

intel
intellic 4
and
Micro Computer
Modules

New, Easy and Inexpensive
Way to Develop Micro
Computer Systems

MCS-4 THE FOUR-BIT
MICRO COMPUTER SET

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Today, Intel offers the systems designer an alternative to expensive minicomputers or even more expensive random logic systems . . . the MCS-4 Micro Computer. Utilizing the technologies and experience gained in becoming the world's largest supplier of LSI components, Intel has made the power of the digital computer available at the integrated circuit level. One LSI circuit in a DIP package contains the entire CPU of the micro computer, and when this circuit is combined with others to provide memory and control programs, the computer is complete. The smallest computer would consist of only two devices, both in DIP packages; when combined with I/O circuits and a clock it could function in relatively simple applications. Computers for more complex applications can be built entirely on one small PC board containing all I/O circuits and clocks.

The final version of the micro computer that is used in your product will consist of a combination of two or more basic parts. The 4004 CPU is the heart of the micro computer and is responsible for all of the basic operations performed by the system. Data and certain types of programs will be stored in 4002 RAM circuits, while the basic program itself is stored in 4001 ROM circuits. Both the RAMs and ROMs provide I/O capability for the system. In addition, a special 4003 Shift Register can be used for expanding the number of system outputs.

Every system will contain one CPU and at least one ROM. While the use of RAMs and Shift Registers is optional, they will be required for most practical applications. These circuits make up the MCS-4 micro computer set, a family of compatible LSI devices that require very little in the way of peripheral circuitry to build working systems. In addition to the basic four devices, two others, the 4008 and 4009, allow the CPU to be used with standard memory devices such as the 2102 RAM and the 1702A PROM for program storage. This eliminates the need for metal-programmed ROMs and allows the user to program his devices himself without requiring the generation of metal masks. The resulting system operates on a 10.8 μ s instruction cycle. The instruction set itself contains 46 instructions, including Conditional Branching, Jump to Subroutine and Indirect Fetching. The system operates in either binary or decimal arithmetic modes; addition of two 8-digit numbers is accomplished in 850 μ s. The use of a bus allows the user to expand the system easily. One CPU can directly drive up to 32,768 bits of ROM and up to 5120 bits of RAM.

Intellec 4, and Micro Computer

Modules: The introduction of the MCS-4 micro computer set by Intel has resulted in the widespread use of microcomputers in everything from banks to blood analyzers. Available at an order of magnitude lower cost than the lowest of the minicomputers, Intel's MCS-4 micro computer is being used in applications that were not feasible only a few short years ago. The use of micro computers reduces the task of system design to one of writing programs and designing I/O circuits. And since systems can be drastically changed with few board changes by simply changing the control programs that direct the micro computer, the problem of obsolescence is reduced. Thus micro computers can bring new systems to market very quickly and at a much lower development cost than previously possible.

Still, the writing of the micro computer control programs does take time, and since the programs are contained in ROMs, metal programmed by Intel to your specifications, any mistake in programming is costly and time consuming. To minimize the time associated with the writing and debugging of programs, Intel has developed the Intellec 4 programming and prototype system for the MCS-4. Since the Intellec system does not use ROMs for program storage, programming errors are easily and quickly corrected.

RAMs are used with special interface circuitry to simulate the ROMs that are normally used with the MCS-4. Because new programs can be written into these RAMs very easily, the time associated with debugging programs is shortened dramatically. Then when the program is correct it can be transferred to either the normal 4001 metal programmed ROMs used with the MCS-4, or optionally into the 1702A PROMs that are becoming increasingly popular with this set. The PROM, Programmable Read Only Memory, is a special type of ROM that can be programmed, erased and reprogrammed, all by the user.

Intellec 4 Four-Bit Micro Computer

Development System: The Intellec 4 is a flexible, inexpensive and simple method for developing OEM systems. It is a self-contained system, complete with 4004 Central Processor, crystal clock, power supplies, displays, control panel and finished cabinet. Built around a set of compatible boards called micro computer modules, the Intellec is easily expanded to cover more complex applications. I/O channels provide sixteen 4-bit input ports and thirty-two 4-bit output ports—all TTL compatible. Programs are executed from one of three 4K program memories. The system comes with a standard software package that includes a system monitor and resident assembler. The programmer can prepare his program in mnemonic form, assemble it, and use the monitor to load the assembled program for execution. Other development tools for the Intellec 4 include a cross assembler and simulator designed to operate on large general purpose computers.

Standard Micro Computer Modules:

Micro computer modules are standard cards that may be purchased individually. They are designed to be used with either the Intellec 4 or a system of your own design. Additional Memory, I/O and other standard modules provide expansion capability.

Intellec 4

The Intellec 4 is a complete micro computer development system for MCS-4 micro computer systems. Its modular design allows the development of any size MCS-4 system, and includes built-in features that make the development process easier than ever before.

The basic Intellec 4 consists of three micro computer modules (CPU, RAM and RAM CONTROL), power supplies, console and displays, all packaged in a compact cabinet. The heart of the system is the imm4-42 Control Processor Module built around the 4004 CPU. 4008 and 4009 interface circuits use 1702A PROMs or 1302 ROMs to simulate the 4001 ROMs that are used for program storage in the standard MCS-4 set (the module contains sockets so that the user may use either 1702A or 1302s at his option). A special set of PROMs contains the System Resident Monitor and when these are in place programs can be loaded into program RAM. Data storage is provided in four 4002 RAMs that have capacity for 320 four-bit words. A crystal controlled master system clock, four 4-bit input ports, eight 4-bit output ports with teletype interface and control complete the module.

Intellec 4: Complete MCS-4 Micro Computer Development System
Allows all Program Development to be done in RAM Memory
Standard Software Includes Resident System Monitor and Assembler
5K Eight-Bit Bytes of Program Memory (Switchable in 4K Segments), Expandable to 12K Consisting of:
4K Bytes of PROM (Monitor)
4K Bytes of RAM
4K Bytes of PROM

320 4-Bit Words of Data Storage Memory (Expandable to 2560 4-Bit Words)
I/O Expandable to 32 4-Bit Output Ports and 16 4-Bit Input Ports
Direct Access to RAM Memory from Front Panel
Crystal Controlled Master System Clock

The main program memory of the Intellec 4 is the imm6-28 RAM Memory Module (4096 x 8). It is interfaced to the Processor Module with the imm4-72 RAM Control Module. Under control of the System Monitor, programs may be loaded into the RAM Module and executed. This allows software development in RAM memory, eliminating the procedure of programming and erasing PROMs.

