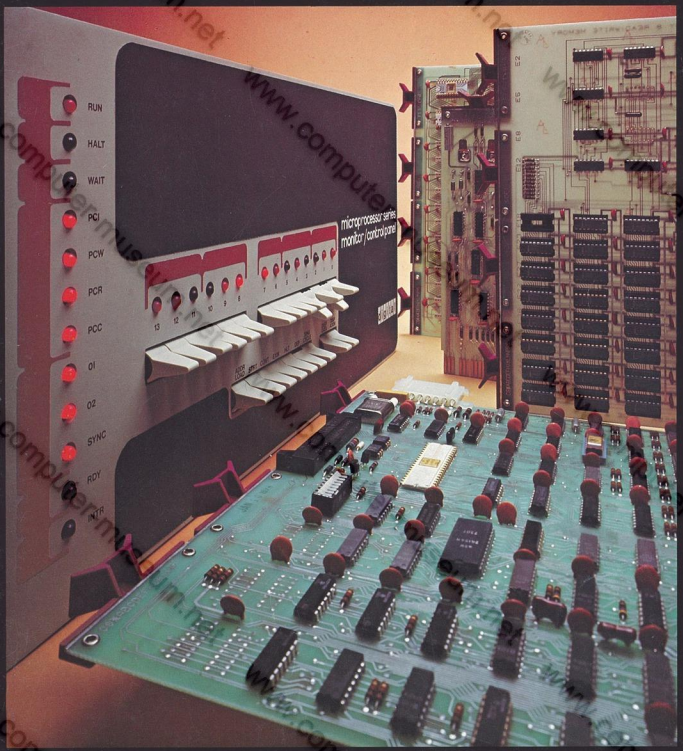
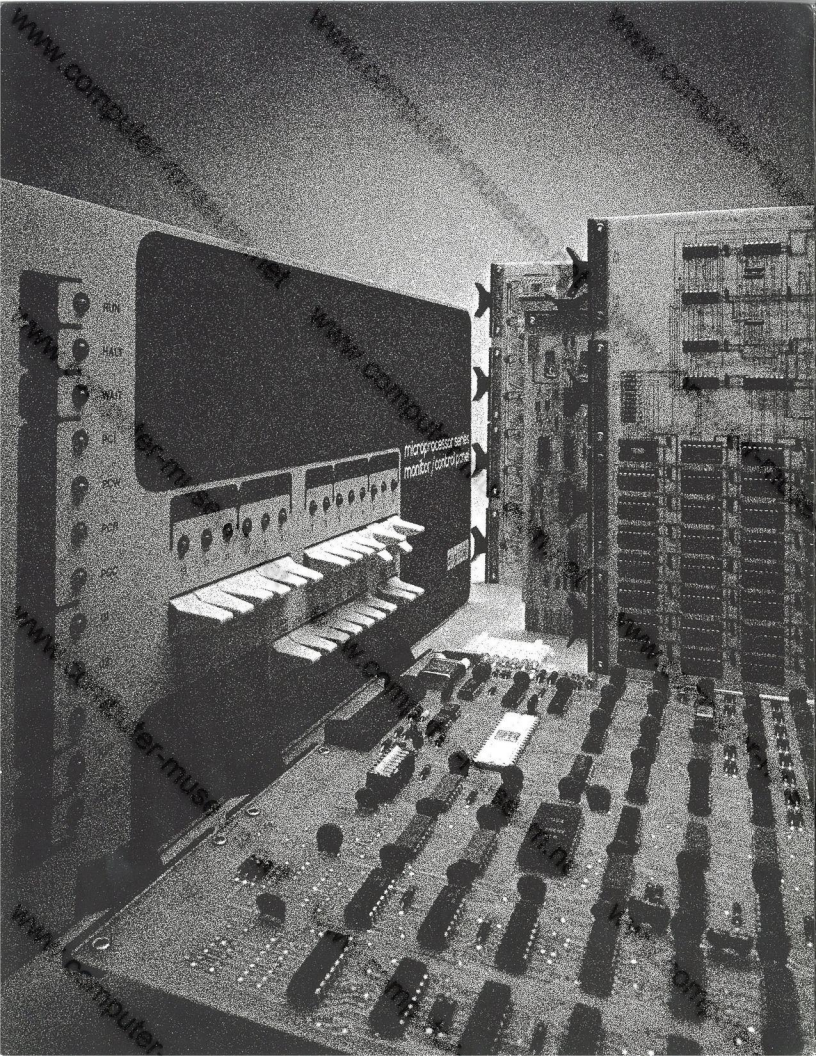
MPS: MICROPROCESSOR SERIES MODULES

