

CDP18S693 and CDP18S694 RCA COSMAC Microboard Computer Development Systems (MCDS)

RCA's Low-Cost Microboard Computer Development System (MCDS) CDP18S693 Combines:

- CMOS Microprocessor Architecture CDP1802A
- CMOS Microboard Computer Module CDP18S601
- CMOS Microboard Memory and Tape I/O Module CDP18S652
- ROM-Based Basic 3 Interpreter with Full Floating-Point Arithmetic
- ROM-Based Monitor Program UT62
- Cassette I/O Unit for Mass Memory Storage
- RS232C or 20-mA Terminal Interface with Baud Rates to 1200
- Five-Card Chassis and Case
- Five-Volt Power Supply

Add a data terminal and you have a CMOS Microcomputer Development System at a surprising, unbelievably low cost.

With the CDP18S693 Microboard Computer Development System YOU can:

- Develop CDP1802 and/or Microboard software
- Program with floating-point Basic 3
- Use the system as a dedicated controller
- Expand system with any of the extensive Microboard family
- Expand system to use ROM-based Assembler/Editor
- Expand memory to full 65 kilobytes
- Extend I/O capabilities with analog and/or digital I/O Microboards

RCA's Higher-Performance Microboard Computer Development System (MCDS) CDP18S694 Combines:

- CMOS Microprocessor Architecture CDP1802A
- CMOS Microboard Computer Module CDP18S601
- CMOS Microboard Memory and Tape I/O Module CDP18S652
- ROM-Based Assembler/Editor Program
- ROM-Based Basic 3 Interpreter with Full Floating-Point Arithmetic
- ROM-Based Monitor Program UT62
- Two Cassette I/O Units for Mass Memory Storage
- RS232C or 20-mA Terminal Interface with Baud Rates to 1200
- Five-Card Chassis and Case
- Five-Volt Power Supply
- PROM Programmer Module and Software CDP18S680

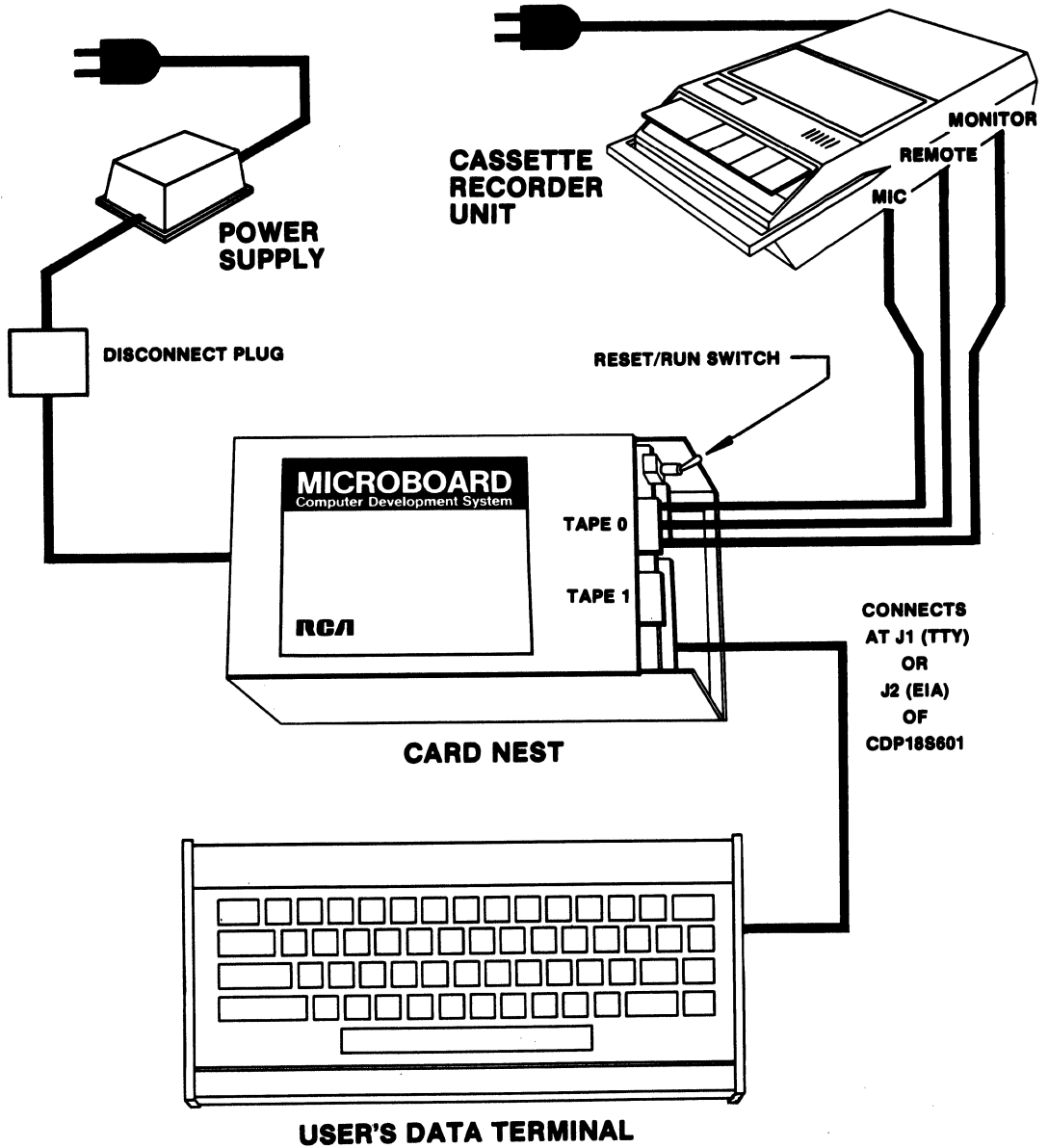
Add a data terminal and you have an even higher-performance CMOS Microcomputer Development System at a surprising low cost.