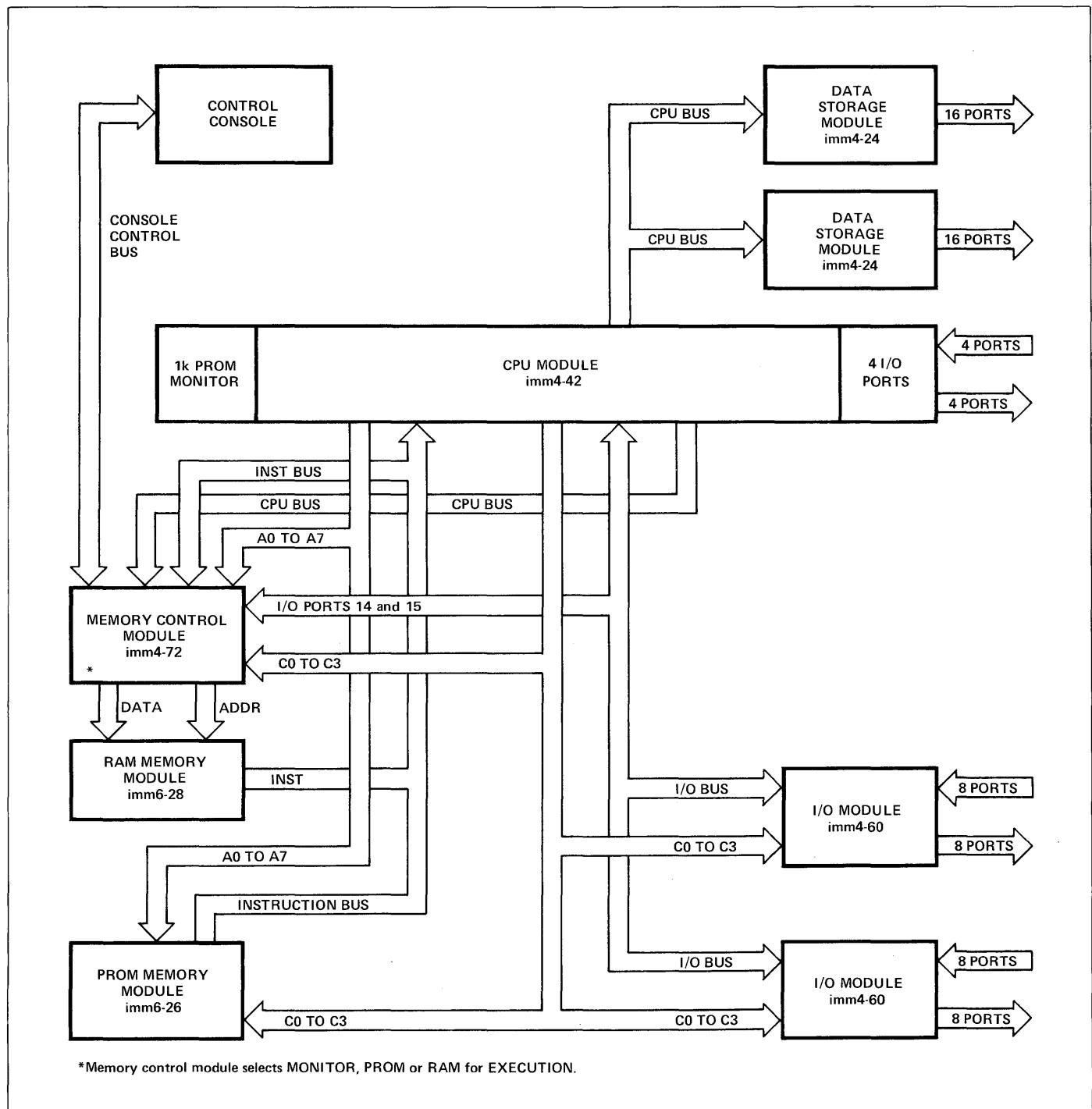
Expansion of the Intellec 4 may be done in three areas: program memory, data storage memory and I/O. Using the imm4-22 expands all three at once—program memory to 4096 bytes, data storage memory to 2560 4-bit words and I/O to sixteen input and sixteen output ports. Other modules expand only certain of the three areas. The imm6-28 RAM Memory Module expands the program storage area, the imm4-24 Data Storage Module expands data storage, and the imm4-60 Input/Output Module expands the system I/O.

Additional module locations are available in the Intellec 4 so the user may develop his own custom interface using the imm6-70 Universal Prototype Module. All necessary control signals, data and address buses are present at the connectors of the unused module locations for this expansion. When memory, I/O and custom interfaces are added to the Intellec 4, care should be taken not to exceed the built-in power supply capability of the Intellec 4.

Every Intellec 4 comes with two pieces of basic software, the System Monitor contained in the 1702As and located on the imm4-42 module as described above, and an Assembler. The Assembler is provided on paper tape and loaded into and executed from RAM program memory.

With the PROM Programmer Module, the imm6-76, 1702A PROMs may be programmed and verified by the Intellec 4.

System Block Diagram



Intellic 4 Control Console and Display

The Control Console directs and monitors all activities of the Intellic 4. Complete processor status and machine cycle conditions are displayed, and operational control of all processor activity is provided. Additional controls facilitating program debugging and hardware checkout are included on the control console.

ADDRESS is a display of the current address being accessed in program memory.

1. INDICATORS 0-11 are a display of the memory address being displayed during CMA or SEARCH operations. (see CMA and SEARCH ADDRESS CONTROL, 18-24)

STATUS is a display of the operating mode of the processor.

2. SEARCH COMPLETE indicates the processor has executed instructions until the search address and pass counter settings have been reached. (see SEARCH ADDRESS CONTROLS, 17-21 and PASS COUNTER, 17)

3. CPU indicates the processor is operating.

4. POINTER VALID indicates that the LAST RAM/ROM POINTER is valid. (see LAST RAM/ROM POINTER 11)

INSTRUCTION is a display of the information contained in the currently addressed location in memory.

5. INDICATORS 0-3 (M2) and 4-7 (M1) are a display of the instruction fetched at M1 and M2 from the location displayed in ADDRESS. (see ADDRESS 1)

ACTIVE BANK is a display of the active bank of RAM data storage memory.

6. CM-RAM 0-3 indicators display the active bank of RAM selected on the previous DCL command.

MODE is a display of the active bank of program memory. (see MODE CONTROL 14, 15 and 16)

7. MON indicates the memory containing the Resident System Monitor is active.

8. PROM indicates that the PROM program memory bank is active.

9. RAM indicates the RAM program memory bank is active.

EXECUTION is a display of the processor data bus during execution of an instruction.

10. INDICATORS 0-7 display the contents of the processor bus during X2 and X3 execution times.

LAST RAM/ROM POINTER is a display of the current RAM and ROM address pointer.