digital
COMPONENTS
GROUP




RUN
HALT
WAIT
INT
microprocessor series
monitor / control panel

Microprocessing... The Industry Revolution

Will microprocessing revolutionize the computer industry? It will, if making computer processing/control available to a whole new market at very low prices can be considered revolutionary. Just as minicomputers opened markets in data communications, laboratory automation, and process control, the "computer-on-a-chip" will bring specialized computing to a new class of industrial and professional users.

What's the world's leading minicomputer manufacturer doing in the microprocessor business? Simply growing with a technology we've been part of since 1957. As the number one supplier of logic modules, it's only natural that we apply our experience to microprocessor modules.

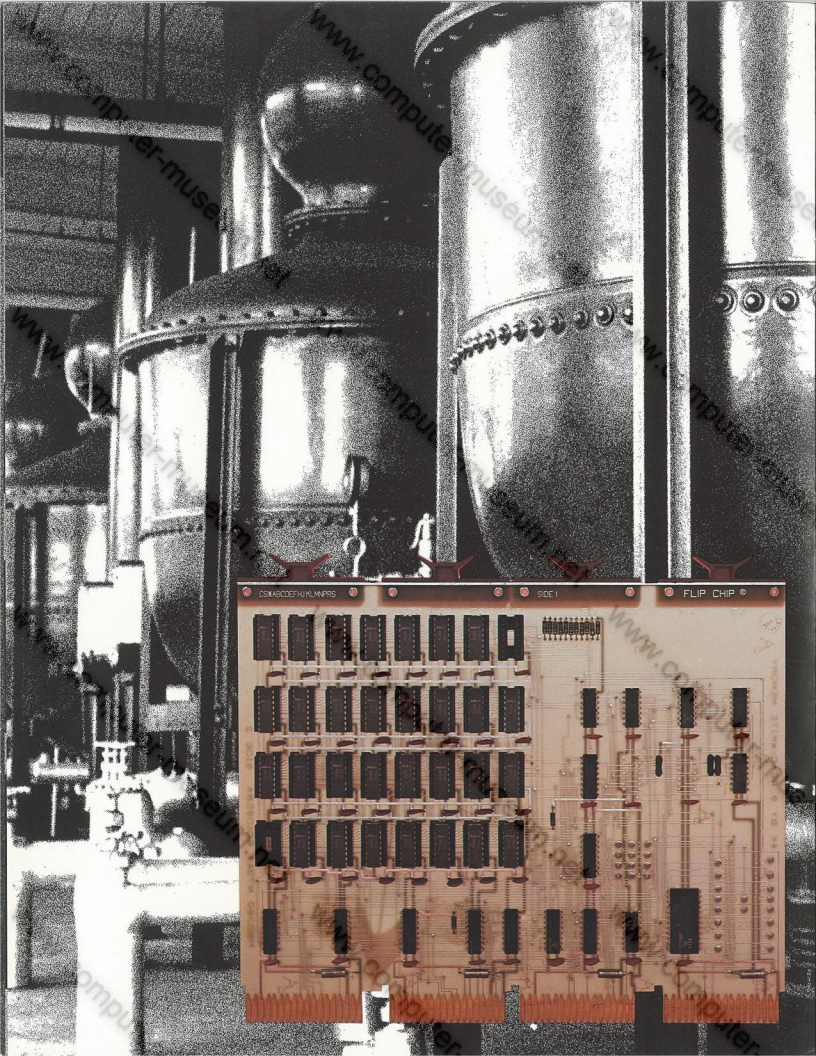
The Microprocessor Series

DIGITAL's Microprocessor Series—MPS for short—consists of four modules and a control panel. The assembled modules form a processing unit with a powerful instruction set and semiconductor memory up to a maximum of 16K words. But MPS is more than just a microprocessor; it's a means of implementing an intelligent interconnection, a way to achieve "smart" interfacing between computers and peripherals.