With the CDP18S694 Microboard Computer Development System YOU can:

- Develop CDP1802 and/or Microboard software
- Program with floating-point Basic 3 or assembly language
- Use the ROM-Based Assembler/Editor to develop software
- Create ASCII files on cassette tape (EDITOR)
- Convert Level I source code on tape into executable machine language on another tape (ASSEMBLER)
- Program RCA and other industry-standard UV-erasable PROM's
- Use the system as a dedicated controller with optional run-time Basic 3 (ROM)
- Expand the system with any of the extensive Microboard family

CDP18S693, CDP18S694

CDP18S693 Microboard Computer Development System Configuration



CDP18S693, CDP18S694

The COSMAC Microboard Computer Development Systems (MCDS) CDP18S693 and CDP18S694 are economical and versatile systems for the development of the hardware and software for applications based on the RCA 1800 series of CMOS microprocessor products. With the optional run-time Basic 3 available on ROM, and with the addition if needed of any of the many available expansion Microboards, the MCDS may be used very effectively for control, testing, or other dedicated microcomputer applications.

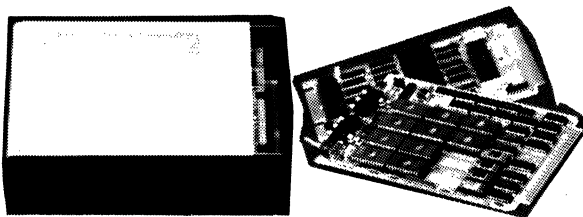
The CDP18S693 includes a five-card chassis with case, a 5-volt power supply, a CDP18S601 Microboard Computer, a CDP18S652 Microboard Combination Memory and Tape I/O Control Module augmented with a ROM-based monitor program and a ROM-based extended Basic 3 interpreter, an audio cassette tape system for mass memory storage, and the cables needed for connecting a data terminal and for connecting the cassette drive system to the CDP18S652.

The CDP18S694 has all the features of the CDP18S693 plus the following. In an additional three-ROM set on the CDP18S652, a Level I text Editor and Assembler enables the user to create CDP1802 machine language programs in Level I mnemonics. A PROM Programmer Module is also provided along with a control program on cassette tape that enables the user to program a wide variety of EPROM's. A second audio cassette drive unit is included to support the Editor and Assembler operations.