11. INDICATORS 0-7 are a display of X2 and X3 during the last SRC (send register control) command. Validity of this display is indicated by the POINTER VALID display. (see POINTER VALID 4)

ADDRESS/DATA consists of twelve switches through which both memory addresses and data are entered during SEARCH and CMA operation. (see SEARCH ADDRESS 18-22 and CMA 25 & 26)

12. SWITCHES 0-11 are used to enter memory addresses for SEARCH MODE and CMA operation. (see SEARCH ADDRESS CONTROLS, 18-22 and CMA 23 and 24)

13. SWITCHES 0-7 are used to enter data into RAM PROGRAM MEMORY during a CMA operation. (see CMA 25 and 26)

MODE CONTROL consists of three switches which select the bank of program memory from which the processor executes code.

14. MON selects the bank of memory containing the system monitor.

15. RAM selects the RAM program memory bank for execution.

16. PROM selects the optional PROM program memory for execution.

PASS COUNTER

17. SWITCHES 0-3 enter the data for successive passes through the search address during a SEARCH OPERATION.

SEARCH ADDRESS CONTROLS:

These switches control SEARCH MODE and CMA addressing. (see CMA 25 and 26)

18. RUN overrides SEARCH MODE OPERATION.

19. NEXT INST. causes search mode to terminate at the next location following the designated search address.

20. DECR decrements the address loaded from the ADDRESS/DATA switches by one.

21. INCR increments the address loaded from the ADDRESS/DATA switches by one.

22. LOAD loads the address from the ADDRESS/DATA switches into an address register for SEARCH MODE or CMA operation.

TEST

23. HOLD sets the processor TEST line to a true or false condition.

24. ONE SHOT momentarily pulses the processor TEST line to a true condition.

CMA Console Memory Access

25. Enables and disables the console memory access feature.

26. WRITE deposits the data in ADDRESS/DATA switches 0-7 in the memory address previously loaded from the ADDRESS/DATA switches.

RESET CONTROL

27. RESET causes the processor or the system to be reset, depending upon the MODE 28.

28. MODE allows either the system or the CPU only to be reset.

POWER and PROM

29. PROGRAM PROM POWER enables the high voltage for PROM programming.

30. PROGRAM PROM is a zero insertion force socket for the PROM to be programmed.

31. POWER is the master system power switch.

Standard Systems and Optional Modules:

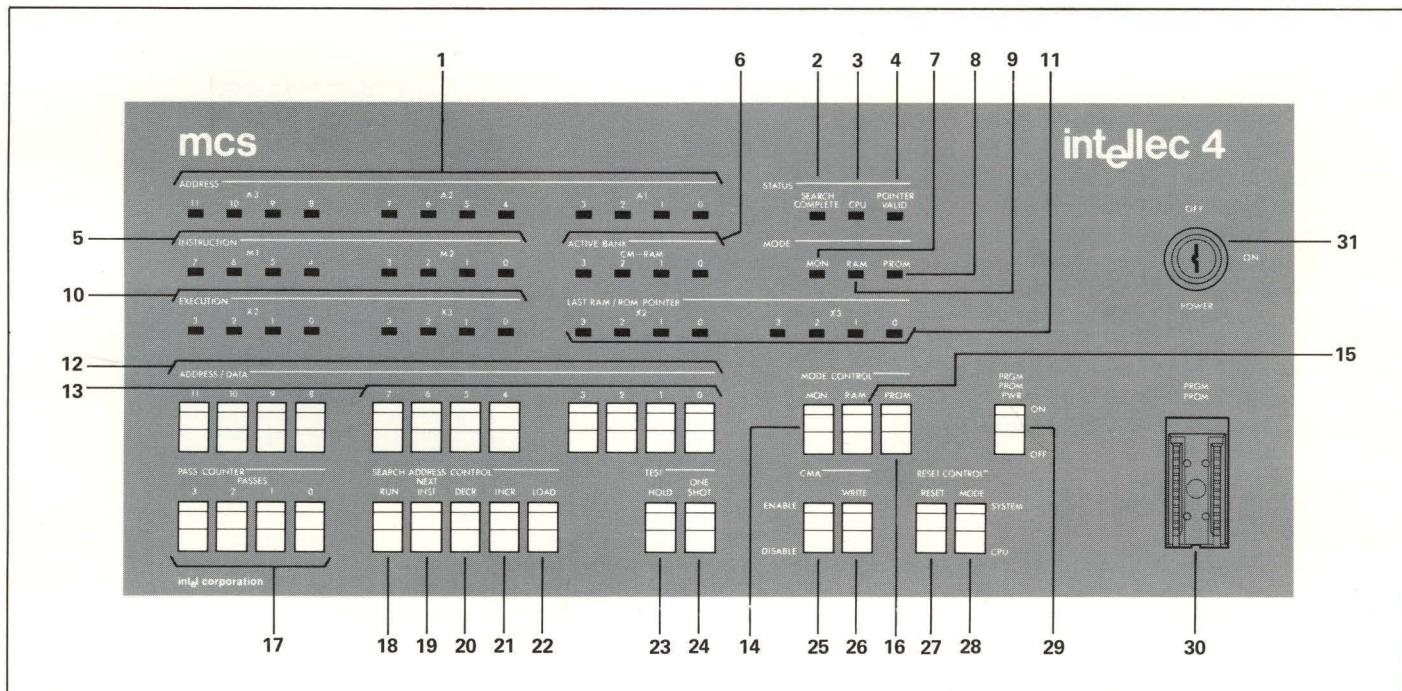
Intellec 4 (imm 4-40A)

Standard system includes the following modules and accessories:

- Central Processor Module
 - Memory Control Module
 - RAM Memory Module
 - PROM Programmer Module
 - Chassis with mother board
 - Power Supplies
 - Control and Display Console
 - Finished Cabinet
 - Standard Software
- System Monitor
Assembler

Optional Modules and Accessories

- I/O Modules
- Data Storage Modules
- Instruction/Data Storage Modules
- PROM Memory Module
- Universal Prototype Module
- Module Extender
- Rack Mounting Kit



System Software

The Intellec 4 is supplied with two software products, the Resident System Monitor and the Symbolic Assembler. The System Monitor is permanently located in PROMs located on the CPU module. The Symbolic Assembler is supplied on paper tape and is loaded using the System Monitor.

System Monitor

Loads and Punches Paper Tape
Displays and Alters Contents of RAM Program Memory
Loads Constants into RAM Program Memory
Moves Blocks of Data in RAM Program Memory
Programs 1602A or 1702A PROMs
The System Monitor is contained in four 1702A PROMs located on the processor module of the Intellec 4, and is executed when the MODE CONTROL on the Control Console is set to MON. It operates on the RAM Program Memory and is used to load programs from paper tape into RAM Program Memory, or to punch programs already contained in RAM Program Memory onto paper tape in either BNPF or hexidecimal format. The monitor also allows the operator to edit the object code in RAM Program Memory. In this mode locations may be displayed and altered, blocks of program may be moved around, and data or instructions may be entered. The System Monitor also contains the software for programming Intel's 1602A or 1702A PROM through the use of the optional imm6-76 Programmer Module. This module can also be used for duplicating or verifying PROMs already containing programs.