MPS makes it possible to replace fixed logic with modules that can perform virtually countless low-cost processing and decision-making functions. The modules can be assembled as required (a minimum configuration could be as small as CPU plus 1K of memory), programmed, and easily interfaced with external devices. They offer all the versatility of customized hardware with the convenience of building-block modularity and they are electrically and mechanically compatible with existing DIGITAL logic modules.

The MPS modules augment DIGITAL's existing arsenal of processing devices, offering a capability that falls between simple integrated circuit modules and sophisticated boxed computers. MPS modules offer low-cost, easy-to-interface processor capability while eliminating expensive user evaluation and design time. Small systems can be implemented without becoming involved in the intricacies of logic design; data is provided in a standard format with minimum overhead; solution power is increased, yet the flexibility of the module approach is retained. MPS is, in short, an ideal way of getting a job done without incurring the costs associated with a multicapability minicomputer.

← M7341 CPU Module


SIDE 1
FLIP CHIP ®

MPS Applications

Microprocessors are viable alternatives to hard-wired circuits for many control-oriented functions. The programmable components are standardized, so you don't have to develop special-purpose circuitry to solve specific problems. Modifications made necessary by product evolution are simplified because the whole focus of the design effort is shifted from hardware to software. Reliability is improved because there are fewer components and interconnections. Uniformity within a series of products is increased. Applications flexibility is enhanced and design time shortened over hard-wired logic; yet the cost is considerably less than the price of a minicomputer.

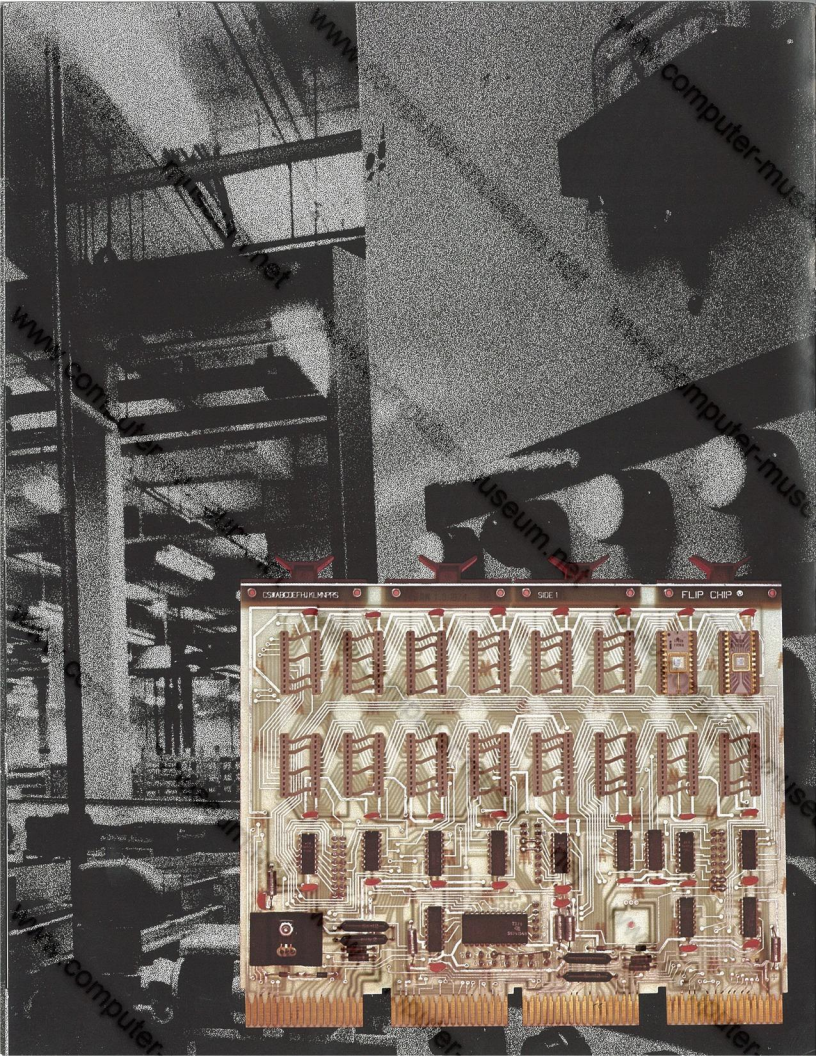
MPS adaptability ranges from devices which already incorporate some degree of automation, such as numerically controlled machine tools or laboratory blood analyzers, to products such as appliances for which digital control hasn't been considered because of cost or complexity. Used with data terminals, MPS can provide higher levels of interactivity among operators while reducing the traffic burden on communication channels. Machines in industrial, commercial, and consumer use can be given capabilities for adapting to loads or demands, operating in a variety of modes, and performing monitoring and control functions automatically. Interfaced with industrial knitting machines, for example, MPS can implement safety interlocks, count pieces for inventory, select stitching parameters and threads, and detect worn or broken needles.