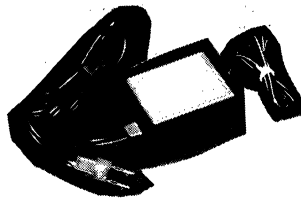
Versions for both domestic and overseas operation are available. Models CDP18S693V1 and CDP18S694V1 operate on 110-120 volts ac, 60 Hz; models CDP18S693V3 and CDP18S694V3 operate on 220-240 volts ac, 50 Hz.

Hardware Features

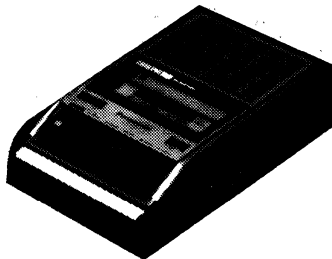
A five-card chassis and case houses the Microboards provided with the MCDS. The CDP18S693 includes the CDP18S601 Microboard Computer and the CDP18S652 Combination Memory and Tape I/O Control Module. The CDP18S694 includes the CDP18S601, CDP18S652, and a PROM programmer module. The chassis and case assembly has openings at the bottom and end to permit easy access to the cabling terminal connections.



The power supply for the card nest is wired through a disconnect plug to the universal backplane. Power Converter Type CDP18S023V1 is for 110-volt operation and Type CDP18S023V3 is for 220-volt operation. The dc output is 5 volts at 600 milliamperes.



The cassette recorder unit is connected to the CDP18S652 controller board by means of a 3-wire interface cable. The unit uses economical audio-type cassette tape. The controls on the cassette recorder include a tone control, a volume control, and play, record, rewind, fast forward, stop, and eject buttons. The unit also has a tape counter. The recorder drive mechanism is controlled through the "remote" jack by the software to provide system control of the tapes. A 60-minute tape can store over 115,000 ASCII bytes per side.



Two cables are provided for connecting the user-supplied data terminal. The CDP18S516 cable is for terminals using the EIA RS232C interface and the CDP18S515 is for terminals using a current loop interface. Either cable can be connected to the CDP18S601 Microboard Computer. No handshaking lines are required for operation. When an EIA RS232C data terminal is used, its 5-volt supply is available at the backplane, but the user must provide the additional -5 to -15 and +12 to +15 volts required.

The CDP18S694 includes all the items provided with the CDP18S693 plus a second cassette recorder unit for additional mass memory storage, a ROM-based Editor/Assembler, and a PROM Programmer module with cassette-tape software. The Editor/Assembler ERPOM's (3) are on the CDP18S652 Combination Memory and Tape I/O Control Module.

CDP18S693, CDP18S694

Software Features

The Microboard Computer Development Systems have a number of programs to aid the user in both hardware and software development. These programs include a full Basic 3 Interpreter with floating-point arithmetic, a resident ROM-based Monitor program, a ROM-based Editor, a ROM-based Assembler, a cassette-tape-based PROM programmer software program, and a ROM-based Basic 3 run-time version for custom applications (CDP18S842).

The full Basic 3 Interpreter and the Monitor are supplied with both the CDP18S693 and the CDP18S694. The Assembler, Editor, and PROM programmer software are supplied with the CDP18S694 but are also available as options for use with the CDP18S693. The run-time Basic 3 is an option for both systems.

Basic 3 is a 12-kilobyte high-level language that can be easily learned and readily used by the beginning programmer. Features of the Basic 3 Interpreter include full floating-point arithmetic, line editing capability, "trace" debugging for program creation, "cold or warm" start capability, tape control, up to 6682 multiple-character variables, 26 string variables or string arrays, and 26 one- or two-dimensional arrays. Because Basic 3 provides the CDP1802 microprocessor I/O constructs, it allows the user to develop his entire program in Basic. However, Basic 3 also allows calls to user machine-language subroutines if desired. A separate manual (MPM-841) describes the Basic 3 language and how to use the interpreter.

```
*B
MCDS BASIC-REL C6.1
```

```
C/W?
WREADY
>LIST
```

```
10 M=0
20 FOR I=1 TO 5
30 A(I)=RND(9)+1
40 M=M+A(I)
50 NEXT
READY
>
```

