Microdata

Micro 1600 Computer

GENERAL DESCRIPTION

The Micro 1600 is a microprogrammable digital computer with broad application capabilities and excellent performance at a practical price. It has a control section which is in itself a programmable computer incorporating a control memory and an organized set of microcommands. These microcommands generate the control and timing signals required to perform all control operations and data manipulations in the machine.

Control memory may be implemented in bi-polar read-only memory (BROM), programmable read-only memory (PROM) and alterable read-only memory (AROM) devices. BROM is for hardwired permanent installation of debugged and field proven routines. PROM permits microprograms to be installed at the field or factory level. It is intended for use where production requirements are limited. AROM permits the debugging of microprograms in a real time environment prior to implementation into the more permanent BROM or PROM systems.

This machine can be applied directly to problem solutions by full programming at the micro level. Or it may be applied by emulating operation of a macro level computer which stores software instructions in core memory. In the latter case, macroinstructions are fetched and interpreted by the micro program with corresponding operations carried out by execution of microprogrammed routines in the control memory. This way emulators may be designed to tailor the software machine for a particular class of applications.

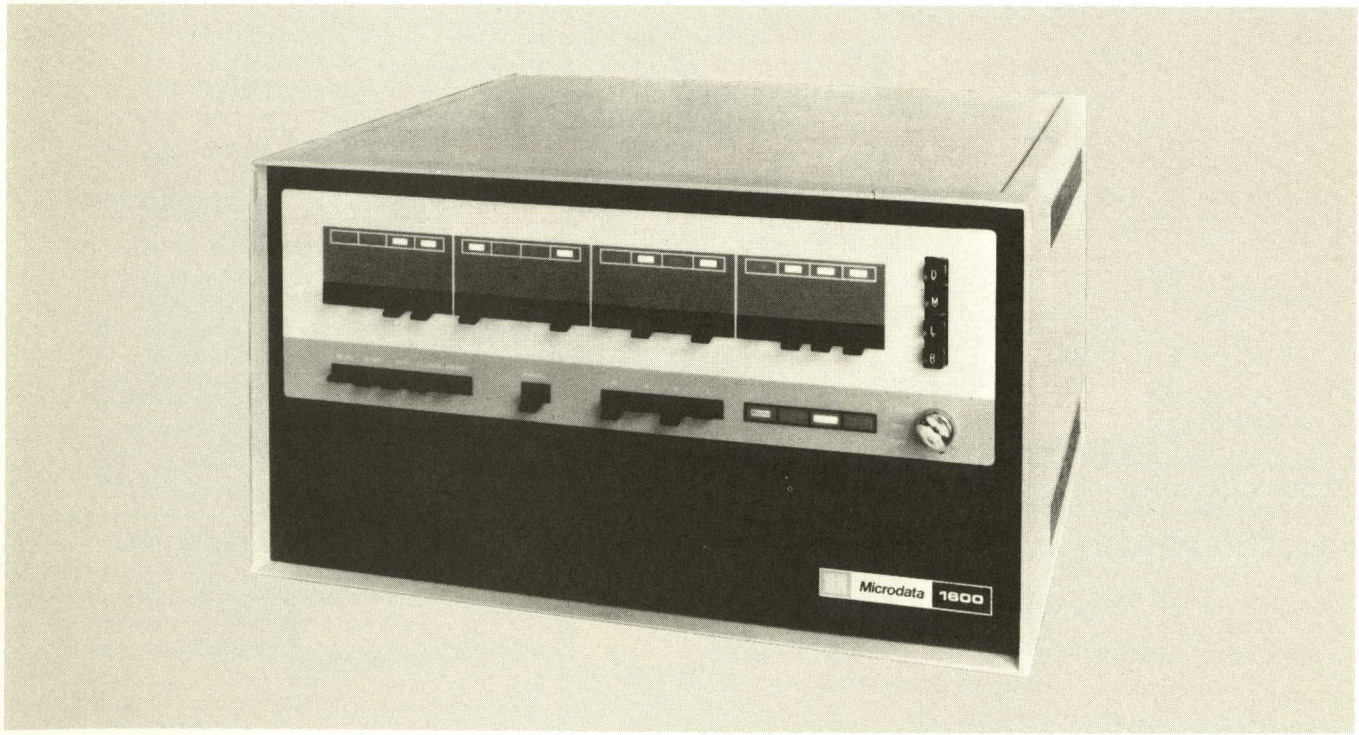
Micro 1600 can be provided with a basic macroinstruction set which is considerably more powerful and an I/O structure which has greater flexibility than conventional machines in its price class. Individual users can add to or modify the basic macroinstruction set and basic I/O structure by a simple addition or change of microcommands in the control memory, thereby increasing the flexibility and utility of the machine.

