hardware tests and determines the amount of available memory before continuing with loading the operating system. If the 8088 CO-POWER Board is missing or defective control is returned to the CP/M system.

DISK SUPPORT

The MS-DOS can access two internal 96 tpi double sided floppy drives and an attached hard disk. Access to internal 48 tpi single sided floppy drives or any external drives will not be possible. This precludes the use of the 8088 with the P2010.

COMMUNICATIONS SUPPORT

Although it is not possible for an MS-DOS application program to access the communication ports directly through 8088 IO, communication applications can be executed via Z80 routines or via the 8088 BIOS through software interrupts.

CP/M SOFTWARE UTILITIES FOR USE WITH THE 8088

        TEST88   A program to test the functions of the 8088 CO-POWER Board

        MSBOOT   A program to load an application into the CP/M TPA if required
                  and then to boot the MS-DOS operating system into the 8088 and
                  transfer control to the MS-DOS.

        MSUTIL   Functions required when using MS-DOS:

                        - format floppy to MS-DOS format.
                        - copy floppy diskettes
                        - backup of MS-DOS hard disk area
                        - configuration of hard disk sharing between CP/M and MS-DOS.

CONTENT OF PRODUCT RELEASE FOR 8088 CO-POWER BOARD

        ° 8088 CO-POWER pcb with 128, 256 or 512 KBytes RAM

        ° Terminal ROM BIOS chip to provide 25 line display
                  (already fitted in later machines)

        ° CP/M-80 (640 KByte format) diskette with files like:
                  - TEST88.COM
                  - MSBOOT.COM   required for MS-DOS
                  - MSUTIL.COM   required for MS-DOS
                  - MSUTIL.MSG   required for MS-DOS
                  - MSKEY.TAB   required for MS-DOS
                  - CONFIG.DAT   required for MS-DOS
                  - CBIOS61.COM   to support RAM disk
                  - CBIOS62.COM   to support RAM disk
                  - CBIOS63.COM   to support RAM disk
                  - INSTCPM.SUB   install for CP/M (RAM DISK)
                  - INSTMS.SUB   install for MS-DOS

        ° MS-DOS (800 KByte format) diskette containing:
                  - system files
                  - standard utilities

        ° DOCUMENTATION including:
                  - P2000C specific introduction
                  - MS-DOS User Guide

TECHNICAL DATA - SUMMARY
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General
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      Dimensions: 540 x 360 x 210 mm
      Weight: 15 kg (approx)
      Power Consumption: 95 W (max)
      Mains Voltage: 90-130 V, 47-66 Hz or
                                180-160 V, 47-66 Hz
      Built in
      Interfaces: SASI (for hard disk)
                                External floppy disks
                                Serial Printer (V24)
                                Data Communications (V24)
                                Slave Monitor
                                Extension slot for optional devices (see below)
      Optional accessory: Protective cover; can be used as a dust cover for
                                the installed machine or as a protective cover
                                during transportation.

Mainboard (CPU)
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      Microprocessor: Z80A, 4MHz
      User Memory: 64 KB RAM
      MFD Controller: for up to 4 floppy drives (5¼")
      SASI Controller: for up to 7 mass storage devices (e.g., hard disk)
      SIO Controller: bidirectional serial (V24)
                                  synchronous and asynchronous communication,
                                synchronous protocols at up to 60 Kbit/sec
      DMA Controller
      System Timer: 1 free timer for user program
      1 Extension Slot: for connection of additional boards e.g.,
                                IEC/IEEE Bus Interface
                              256 KB Memory Extension Board
                              8088 CO-POWER Board with 128, 256 or 512 KB memory

Terminalboard

Microprocessor:	Z80A, 4MHz
Video Memory:	32 KB dynamic RAM
Character Generator:	256 characters
Video Modes:	1. Alpha:

    24 or 25 lines and 80 columns
    character attributes are:
    underline, inverse, blink & 4 intensity levels.

2. Graphic:
    512 x 252 pixels (1 intensity level)
    256 x 252 pixels (4 intensity levels)

Keyboard Controller
Beeper

Monitor

Built In
Monochrome CRT:	Green phosphor P31
Size:	9" diagonal
	150 x 120 mm used screen area

Non-glare screen
Character size:	greater than 2.6 mm
Scan:	50 frames per second

Optional
Monochrome CRT:	12"

Keyboard

Low profile ergonomic keyboard:
 Various language versions available
 Non-glare keytops
 3 keyboard sections:
      - alphanumeric: 59 sculptured keys
      - function pad: 15 stepped keys
      - numeric pad: 19 stepped keys

Floppy Disk Drives

Built in 5¼" drives:	CP/M p-System	CP/M p-System	MS-DOS
Recording method:	MFM	MFM	MFM
Used surfaces:	1	2	2
Tracks per side:	40	80	80
Sectors per track:	16	16	10
Bytes per sector:	256	256	512
Storage capacity:	160 KB	640 KB	800 KB

P2091 - IEC/IEEE Bus Interface

Max devices:	15 plus P2000C
Max distance:	20 metres
Data transfer:	Byte serial (dependent on software)
Address/command codes:	Standard ASCII or ISO 7 bit
Baudrates:	May differ in devices

Application: Ideal for simple instrumentation systems at medium data rates and over short distances.

The IEC/IEEE bus interface allows the P2000C to be incorporated into a system in the following roles:

- system controller
- controller
- non-controlling device
- analyser/bus controller

P2092 - Memory Extension

RAM:	4 banks of 8 dynamic RAMs (HM 4864-2 - 64 Kbit)

P2093 - 8088 CO-POWER Board

Microprocessor:	8088 5 MHz
User Memory:	128, 256 or 512 KBytes
Maths processor:	8087 (optional)
I/O Control:	Via Z80A on Mainboard

The 8088 CO-POWER Board can also be used as memory extension for the CP/M in the role of RAM floppy.