The ROM-based **Monitor program UT62** (2 kilobytes) allows the user to (1) inspect and modify memory, (2) to store and retrieve data on tape, (3) start execution of the Basic 3 Interpreter, the Editor, the Assembler, or a user-generated program at any address, and (4) debug programs. The twelve UT62 Monitor commands are Memory Move, Memory Fill, Memory Substitute, Memory Display, Memory Insert, Program Run, Read Tape, Write Tape, Rewind Tape, Run Basic, Run Editor, and Run Assembler. The Monitor program also includes Read and Type routines for communication between the MCDS and the data terminal and for I/O data transfers.

The resident ROM-based **Editor program** is supplied with the CDP18S694 and is an option for the CDP18S693. It allows the user to create ASCII files on cassette tape. These files can be Level I CPD1802 language, Basic 3 instructions with line numbers, or simply text. The Editor output file becomes the input file for the Assembler. The Editor commands include: Move pointer to beginning of buffer, Move pointer to end of buffer, Move pointer by n characters, Move pointer by n lines, Define input tape, Append lines, Insert text, Delete n characters, Delete n lines, Save n lines, Get saved text, Find text, Substitute text, Define output tape, Type n lines, Write n lines to output tape, Write entire buffer to output tape, Print n lines, Return to UT62, and Quit session and restart Editor.

```
*A
MCDS ASSEMBLER VER.0.0
READY?
WRITE?1
PRESS PLAY ON READ TAPE
TYPE ANY KEY
H,L,U,J7H
00AA QTY
0001 R1
0008 R8
0124 SHORT
2000 LONG
4000 DATA
A000;
```

The resident ROM-based **Assembler program** is also supplied with the CDP18S694 and is an option for the CDP18S693. It allows the user to convert a Level I source file on tape (source code) into an executable machine language program on another tape (object code). The object code can then be loaded into memory by the UT62 Monitor program for execution, or it can be placed in an EPROM by the PROM programmer. The Assembler permits the user to write programs using convenient mnemonic expressions rather than machine language. It is a two-pass assembler with COSMAC Level I syntax. The Assembler also provides error messages to assist in debugging.

The **PROM programmer software** is supplied with the CDP18S694 and is included with the PROM programmer module in the CDP18S680 as an option for the CDP18S693. It enables the rapid programming of the RCA 18U42, the Intel 2704, 2708, 2758, and 2716 UV-erasable PROM's or any other equivalent PROM's. In addition, Intel 1702-type PROM's can be read (but not programmed) so that they can be copied into lower-power CDP18U42 CMOS PROM's or combined into other larger-sized PROM's. Operations can be with either positive or negative data. The operating software object code for the PROM programmer is provided on a tape. Operations available include (1) programming a PROM from a RAM buffer or file, automatically

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followed by a verification; (2) verifying a PROM against a RAM buffer or file; (3) copying a PROM into a RAM buffer, automatically followed by a verification; (4) filling a RAM buffer with all 1's or 0's used in verifying PROM erasure; and, (5) saving a RAM buffer onto a tape. The software is designed for flexibility so that, in addition to the basic operations provided, more sophisticated procedures can be derived.

Optional Software

The **Basic 3 Run-time** version CDP18S842 allows the user to execute his program in any CDP1802-based system. This version starts program execution automatically after reset. Thus, the user may develop his program using the Basic 3 development version supplied with the MCDS and then for his final turnkey operation, use the **Basic 3 Run-time** version. To use Run-time Basic an additional Microboard such as the CDP18S626 32/64-kilobyte ROM/PROM/RAM is required. (Part number CDP18S842)