There are 30 general-purpose file registers which are implemented with MSI/LSI semiconductor devices. Under program control, these registers can be assigned the function of buffer register, accumulator, index register, or program counter. This key feature provides flexible architecture and effective cost/performance.

Operation is byte oriented with an 8 bit word length. Under control of microprogram commands, effective word length, may be a variable number of bytes in length.

APPLICATION INFORMATION

Through microprogramming, the 1600 can operate in a variety of applications. It works as a direct-function processor, general-purpose computer, special-purpose computer, emulator or compiler-language processor. It is particularly effective as a direct compiler language processor because the micro memory can be extended up to 16K X 16. This permits implementation of higher level languages such as



BASIC, COBOL, FORTRAN, SNOBOL, ATLAS or equivalent. Utilization of large arrays of high-speed read-only memory for language implementation eliminates intermediate compile operations and results in an interpretive processor with compile-and-go capability in the machine at all times.

Packaging variations permit operations ranging from a stripped down mini computer with 2 printed circuit boards and a card cage to a "super" computer utilizing multiprocessor capability.

FUNCTIONAL ORGANIZATION

The control, processor, memory and input/output sections are the four major segments of Micro 1600 organization.

Control Section

This section consists of the microprogram control memory, microprogram locations counter (L), R register, U register, timing and control circuits, R Bus and command decoders. Control console inputs for manual operation are also provided.

The microprogram control memory contains stored commands which determine the microprogram sequences of the machine. It is implemented with LSI semi-conductor elements in groups of 256 words. Operating speed is 200ns. Capacities range from 256 to 16,384 words (16 bits per word).

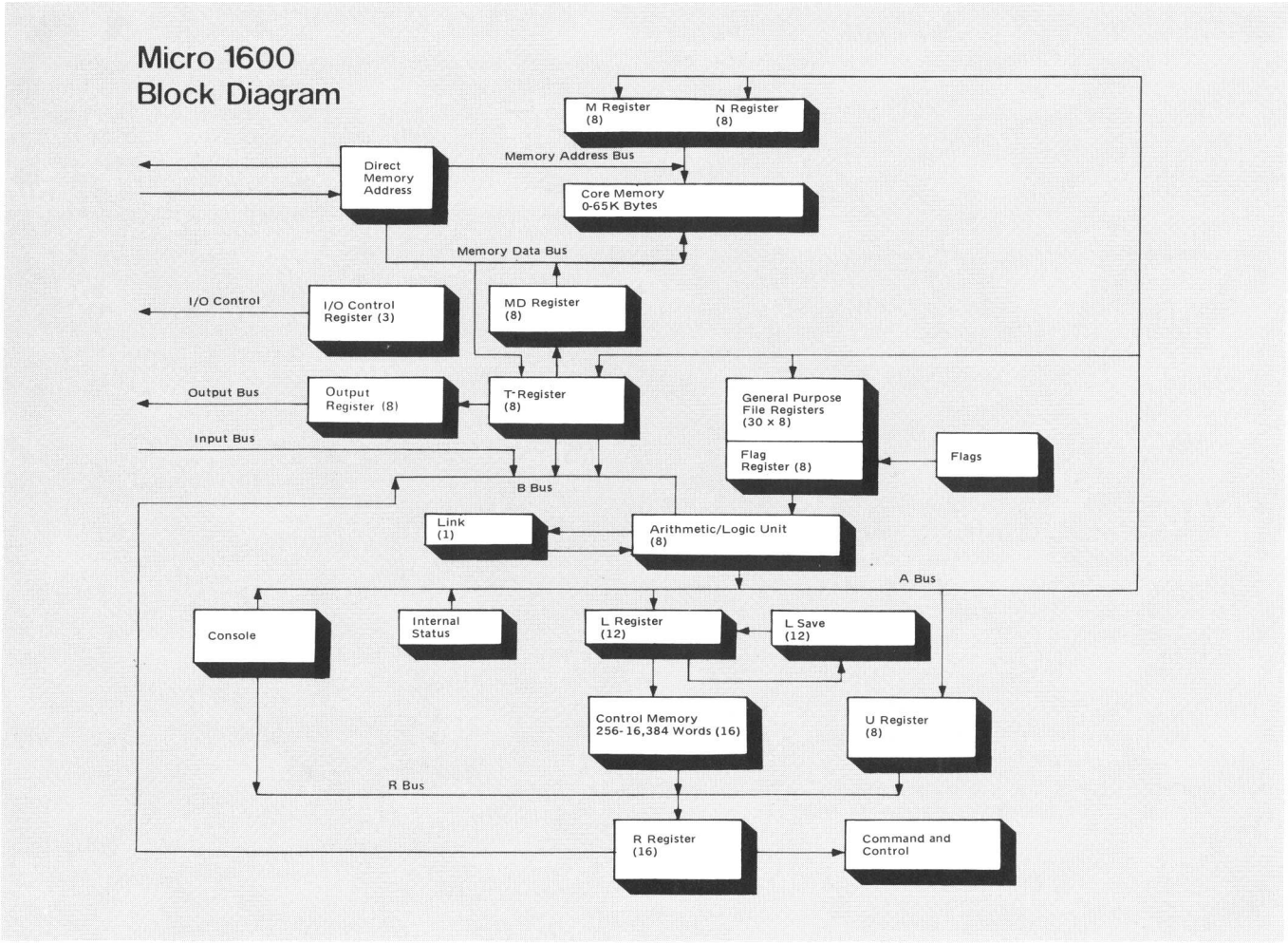
The maximum amount of bi-polar ROM using present devices is 16,384 words although addressing is provided for up to 32,768 words. Control memory addressing is direct within the first 4096 words, and no special programming procedures are required. Expansion above the first 4096 words is accomplished by the addition of standard expansion modules which can contain up to 4096 words each. Use of these modules requires the control memory extended addressing option to permit block selection by the microprogram.