MPS modules are particularly adaptable to OEM use because they eliminate the need for designing special-purpose logic to solve specific problems, they shorten product design time, and they make product changes easier to implement. Other advantages include the lower cost of standardized hardware and added flexibility in design and operation.

When do you specify Microprocessor Series modules? The crossover point between fixed and programmable logic depends on the application, but rule-of-thumb tends to favor microprocessors when the number of integrated circuit packages required to implement the control of a dedicated logic system approximates forty. The rapidly improving cost/performance ratio, however, makes the programmable approach attractive for even less complex circuits, especially when product line continuity is a factor.

Typical Application Areas

- Industrial Control
  - —Machine tool control
  - —Material flow
- Process Control
  - —Batch mixing
  - —Furnace monitoring
  - —Batch weighing
- Small Laboratory Automation
  - —Analog and digital instrument data acquisition
  - —Blood analyzers
- Data Communications
  - —Data concentrators
  - —Communications processors
  - —Minicomputer preprocessors
  - —Intelligent terminals
- Business Machines
  - —Optical character recognition
  - —Automatic banking
  - —"Smart" copying machines
- Health, Education, and Welfare
  - —Environmental control of large buildings
  - —Automatic teaching machines
  - —Remote pollution-monitoring systems
- Transportation
  - —Traffic signal controllers
  - —Vehicle recognition scanners
  - —Traffic flow monitoring


SIDE 1
FLIP CHIP

Product Description

The Microprocessor Series consists of the following products:

M7341 CPU Module

M7344—YA 1K x 8 Read/Write Memory Module
M7344—YB 2K x 8 Read/Write Memory Module
M7344—YC 4K x 8 Read/Write Memory Module

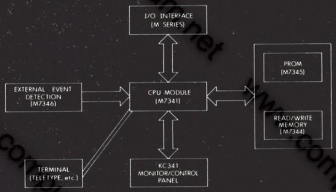
M7345 Programmable Read-Only Memory (PROM, capacity to 4K x 8)

M7346 External Event Detection Module

KC341 Monitor/Control Panel

The largest module in this series measures only 8-1/2 by 11 inches. This compact size offers great flexibility since combinations of modules can be selected to satisfy various applications.

Compactness and flexibility are also enhanced by the separation of memory from the CPU Module. This helps maintain small board size and lets the user select the minimum storage capacity required, from as few as 256 8-bit words of PROM to 1K 8-bit words of read/write memory.



M7341 CPU Module

The CPU Module contains the basic processing elements of the system. Processing capability is supplied by a commercially available P-channel MOS/LSI microprocessor chip, a complete computer system central processor unit which can be interfaced with memories of up to 16K 8-bit words capacity. The processor communicates over an 8-bit data and memory bus and makes 14 bits of address available for memory selection. The CPU contains an 8-bit parallel arithmetic unit, seven 8-bit data registers, eight 14-bit registers (all implemented by dynamic read-only memory) and full control logic and instruction decoding.

Features

- Single chip, 8-bit parallel processor.
- 48 data-oriented instructions.
- 12.5 μs cycle time.
- Complete instruction decoding and control.
- TTL-compatible input/output.
- Directly addresses up to 16K 8-bit words of memory.
- Address stack contains eight 14-bit registers, including the Program Counter.
- Allows nesting of subroutines up to seven levels.
- Contains seven 8-bit registers.
- Will Multiplex:
  - 8 bits of I/O data.
  - 8 bits of memory data.
  - 8 bits STOP/EXTERNAL EVENT address.
  - 8 bits initial START/BRANCH address.
- Provides 14 bits of buffered, latched memory address.
- Control lines consist of:
  - Memory Read.
  - Memory Write.
  - I/O In.
  - I/O Out.
  - STOP/EXTERNAL EVENT detection.
  - I/O START/BRANCH interrupt.
- Includes full-duplex serial-line interface implemented byMOS/LSI UART (Universal Asynchronous Receiver/Transmitter).
- Fully interfaced to KC341 Monitor and Control Panel for maintenance and program debugging purposes.