Symbolic Assembler

Input via Prepunched Paper Tape
Output in 4004 Object Code
The Symbolic Assembler is a two pass type. During pass one the assembler constructs a symbol table from the source text and generates a source listing. Diagnostics are also printed during pass one and errors are flagged. Operator intervention of the tape reader and subsequent keyboard entries can be used to edit these errors. During pass two the assembler decodes instructions, searches tables for addresses and generates the program object tape. It also prints diagnostics to flag unrecognized instructions, undefined symbols and off page references.

Development Support: Cross Assembler and Simulator:

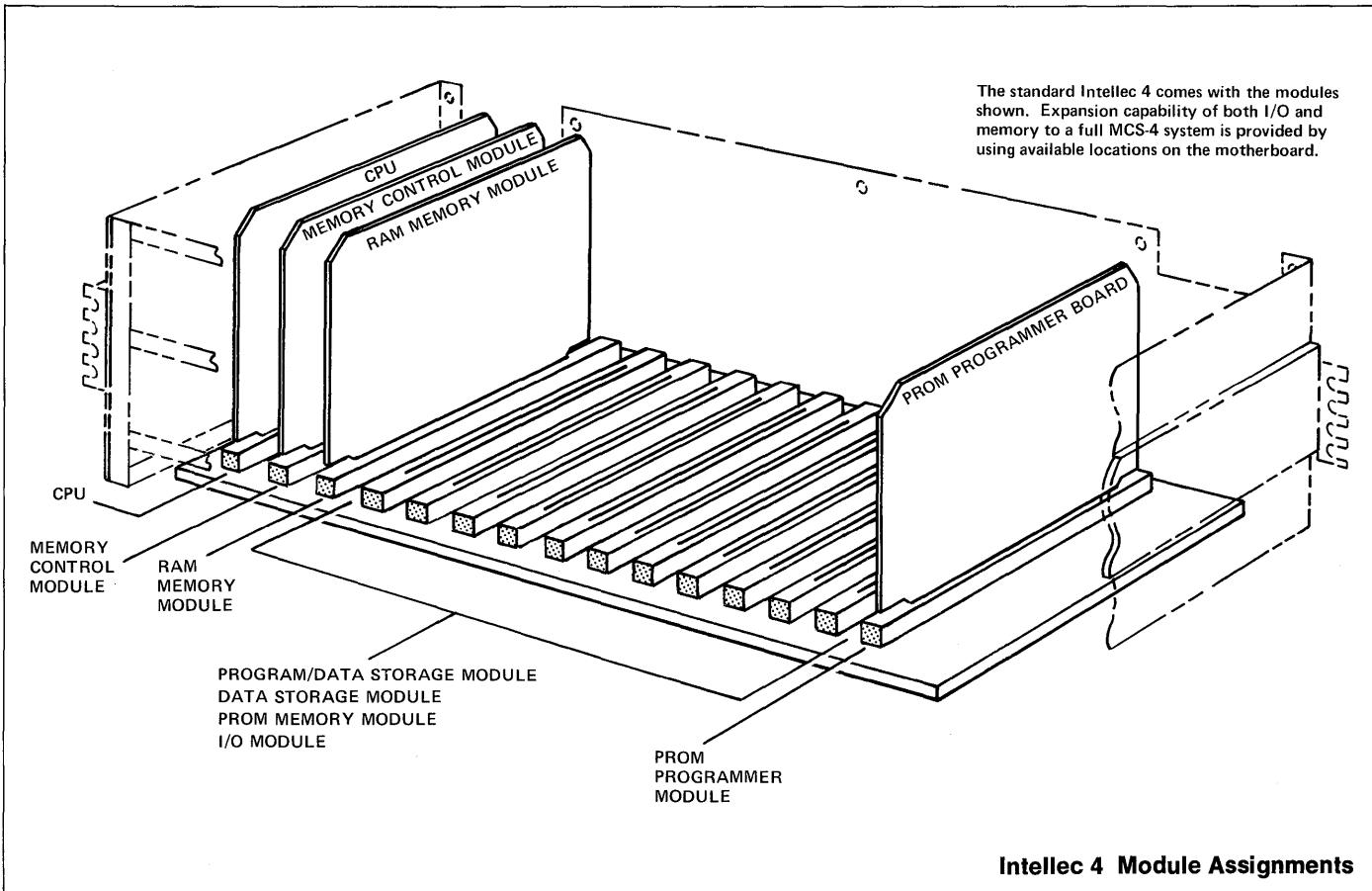
In addition to the standard software available with the Intellec 4, Intel offers a cross assembler and simulator written in FORTRAN IV and designed to run on a large scale computer. These programs may be procured directly from Intel, or alternatively, designers may contact one of several nation-wide computer time-sharing services for access to programs.

Assembler: The MCS-4 cross assembler generates 4004 object code from symbolic assembly language instructions. It is designed to operate from an interactive terminal.

Simulator: The MCS-4 simulator provides a software simulation of the Intel 4004 microcomputer system. It also provides execution monitoring commands to aid in program development.

SYSTEMS SPECIFICATIONS

Word Size:	Data: 4 bits Instruction: 8 or 16 bits	Operating Temp:	0°C to 55°C
Memory Size:	5K bytes expandable to 12K bytes in three 4K byte memories selectable for execution from the control console.	DC Power Supplies:	$V_{CC} = 5V \pm 5\%$, $I_{CC} = 12A$
Instruction Set:	46, including: conditional branching, binary and BCD arithmetic, register to register and memory reference operations.	AC Power Requirement:	$V_{DD} = -10V \pm 5\%$, $I_{DD} = 1.8A$
Machine Cycle Time:	10.8 μ sec	Physical Size:	60Hz, 115 VAC, 200 Watts
System Clock:	Crystal controlled at 750kHz $\pm 0.01\%$	Weight:	Intellec 4: 7" x 17 $\frac{1}{8}$ " x 12 $\frac{1}{4}$ "
I/O Channels:	4 input, expandable to 16. 8 output, expandable to 48. TTL Compatible	Standard Software:	30 lb.
Test Line:	Single level, under program control.	Support Software:	System Monitor Assembler
Memory Cycle Time:	RAM: 1.0 μ s PROM: 1.7 μ s	Cross Assembler Simulator	Written in Standard Fortran IV

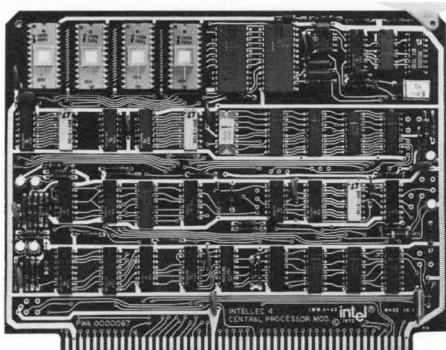


imm4-42 FOUR-BIT CENTRAL PROCESSOR MODULE

Complete microcomputer system with the processor, program storage, data storage, and I/O in a single module
The heart of this module is Intel's 4004 single chip four-bit parallel processor—p-channel silicon gate MOS
Accumulator and sixteen working registers (4-bit)
Subroutine nesting up to 3 levels
CPU interfaces to standard semiconductor memory elements (provided by Intel's standard memory and I/O interface set 4008/4009)