An electrically alterable control memory (AROM) is available which permits microprograms (firmware) to be easily changed using standard I/O devices. This memory uses semiconductor bi-polar random access devices, implemented in groups of 256 words, with a maximum system capacity of 4096 words.

The Alterable Control Memory (AROM) may be used in conjunction with other fixed-control memory. 1024 words can be plugged into the standard enclosure. If more AROM is required, auxiliary +5V power and system cooling should be provided, requiring a special system configuration.

Processor Section

The processor section is organized around the arithmetic/logic unit (ALU) with two busses (A and B) provided for data transfers. A temporary buffer (T) plus a dual set of general purpose file registers are provided for high-speed data manipulation and storage. The T register is buffered by transient data registers which are transparent to the micro-



program: the MD register buffers T during memory write cycles; the output register buffers T during I/O data output operations.

The CPU contains two sets (primary and secondary) of 15 general-purpose file registers. Selection of the primary or secondary group is by the microprogram. Registers within the selected group are directly addressable 1-15 by microcommands. Functionally, register 0 of both groups stores various flags which are common to both groups. This register cannot be program loaded but can be read by microcommand by addressing file register 0 regardless of the group presently selected.

Memory Section

The memory section consists of modular 4096 or 8192 word pluggable magnetic core memory modules which permit expansion to 65,536 bytes within the computer cabinet. Modules of different sizes may be intermixed within a given system. For example, a 4096 byte module may be combined with an 8192 byte module to yield a 12,288 byte capacity. Core memories may be run on either full or half cycles as specified by the microprogram. The full cycle time is 1.0 microseconds, with an effective access time of 400ns relative to the 200ns microcommand cycle time. The effective repetitive half cycle time is 600ns relative to the 200ns microcommand clock.

This section also includes address and data registers plus control and timing circuits for memory operations. Direct memory access is standard with complete selector channel available as options. In addition, interface and control circuits are provided to permit connection of a second slave microprogrammable CPU to share core memory with the main CPU.

Input/Output Section

The input/output consists of a set of data input and data output lines plus a group of three encoded I/O control lines controlled by the microprogram. These I/O lines are available on the computer backplane for direct use by device controllers mounted within the enclosure. Standard option cards buffer the internal I/O onto an external I/O bus containing the same set of control and data lines for device controllers external to the computer enclosure.

SPECIAL CPU FEATURES

Power Fail Detect and Automatic Restart

In conjunction with the power supply, this standard feature monitors the ac line for power drop-out on significant voltage transients. Upon detection of such a condition, it generates an internal power fail interrupt to the processor. This interrupt should cause a jump to a "power-is-failing" subroutine. Purpose of the subroutine is to store in memory all flags and registers which are volatile during power shutdown or turn on.