← M7345 Programmable Read-Only Memory Module

M7345 Programmable Read-Only Memory (PROM) Module

The Programmable Read-Only Memory Module uses semiconductor PROM's to provide storage capacity of up to 4K x 8 bits. Memory storage is implemented with 256 x 8 silicon gate erasable and electrically-programmable, static MOS memory chips (Intel 1702A). A transparent quartz lid allows erasure of the stored-bit pattern by exposing the individual chip to ultraviolet light. A new program can then be written into memory. The entire process may be repeated as many times as required.

A total of 16 memory chips can be mounted in the sockets provided on the module to yield the maximum capacity of 4K x 8. The board may be configured with any combination of memory chips from a minimum capacity of 256 x 8 bits.

Features

- Fully self-contained memory.
- Standard DIGITAL quad module.
- Contains 16 24-pin memory chip sockets (for maximum storage capacity of 4K).
- Any multiple of 256 x 8 up to a maximum of 4K x 8 is selectable on the module.
- Contains all address decoding logic.
- Address-Expansion input.
- Data-Ready line for use during Read cycle.
- Power requirements: + 5 volts dc, – 15 volts dc.

M7344—YA, —YB, —YC Read/Write Memory Modules

The Read/Write Memory Module is a semiconductor read/write memory with a maximum storage capacity of 4K x 8 bits. Memory storage is implemented by a 1024 x 1 static random-access memory element (Intel 2102) that uses normally-off N-channel silicon-gate MOS technology. The chip uses static circuitry and, therefore, requires no clocks or refreshing.

This module is available in three "off-the-shelf" versions:

M7344-YA — 1K x 8 bits
M7344-YB — 2K x 8 bits
M7344-YC — 4K x 8 bits

Features

- Fully self-contained memory.
- Standard DIGITAL quad module.
- Contains all address decoding logic.
- Memory-Read line.
- Memory-Write line.
- Address-Expansion line.
- Data-Ready line during Read operations.
- Data-Accepted line during Write operations.
- Only + 5 volts dc power required.
- Includes complete interface to CPU Module.

M7346 External Event Detection Module

The External Event Detection Module is a dual-purpose module designed to provide power failure detection capability and implement priority interrupt schemes and the processor start up and halt functions. The module is contained on a single-height, extended-length PC board.

Features

- Eight interrupt priority lines available to provide eight arbitrated priority levels.
- Power fail detection highest arbitrated priority.
- Processor halt function is ninth and highest priority.
- Ac voltage continuously monitored for power loss detection.
- Power requirements: +5 volts dc, 6.3 volts ac for line voltage monitoring.