Sockets for 1K bytes of PROM (Intel 1702A PROM) are provided
320 words (4-bit) of data storage (Intel 4002) are provided
Four 4-bit input ports and eight 4-bit output ports (includes TTY interface)
Bus oriented expansion of memory and I/O (maximum of 4K x 8 of program storage, 2560 x 4 of data storage, 16 input ports, 48 output ports)
Two phase crystal clock

This 4-bit Central Processor Module is a complete MCS-4 micro computer system in itself. This is the main module for Intel's Intellec 4™ systems, but it also contains all the elements to make it a complete free-standing computer: the 4004, 4-bit parallel CPU; 320 words (4 bits) of data storage; capacity for 1K words (8 bits) of instruction storage; I/O ports (4-bit); and a crystal controlled clock.



Central Processor Module

The heart of the module is Intel's 4004 CPU. This is a single-chip MOS processor. It interprets and executes 46 instructions including decimal arithmetic, register to register transfers, and conditional branching. Sixteen 4-bit index registers are provided and subroutines may be nested up to three levels. Up to 4K instructions may be directly addressed, and instruction memory can be expanded through bank switching.

Sockets are provided on the CPU module for up to 1K words of instruction in PROM memory (using Intel's 1702A programmable and erasable read-only-memory). Thus systems may be developed on a custom basis and the system personality may be altered merely by changing a PROM. This CPU module is most advantageously used on a free-standing basis when custom systems are required.

Intel's 1302 metal mask programmed ROM may be used in place of 1702A for volume requirements or when it is desirable to mix ROM with PROM in the same system to satisfy semi-custom requirements.

To extend the instruction storage capability, use the PROM Memory Module (imm6-26) to extend up to an additional 4K of memory. Instructions may also be stored in RAM memory using the imm6-28 RAM Memory Module (4K x 8) and the imm4-72 Control Module. The imm4-72 provides complete capability for loading programs into RAM memory and bank switching of instruction memory from the imm4-42 to the imm6-28 for execution.

Data Storage for the CPU module is contained in four 4002 RAMs, each with a capacity of eighty 4-bit words. Data Storage may be expanded to a maximum of 32 RAMs using two Data Storage Modules (imm4-24). Each RAM in the module also contains a 4-bit output port.

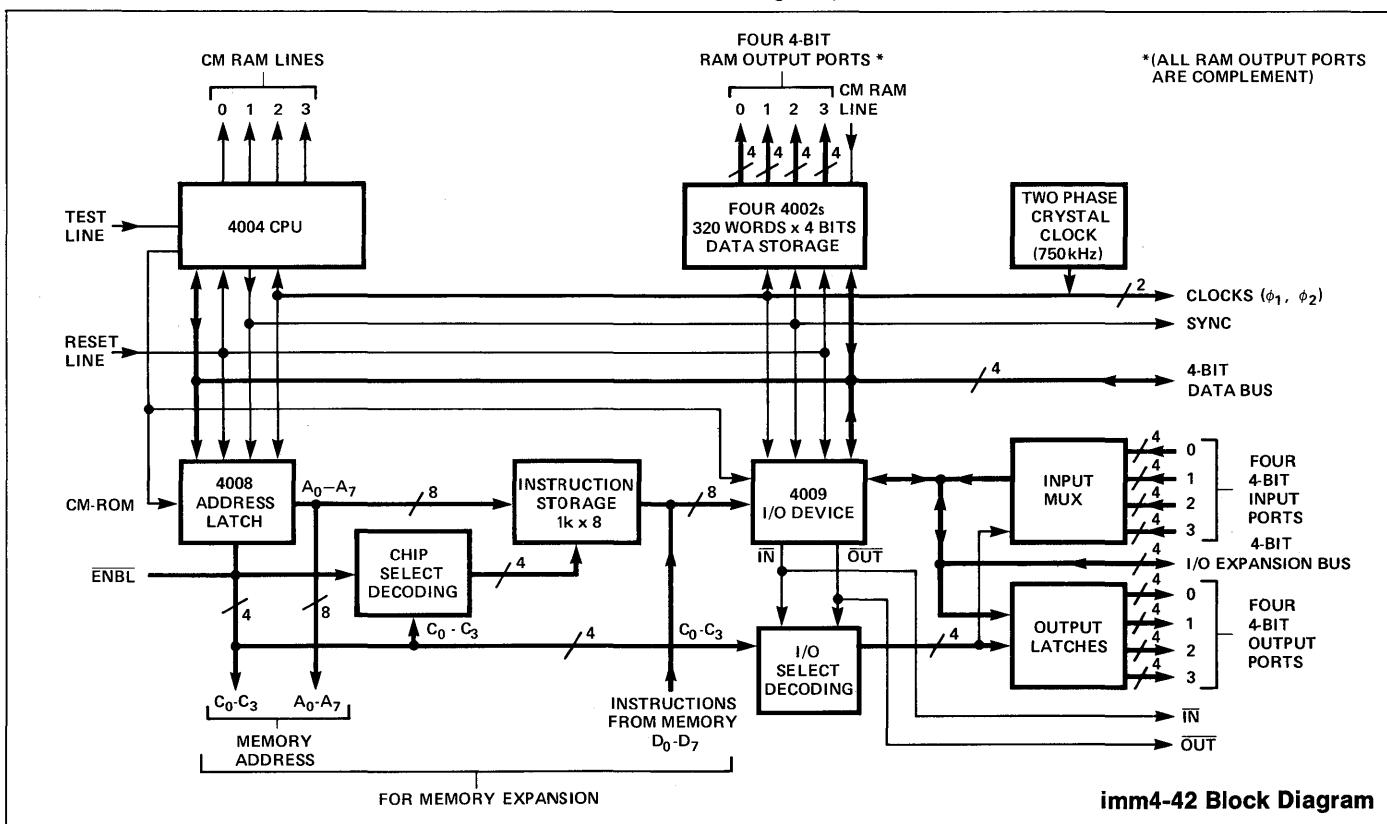
The CPU Module contains a total of four 4-bit input ports and eight 4-bit output ports. All I/O ports are TTL compatible. I/O capability may be expanded by the addition of Input/Output Modules (imm4-60). A combination of I/O, instruction storage and data storage expansion is also provided by the Instruction/Data Storage Module (imm4-22).

All MCS-4 devices used in this module are manufactured using Intel's standard p-channel silicon gate process.