Real Time Clock

The optional real time clock is a 12-bit preset counter which, when enabled, will generate an internal interrupt each time it counts to all one's. Presetting the counter to the proper value determines the interrupt rate. Although set for a 1KHz rate, other interrupt rates from less than 500Hz to greater than 100KHz are available by selective strapping on the board.

SYSTEM POWER SUPPLIES

The integral system power supply physically mounts in the Micro 1600 cabinet along the left-hand side (from rear) by sliding into standard card-guide assemblies. A direct plug in to the backplane via a standard printed circuit connector supplies d.c. voltages directly to the circuit boards via etched conductors. By using an extension cable a remote system power supply may be rack mounted separate from the Micro 1600 cabinet.

CONTROL CONSOLE OPTIONS

Two control console options are available with the Micro 1600: system console and basic console. This feature permits the user to tailor the cost vs. control capability to a particular application.

The basic console provides a minimal control capability and is designed for dedicated system installations where the system control point is removed from the 1600.

The system console provides expanded control plus a selectable display of all hardware registers in the machine including the files. It is designed for maintenance operations and for installations where system development and firmware checkout is being performed.

Both console panels are pluggable and fully interchangeable without modification to the computer.

ADVANTAGES

Economy

Low price, both for basic and expanded configurations. Simple interfacing and expansion in standard enclosure minimize overall system cost.

Flexibility

Microprogramming permits tailoring of processor architecture to individual applications.

Modularity

Modular design of core memory, processor, microprogram control memory, and input/output modules provides easy, economical expansion of all functional areas of the machine.

Expandability

Extra space and power in the basic enclosure permits growth from a minimum to a fully expanded configuration without the need for special or expansion enclosures. User designed interfaces can be installed in the computer cabinet.

Utility

Many designed-in features make the 1600 easy to install, program, operate and maintain.

Packaging

Convenience and economy for both the OEM and end user are provided through a range of packaging options, starting with a simple rack-mounted card cage and extending through an attractive and distinctive table top enclosure. The rack-mount version has a panel height of 10.5 inches and a depth of 20 inches.

Dual Processor

Two microprogrammed CPU's can share core memory to provide essentially twice the throughput of a single CPU at only a small increase in processor cost.

Macro Processors

Three standard macro processors, the 1600/10, 1600/20 and 1600/21, are presently provided, with others now in development. They permit users to apply the machine using conventional software programming but provide system features which are found only in machines outside the minicomputer class.

EXTENSIVE SOFTWARE/FIRMWARE

Extensive software and firmware are available to support application of the Micro 1600, including firmware development:

Micro 1600

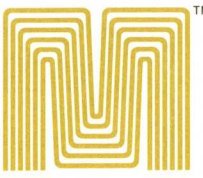
AP1600	Micro language cross assembler written in FORTRAN for operation on numerous large-scale computers.
MAP1600	Micro language assembler written for use on the Micro 1600/20/21 computers.
SIM 1600	Micro 1600 simulator written for use on the Micro 1600/20/21 computers.
SIM 16F	Micro 1600 simulator written in FORTRAN IV for operation on medium and large scale computer systems.
ICM	Integrated circuit memory MAP generator permits direct conversion of AP/MAP1600 outputs to control memory bit patterns.
ROM Diagnostics	Standard CPU diagnostics in read only memory can be added to the basic computer or plugged in for maintenance purposes.

Micro 1600/10/20/21

AP1600/10/20/21	Cross assemblers written in FORTRAN for operation on numerous large-scale computers.
MAP1600/10/20/21	Machine language symbolic assemblers for use on the 1600/10/20/21 computers.
TOS	Teletype operating system.
TED	Tape editor.
Diagnostics	CPU, memory, and peripheral interface diagnostics for 1600/10/20/21 computers.
MUX1600/20	Communications multiplexer firmware option for 1600/20 computer to handle multiple asychronous communications lines.
AROS	Alterable read only memory (AROM) operating system for control of AROM used for firmware checkout and debug.

MICRO 800/1600 COMPATIBILITY

From the beginning, the Micro 1600 was meant to be a computer with performance characteristics which exceeded those of the conventional machine. Each phase of design and development proceeded with improved performance as a goal. As a result, the Micro 1600 is a completely new computer. Yet it has the unique advantage of upward compatibility with over 1000 Micro 800 systems already delivered. In most instances, hardware, software and firmware created for the Micro 800 can be converted to Micro 1600 use with improved cost/performance.



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