KC341 Monitor/ Control Panel

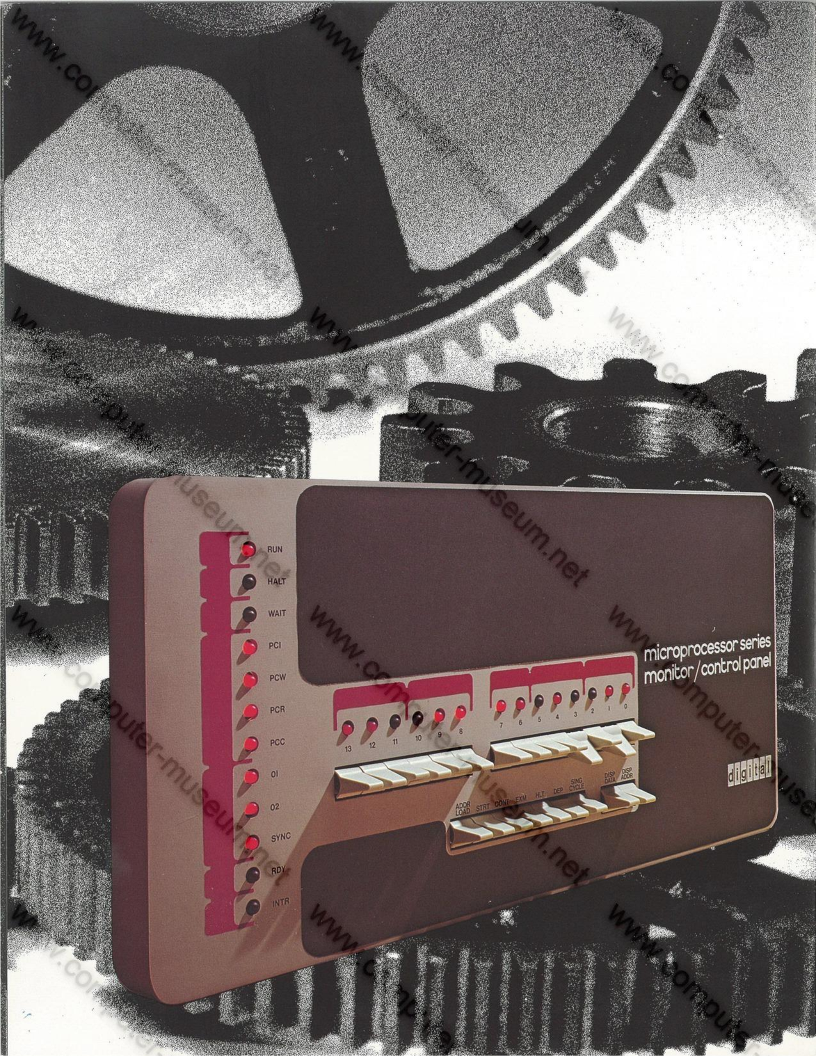
The Monitor/Control Panel may be considered as the programmer's console for the Microprocessor Series. The panel performs such typical functions as the monitoring of data paths, memory, and addresses as well as handling general system operational checks and diagnostic checks.

Features

- Convenient size (18-inches wide by 8-3/4-inches deep by 1-3/4-inches high) for placing on bench, desk top, etc.
- Completely interfaced with CPU Module via cable.
- Allows interrogation of CPU timing signals through an LED array.
- Address data can be loaded into the CPU Module via 14-bit switch register.
- Address and memory data can be displayed.
- Controls supplied:
  - Address Load.
  - Start.
  - Halt.
  - Deposit.
  - Continue.
  - Examine.
  - Single cycle.
  - Display Data.
  - Display Address.
- Integral read/write scratch-pad memory for diagnostic use.
- Integral read-only memory bootstrap loader program.
- Power requirements: + 5 volts dc, – 15 volts dc.

Interface Modules

The ability to develop custom interface circuitry is supplied by DIGITAL's wire wrappable modules. The appropriate module for a particular application may be chosen from a wide variety of W Series modules, typical of which are the W966 and W967. These boards are compatible with MPS modules and provide a foundation upon which to build integrated circuit interface designs.



Software/Programming

MPS modules make it possible to implement cost-effective systems with the added benefits of inexpensive modification and flexibility during prototyping. MPS modules have as the central control element the M7341 CPU Module. This module has a flexible instruction set which consists of 48 data-oriented instructions presented as five instruction categories:

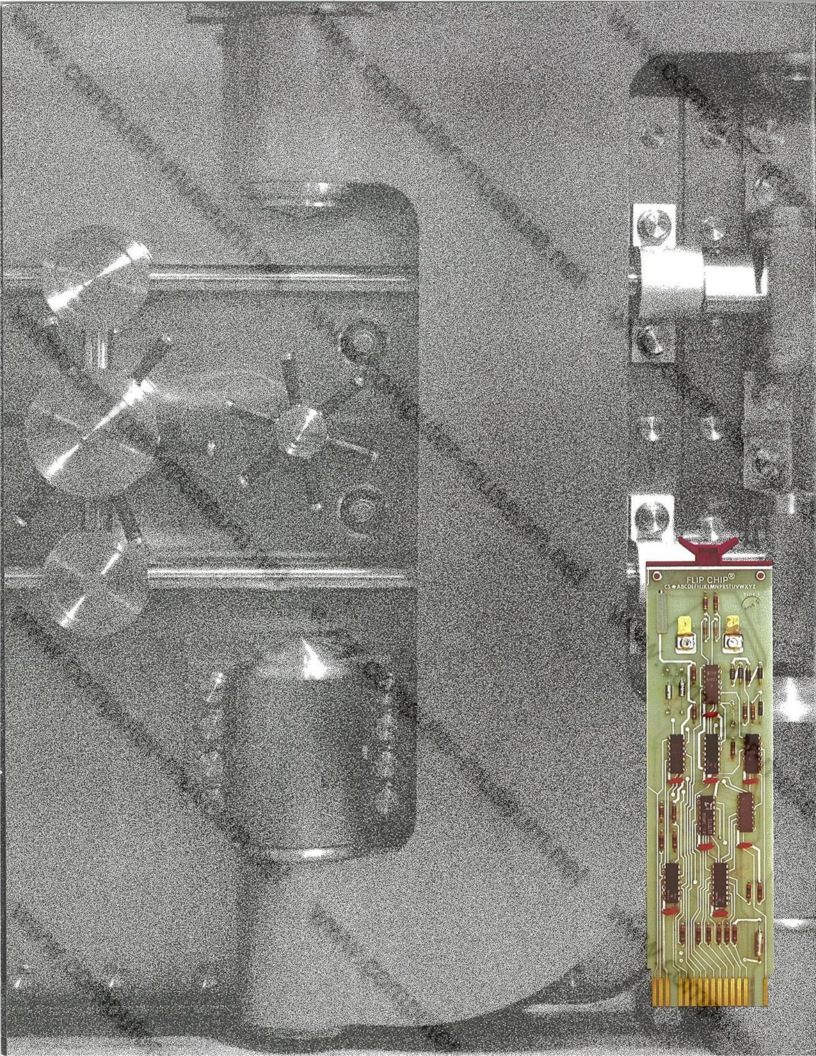
- Register Operations
- Accumulator Operations
- Program Counter & Stack Control Operations
- I/O Operations
- Machine Operations

MPS module programs may be prepared with a small, low-cost PDP-8 minicomputer (excluding the PDP-8/S) with 4K memory, Teletype terminal, and paper tape reader/punch. The software necessary to program the Microprocessor Series is provided in a Software Kit which consists of the following programs. All programs are provided in paper tape form.

Program	Function
MLE (Microprocessor Language Editor)	Allows editing of source tapes from the Teletype console. Runs on PDP-8*.
MLA (Microprocessor Language Assembler)	Assembles source programs into binary tape format. Runs on PDP-8*.
MRP (Microprocessor ROM Programmer)	Programs PROM's from assembler's binary tape output. Runs on PDP-8*.
MDP (Microprocessor Debugging Program)	Aids in debugging of binary programs. Runs on MPS.
MTD (Master Tape Duplicator Program)	Copies paper tapes. Runs on PDP-8*.
MHL (Microprocessor Host Loader Program)	Loads binary-coded tapes into PDP-8 memory. Runs on PDP-8*.

* Except PDP-8/S

KC341 Monitor and Control Panel


FLIP CHIP®
CS ABCDEFHJKLMNPRSTUVWXYZ

Microprocessor Language Editor (MLE)

The Microprocessor Language Editor is a PDP-8 based editor oriented to paper tape usage. It is interactive and offers an extensive set of commands which can be entered from the Teletype terminal or similar keyboard terminal. It is used primarily as an on-line tool for the creation and modification of source program tapes.

The Editor is the standard PDP-8 PAL Editor and is provided in the form of a binary tape which is loaded into memory by means of the MHL program, using either the low- or high-speed paper tape reader.

The Editor facilitates both program entry and program correction. Source text is entered either directly from the keyboard or via the low-speed (Teletype terminal) or high-speed paper tape reader. Once in memory, the program text can be freely changed, deleted, or reformatted.

Microprocessor Language Assembler (MLA)

The Microprocessor Language Assembler is a powerful paper tape-oriented system which is used to assemble source code on a PDP-8 minicomputer and convert it into binary output which is then loaded and executed on the CPU Module. Input to the MLA is usually prepared with the aid of the MLE program; source text can, however, be generated off-line on a DIGITAL LT33-D Teletype terminal.