Accessory and Expansion Options

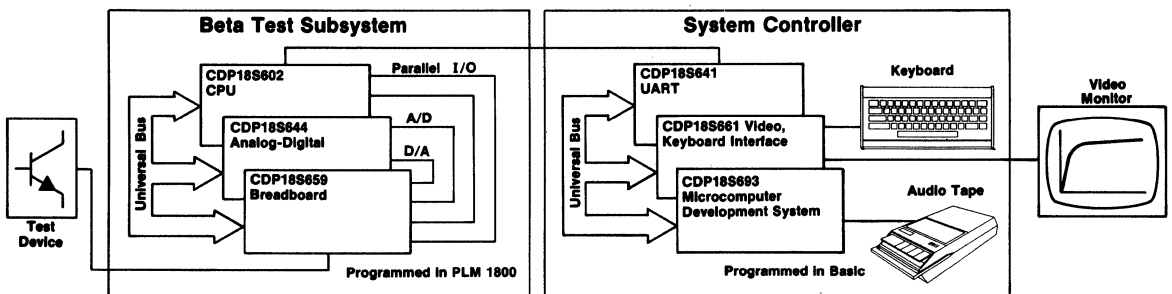
Microboard Expansion Modules. The user can add any of the many CPD18S600-series Microboards to provide I/O expansion or expanded peripheral interfacing. Microboards have a wide temperature range; normal operation is at -40 to $+85^{\circ}\text{C}$ with exceptions. (Booklet: COSMAC Microboard Computer Systems CMB-250)

Printer Option

With the CDP18S646 Microboard printer interface, the user can add a parallel Centronics-type printer and obtain hard copy output from cassette tape using the Editor P command. With a serial printer used in combination with a video terminal and connected to one of the CDP18S601 serial output ports, the user can obtain a hard copy output through the T command.

Components Available Separately for Replacement or Upgrading

- CDP18S601 Microboard Computer Control
- CDP18S652 Combination Memory and Tape I/O
- CDP18S680 PROM Programmer Module and Software
- CDP18S810 Audio Cassette Recorder Unit
- CDP18SUT62 MCDS Monitor ROM
- CDP18S841 MCDS Basic 3 Interpreter ROM set (development)
- CDP18S842 MCDS Basic 3 Interpreter ROM set (run-time)
- CDP18S843 MCDS Assembler/Editor ROM's
- CDP18S646 Microboard Printer Interface, Parallel Centronics Type



Actual MCDS Application

This diagram illustrates a practical application of Microboards and the Microboard Computer Development System (MCDS) in custom production test equipment. This particular custom tester, in actual use in RCA's Malaysian plant, tests and sorts transistors. In addition to the Beta test shown, other processor-controlled subsystems test for saturation voltage, breakdown voltage, leakage, and switching parameters. High-level

languages were used for rapid program development. For the test subsystems, PLM was chosen because it contains built-in constructs for programming the I/O Microboards. For the system controller, Basic was chosen because it provides the human interaction and the floating-point arithmetic needed for displays and report generation.

Note that the MCDS was both the basic development tool and the final control system.

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Specifications**CDP18S693V1 and CDP18S693V3
System Components**

CDP18S601 Microboard Computer
 CDP18S652 Combination Memory and
 Tape I/O Control Module
 5-Card Chassis with Protective Base and
 Cover
 CDP18S023V1 or CDP18S023V3 Power
 Converter
 CDP18S515 TTY Terminal Interface Cable
 (20 mA)
 CDP18S516 EIA Terminal Interface Cable
 (RS232C)
 CDP18SUT62 ROM-based Monitor
 Program
 CDP18S841 Basic 3; ROM-base Extended
 Basic Interpreter
 CDP18S810 Audio Cassette Recorder Unit
 CDP18S529 Cassette Interface Cable
 Technical Literature

**CDP18S694V1 and CDP18S694V3
System Components**

All the components of the CDP18S693
 System plus:
 CDP18S810 Audio Cassette Recorder Unit
 Cassette Interface Cable
 CDP18S680 PROM Programmer Module
 with PROM programmer software on
 cassette tape
 Text Editor, ROM-based
 Level I Assembler, ROM-based

Five-Card Chassis and Case

Dimensions:
 Width 5-1/8 inches (130 mm)
 Length 9-7/16 inches (240 mm)
 Height — 3-7/16 inches (87 mm)