Modules use identical pins for V_{CC} , GND, V_{DD} , clock, sync, and data bus lines to simplify back plane wiring. The complete Intellec 4 system, along with support software, is available for development of 4-bit micro computer systems.

CENTRAL PROCESSOR MODULE specifications

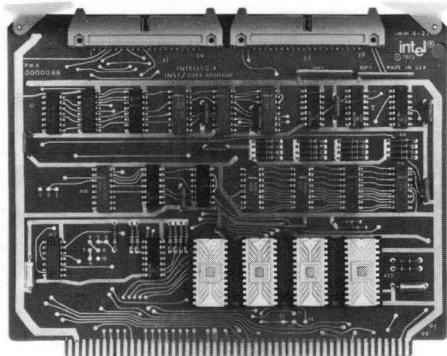
Word Size:	Instruction: 8 or 16 bits Data: 4 bits	I/O Expansion: (via additional modules)	To 16 input ports and 48 output ports
CPU:	4004 CPU 4-bit accumulator Sixteen 4-bit registers Subroutine nesting to three levels 46 including conditional branching, binary and decimal arithmetic, register to register, and I/O	I/O Interface:	All I/O ports TTL compatible. Bus for I/O expansion is TTL compatible. (Positive true logic)
Instruction Set:		Peripherals:	Interface for standard ASR 33 teletype is provided
Memory Size:	Instruction: Capacity for 256 to 1K bytes (8 bits) in PROM or mask programmed ROM (program memory must be purchased separately) Data Storage: 320 words (4 bits)	MCS-4 Components on Module:	one 4004 CPU two 4002-1 RAMs two 4002-2 RAMs one 4008 (Interface)
Memory Expansion:	Instruction: To a maximum of 4K bytes in PROM or switchable to additional 4K bytes in RAM through special control card Data: To 2560 words	Board Dimensions:	one 4009 (Set) four sockets for 1702A PROM 6.18" x 8.0" x 0.062"
Memory Interface:	Instruction Storage: TTL compatible MOS via Intel's 4008/4009 Data Storage: MOS via 4004 CPU data bus	Connector:	Board to be on 0.5" centers min Dual 50-pin on 0.125" centers Connectors in rack must be positioned on 0.5" centers min Wirewrap P/N C800100 from SAE P/N VPB01C50E00A1 from CDC
System Clock:	Crystal controlled, 750kHz ($\pm 0.01\%$) Processor Cycle Time: $10.8\mu s$	Operating Temp:	0°C to 55°C
I/O Channels:	Four 4-bit input ports, eight 4-bit latching output ports	Power Requirement:	$V_{CC} = +5V \pm 5\%$ $I_{CC} = 1.2A$ max, 0.8A Typical $V_{DD} = -10V \pm 5\%$ $I_{DD} = 0.2A$ max, 0.1A Typical
		Support Software:	Cross Assembler Simulator Written in FORTRAN IV



imm4-42 Block Diagram

imm4-22 INSTRUCTION/ DATA STORAGE MODULE

**Sockets for up to four 1702A PROMs
(1024 words of program storage)**
**Four 4002 RAMs (320 words of data
storage)**
Four 4-Bit Input Ports (16 bits)
**Eight 4-Bit Latching Output Ports
(32 bits)**
**Direct Interface with imm4-42 Central
Processor Module**