Microprocessor Read-Only Memory Programmer (MRP)

The MRP is a PDP-8 based program which, in conjunction with the PDP-8 and a PROM hardware programming option, allows the user to load, verify, and modify programs in a PROM chip. Data can be entered by means of binary paper tapes produced by the MLA, or directly from the Teletype terminal keyboard.

Microprocessor Debugging Program (MDP)

The MDP resides in the Microprocessor Series memory and is used during application program development to assist in debugging. It permits debugging via the Teletype keyboard and offers the following capabilities:

- Load a binary paper tape produced by MLA.
- Punch the contents of part or all of MPS memory in MLA binary format.
- Inspect part or all of MPS memory (octal type-out).
- Modify read/write memory (octal type-in).
- Set or move a program breakpoint.
- Start program execution at specified address (octal type-in).

Master Tape Duplicator Program (MTD)

The MTD copies and verifies 8-channel paper tapes. It is provided in the form of a binary paper tape which is loaded into memory by means of the MHL program.

Microprocessor Host Loader Program (MHL)

The MHL is a RIM-formatted tape used to load 8-channel paper tapes that are punched in binary code into the PDP-8 memory.

← M7346 External Event Detection Module

digital

COMPONENTS GROUP

Unbundling the world's most popular minicomputers.

Meet the Components Group now—we've got a lot to talk about.
Call us direct at

800-225-9480

Toll-free from 8:30 AM to 5:00 PM your time.*
* US only. Massachusetts residents, please dial (617) 481-7400.

Digital Equipment Corporation, Components Group,
One Iron Way, Marlborough, Massachusetts 01752.

In Canada: Digital Equipment of Canada Limited,
P.O. Box 11500, Ottawa, Ontario, K2H8K8, (613) 592-5111.

DIGITAL EQUIPMENT CORPORATION, Maynard, Massachusetts, Telephone: (617) 897-5111 • ARIZONA, Phoenix • CALIFORNIA, Sunnyvale, Santa Ana, Los Angeles, Oakland, San Diego and San Francisco (Mountain View) • COLORADO, Englewood • CONNECTICUT, Meriden, Fairfield • DISTRICT OF COLUMBIA, Washington (Lanham, Md.) • FLORIDA, Orlando • GEORGIA, Atlanta • ILLINOIS, Northbrook • INDIANA, Indianapolis • LOUISIANA, Metairie • MASSACHUSETTS, Marlborough and Waltham • MICHIGAN, Ann Arbor and Detroit (Southfield) • MINNESOTA, Minneapolis • MISSOURI, Kansas City and Maryland Heights • NEW JERSEY, Fairfield, Metuchen and Princeton • NEW MEXICO, Albuquerque • NEW YORK, Huntington Station, Manhattan, New York, Syracuse and Rochester • NORTH CAROLINA, Durham/Chapel Hill • OHIO, Cleveland, Dayton and Euclid • OKLAHOMA, Tulsa • OREGON, Portland • PENNSYLVANIA, Bluebell and Pittsburgh • TENNESSEE, Knoxville • TEXAS, Dallas and Houston • UTAH, Salt Lake City • WASHINGTON, Bellevue • WISCONSIN, Milwaukee • ARGENTINA, Buenos Aires • AUSTRALIA, Adelaide, Brisbane, Canberra, Melbourne, Perth and Sydney • AUSTRIA, Vienna • BELGIUM, Brussels • BRAZIL, Rio de Janeiro, Sao Paulo and Porto Alegre • CANADA, Calgary, Montreal, Ottawa, Toronto and Vancouver • CHILE, Santiago • DENMARK, Copenhagen • FINLAND, Helsinki • FRANCE, Grenoble and Paris • GERMANY, Berlin, Cologne, Hannover, Frankfurt, Munich and Stuttgart • INDIA, Bombay ISRAEL, Tel Aviv • ITALY, Milan and Turin • JAPAN, Tokyo • MEXICO, Mexico City • NETHERLANDS, The Hague • NEW ZEALAND, Auckland • NORWAY, Oslo • PHILIPPINES, Manila • PUERTO RICO, Santurce • SPAIN, Barcelona and Madrid • SWEDEN, Stockholm • SWITZERLAND, Geneva and Zurich • UNITED KINGDOM, Birmingham, Bristol, Edinburgh, London, Manchester and Reading • VENEZUELA, Caracas

PRINTED IN U.S.A. RA 04271 75 0150/53 M 20 15