Operating Temperature Range:
 0 to 70°C

Memory, I/O, and Control Specifications

RAM:
 4 kilobytes on CDP18S601 at 0000H-
 0FFFH
 1 kilobyte on CDP18S652 at 8C00H-
 8FFFH

ROM:
 4 sockets for 8 kilobytes on CDP18S601
 2 kilobytes preprogrammed with UT62 on
 CDP18S652 at 8000H-88FFFH
 12 kilobytes preprogrammed with Basic 3
 on CDP18S652 at B000H-DFFFFH
 6 kilobytes preprogrammed with Editor/
 Assembler on CDP18S652 at 9000H-
 A7FFFH

Parallel I/O:
 20 lines, programmable
 4 external flag inputs
 1 Q line output

Serial I/O:
 RS232C or 20-mA loop, software driven,
 automatic baud rate selection up to
 1200
 Two audio cassette tape unit channels
 with start/stop controls

System Control:
 RESET/RUN switch linkable to start
 running at 8000H for UT62 or at
 0000H for user program

Instruction Set

255 CDP1802 Microprocessor instructions

Power Converter CDP18S023V1

Input: 120 V, 50/60 Hz, 9 W
 Output: +5 V dc, $\pm 5\%$ at 600 mA,
 regulated
 Dimensions: 2.7 x 2.1 x 1.6 inches
 Weight: 12.5 ounces

Power Converter CDP18S023V3

Input: 210-250 V, 50 Hz, 9 W
 Output: +5 V dc, $\pm 5\%$ at 600 mA,
 regulated
 Dimensions: 130 x 63.5 x 50.8 mm
 Weight: 482 grams

PROM Programmer

Basic Operations:
 Program a PROM from a RAM buffer or
 tape; automatically followed by a
 verification
 Verify a PROM against RAM buffer or
 tape
 Copy a PROM into RAM buffer, auto-
 matically followed by a verification
 Fill RAM buffer with all 1's or 0's; used
 in verifying PROM erasure
 Save RAM buffer onto a tape

Plug-In Module:
 Dimensions: 4.5 x 7.5 inches (114.3 x
 190.5 mm)
 Three Zero-Insertion Force PROM
 Sockets:
 1 for 1702/CDP18U42
 1 for 2704/2708
 1 for 2716/2758
 Plugs into 5-Card Chassis
 Assigned to Group Select 4

Power Supplies:

External-Programming Power:
 +25 V ± 0.1 V at 50 mA for 2716/2758
 +26 V ± 0.1 V at 20 mA for 2704/2708
 -9 V $\pm 5\%$ at 70 mA for reading 1702
 PROM's
 -5 V $\pm 5\%$ at 50 mA (pin 11) for
 2704/2708
 +12 V $\pm 5\%$ at 70 mA (pin 20) for
 2704/2708
 +22 V ± 0.1 V at 10 mA for CDP18U42

LED Indicators

Power ON to PROM
 External Programming Power ON
 Programming ON

Switches:

Power to PROM ON/OFF
 Selector Switch

Programming Times:

2704 — 1 minutes 25 seconds
 2708 — 2 minutes 45 seconds
 2716 — 1 minutes 45 seconds
 2758 — 50 seconds
 CDP18U42 — 3 seconds

Types of PROM's handled:

CDP18U42 256 word by 8 bit	} Intel PROM's or equiv- alent
1702 256 word by 8 bit-read only	
2704 512 word by 8 bit	
2708 1024 word by 8 bit	
2758 1024 word by 8 bit	
2716 2048 word by 8 bit-single voltage only	

CDP18S810 Audio Cassette Recorder Unit

Model: Panasonic RQ-2309A, or equivalent
 Power requirements: 110 or 220 V, 50/60
 Hz, 6 W

Controls: tone control, volume control,
 play, record, rewind, fast forward,
 stop, eject buttons, tape counter

Literature Supplied

MPM-293 User Manual for the RCA
 COSMAC Microboard Com-
 puter Development Systems
 (MCDS) CDP18S693 and
 CDP18S694
 MPM-841 Use of Basic 3 Interpreter
 CDP18S841 with the RCA
 COSMAC Microboard Devel-
 opment Systems CDP18S693
 and CDP18S694
 MPM-920A Instruction Summary for the
 CDP1802 COSMAC
 Microprocessor
 MB-601 RCA COSMAC Microboard
 Computer CDP18S601

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Here are some answers you might want while you are considering the many advantages of the MCDS.