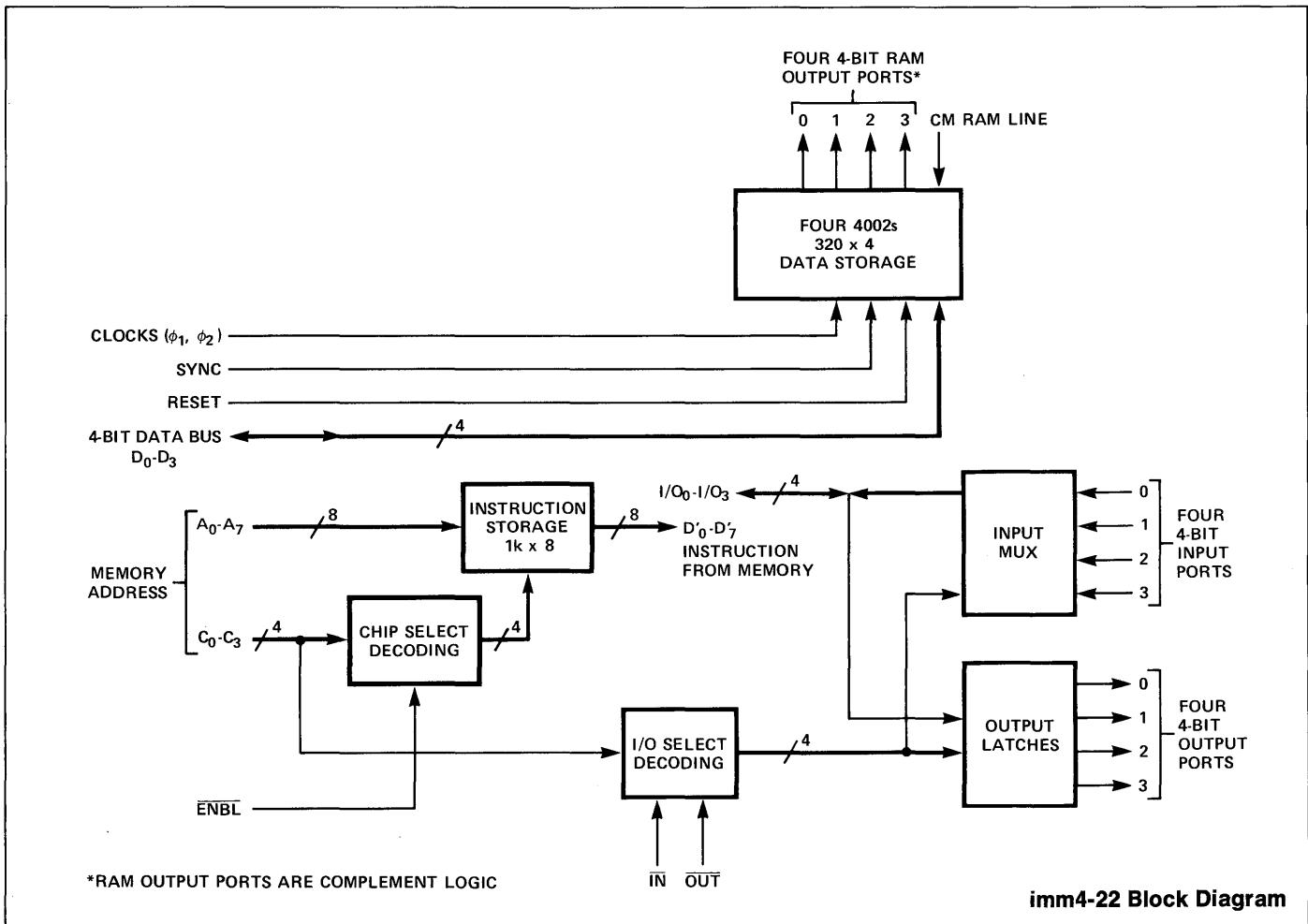
Instruction/Data Storage Module

The imm4-22 Instruction/Data Storage Module provides the most economical approach for program/data storage memory and I/O expansion of your Intellec 4 or custom MCS-4 system. Each imm4-22 contains both program memory and data storage memory as well as associated I/O ports. Up to 1024 eight-bit words of program storage may be had in the form of 1702A PROMs or 1302 ROMs which plug into four available sockets on the imm4-22 module. The module comes with four 4002 RAMs for 320 4-bit words of data storage. Each 4004 RAM contains a 4-bit latching output port; and, in addition, there are four each input and output ports which interface directly with a Central Processor Module. A complete system of 4096 words of program storage, 128 words of data storage, 16 input ports and 32 output ports may be assembled with only one imm4-42 Central Processor Module and three imm4-22 Instruction/Data Storage Modules.

**INSTRUCTION/DATA
STORAGE MODULE**
specifications

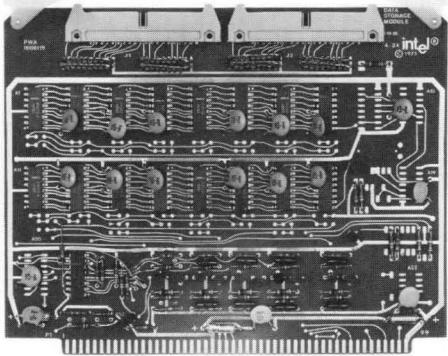
Word Size:	Program Memory: 8 bits	Connector:	Dual 50-pin on 0.125" centers.
Memory Capacity:	Data Memory: 4 bits	Connectors in rack must be positioned on 0.5" centers min	Wirewrap P/N C800100 from SAE P/N
MCS-4 Components on Module:	Program Storage: 1024 words Data Storage: 320 words	Board Dimensions:	VPB01C50E00A1 from CDC 6.18" x 8.0" x 0.062".
I/O Capacity:	two 4002-1 RAMs two 4002-2 RAMs four sockets for 1702 PROMs	DC Power Requirement:	Board to be on 0.5" centers min.
	Program Memory Associated: Four 4-bit input ports and four 4-bit latching output ports		$V_{CC} = +5V \pm 5\%$ $I_{CC} = 1.4A$ max., 0.8A Typical*
	Data Storage: Four 4-bit latching output ports		$V_{DD} = -10V \pm 5\%$ $I_{DD} = 0.5A$ max., 0.25A Typical*

*Includes four C1702As



imm4-24 DATA STORAGE MODULE

- Up to sixteen 4002 RAMs (1280 4-bit words of Read/Write data storage)
- Up to sixteen 4-bit Latching Output Ports (64 bits)
- On-board decoding for system expansion to 32 4002 RAMs (2560 4-bit words)

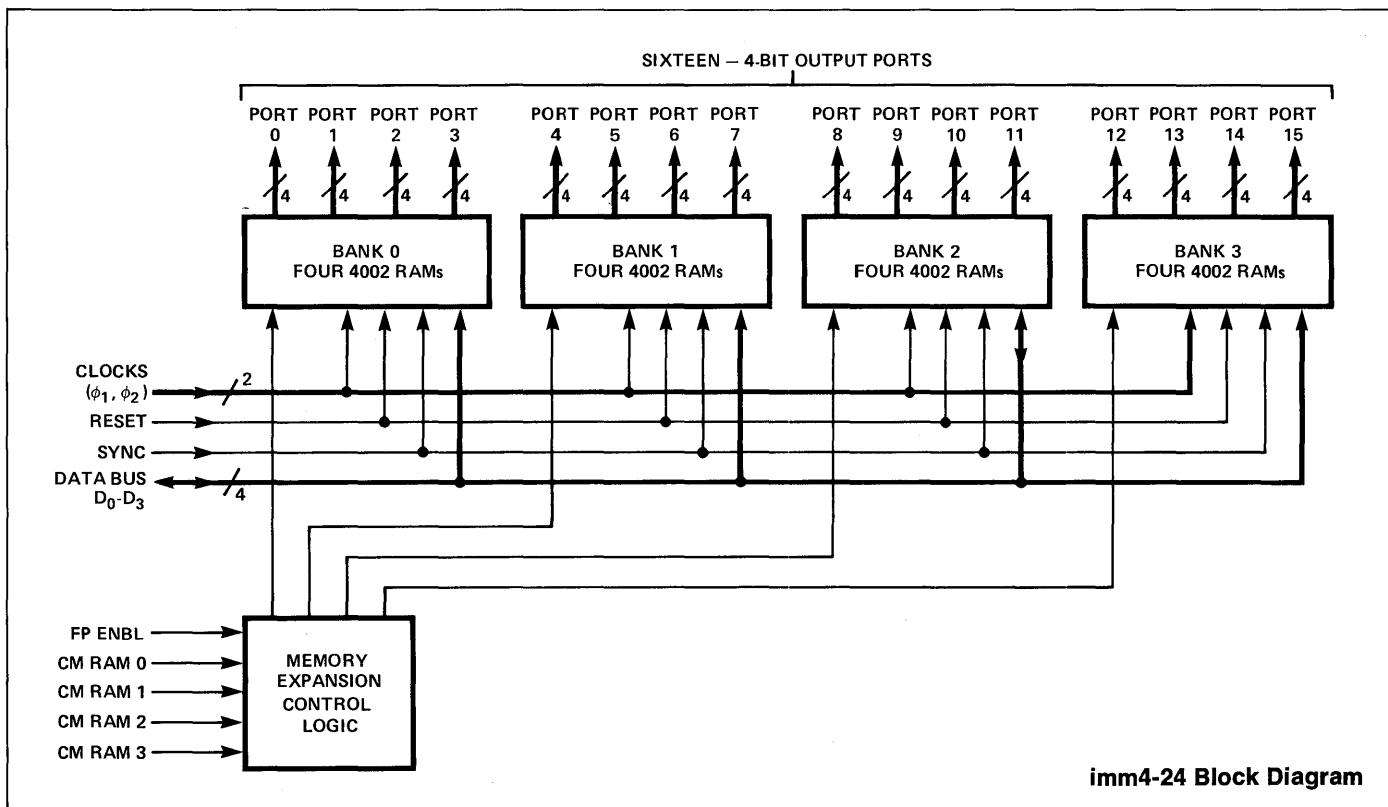


Data Storage Module

The imm4-24 Data Storage Module is designed to provide data storage and output capability for an MCS-4 system. The module initially contains one bank of four 4002 RAMs (320 4-bit words). This may be expanded to four banks totaling 1280 words of storage. Each 4002 RAM has a 4-bit latching output port built in. For a full complement of 4002 RAMs there are 64 bits of output organized as sixteen 4-bit outputs. The imm4-24 is designed for a direct interface with the imm4-42 Central Processor Module. In systems requiring larger amounts of storage than 1280 words, decoding on the imm4-24 module allows the user to expand his total storage to 2560 4-bit words using two imm4-24 Data Storage Modules.