Why CMOS?

The many advantages of CMOS (Complementary-Symmetry Metal-Oxide Semiconductor) include ultra-low power dissipation, high noise immunity, operation from a single power supply with a wide operating range or even from batteries, and a wide temperature range. RCA has been the leader in CMOS since its inception.

Why Microboards?

RCA Microboards are simple-to-use, small-size (4.5 x 7.5 inches), high-performance modules that take advantage of all the CMOS features. CMOS Microboards can provide reliable operation in high-noise process-control, automotive, or production environments and are especially effective in remote or portable applications. Because Microboards are designed to fit a compact universal backplane, you have a broad selection of readily interchangeable Microboards for performance expansion. To assure reliable operation, all Microboards are tested, burned-in for 72 hours at maximum rated temperature, and then retested.

Why should I use the MCDS?

MCDS is an economical highly versatile development system for CDP1802 CMOS Microprocessor hardware and software applications. With MCDS you can program with floating-point Basic 3 or the ROM-based Assembler/Editor and take advantage of the PROM programmer. You can expand your system with any of more than 45 different Microboard products, expand memory to 65 kilobytes, and extend the I/O with both analog and digital Microboards. MCDS can be not only your development system but also your final target system.

What's so unusual about MCDS Basic 3?

The Basic 3 Interpreter ROM features full floating-point arithmetic, line editing, trace debugging, cold or warm start, tape control, up to 6682 multiple-character variables, strings and arrays, plus access to CDP1802 I/O constructs. It allows calls to user machine-language routines and provides I/O instructions for any added Microboard. **Another big plus for Basic 3 is a special ROM-based run-time version for executing your program on any CDP1802 system. With run-time Basic 3 and the user program in memory (either RAM or ROM), your program will begin execution immediately after reset.**

How will the Editor/Assembler help me?

The ROM-based Editor supplied with the CDP18S694 will help you generate ASCII files in CDP1802 Assembly language, Basic 3 instructions with line numbers, or simply text. The Assembler converts source files into executable machine language programs. With the Editor/Assembler, you can write programs faster and more accurately using mnemonics instead of machine language. And you get error messages to speed up program debugging.

How much memory do I get?

With the MCDS you get 5 K of RAM and 4 sockets for up to 8 K of ROM. You also get 20 K of ROM containing the UT62 Monitor (2 K), Basic 3 (12 K), and, in the CDP18S694, the Editor/Assembler (6 K). Microboard Memories can be added and for mass memory storage you can use the tape cassettes.

Why audio tape cassettes?

Audio-type magnetic tapes on cassettes provide a low-cost, reliable means of mass memory storage. On a 60-minute tape you can store over 115,000 ASCII bytes per side. The record unit is software controlled and operated through the Monitor program. With two units, provided with the CDP18S694, the Editor/Assembler operations are supported at minimum cost.

Can I use this low-cost microcomputer as a dedicated controller?

Very definitely. Because of its relatively low cost, the optional run-time Basic, and its mass memory storage, the MCDS is an excellent choice for many dedicated control, custom testing, or data acquisition tasks. A practical example is shown on page 460.

How can I expand the MCDS capabilities?

An easy question. Just request a copy of **COSMAC Microboard Computers Systems CMB-250** and read about the more than 45 different CMOS Microboard products for your system. This comprehensive product guide describes Single-Board Computers, Memories, Digital I/O's, Video-Audio-Keyboard Interfaces, A/D Converters, D/A Converters plus accessory hardware. And our rapidly growing Microboard family always has more on the way.

Is the MCDS really "unbelievably" low cost?

This question you can best answer for yourself by making the same comparisons that we did. If you find any other system with comparable performance at anything near a comparable price, please let us know.

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