DATA STORAGE MODULE
specifications

Word Size:	4 bits	Connector:	Dual 50-pin on 0.125" centers.
Storage Capacity:	1280 words (Four 4002 RAMs included on module. Twelve additional 4002 RAMs may be added to the module. Each 4002 RAM contains one 4-bit latching output port.)	Connectors in rack must be positioned on 0.5" centers min.	Wirewrap P/N C800100 from SAE P/N VPB01C50E00A1 from CDC Ribbon Type P/N 3417 from 3M
	MCS-4 components on module: four 4002-1 RAMs, twelve additional sockets for 4002 RAMs.	Board Dimensions:	6.18" x 8.0" x 0.062". Board to be on 0.5" centers min.
Output Capacity:	Sixteen 4-bit ports (64 bits)	Operating Temperature:	0°C to 55°C
		DC Power Requirement:	$V_{CC} = +5V \pm 5\%$ $I_{CC} = 0.6A$ max., 0.3A typical $V_{DD} = -10V \pm 5\%$ $I_{DD} = 0.6A$ max., 0.3A typical

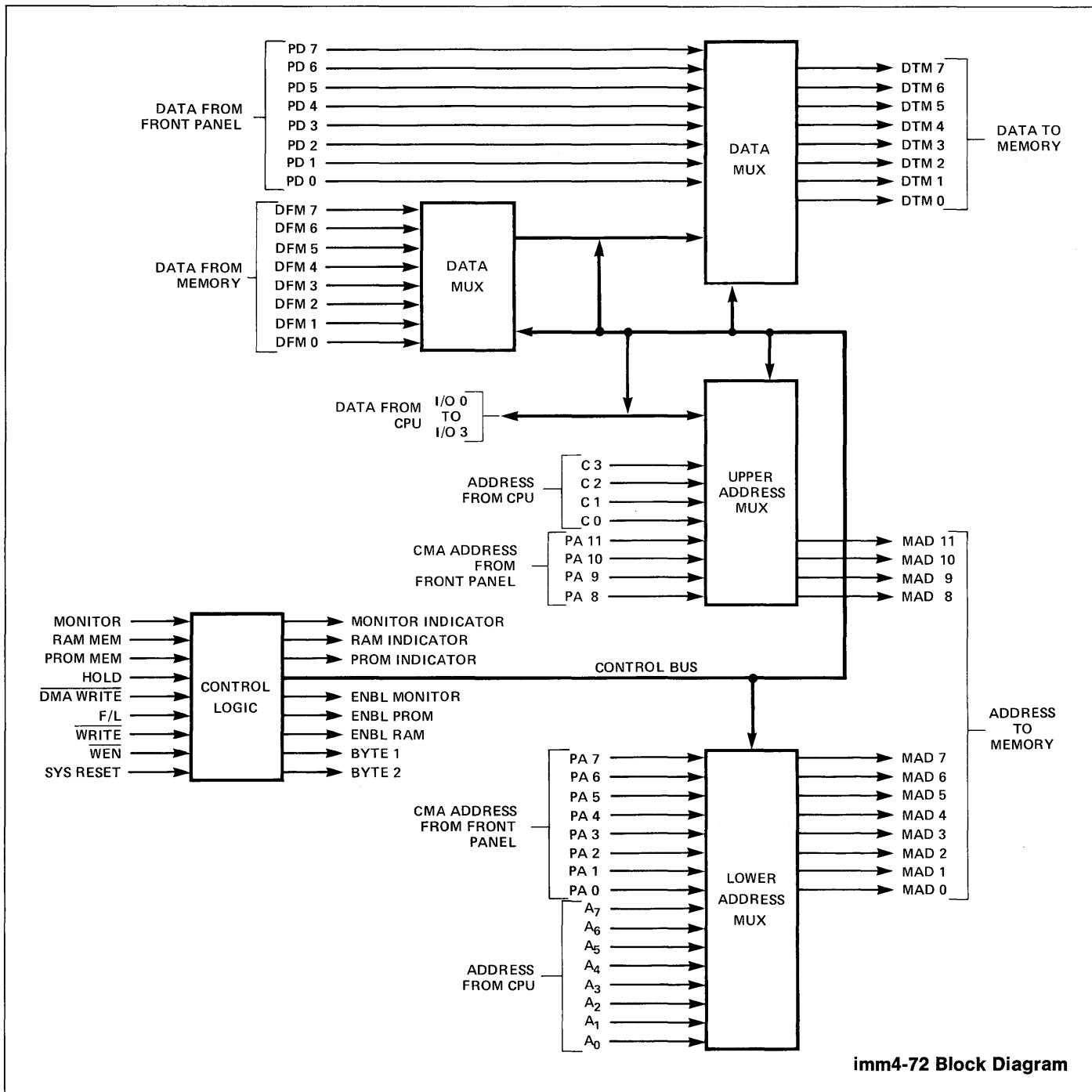


imm4-72 RAM CONTROL MODULE

**Complete interface for imm4-42
Central Processor Module to imm6-28
RAM Memory Module**
**Facilitates program development in
random access read/write memory
for MCS-4 systems**
**Capability of direct access to program
memory**
**Provides direct access to 4k bytes of
RAM with ability to alter any location**
**Controls selection of three separate
Program Memories (2 PROM Mem-
ories, 1 RAM Memory)**

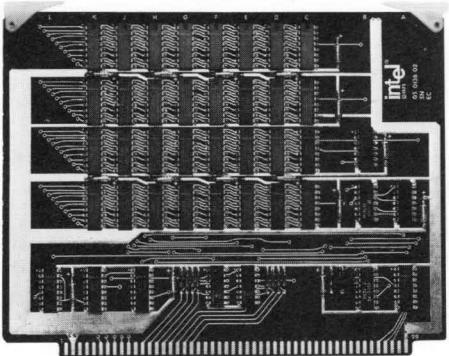
The imm4-72 RAM Control Module gives the MCS-4 the convenience of random access read/write program memory with complete freedom to select any one of three separate memories. Memory No. 1 is located on the imm4-42 Central Processor Module and is 1024 x 8 bits in size. It may be composed of one to four 1702A PROMs. In use it may contain a user program or a system executive monitor as in the case of the Intellec 4. Memory No. 2 is a random access read/write memory 4096 x 8 bits in size. This memory is a separate module, the imm6-28 RAM Memory Module. When it is selected it may be used as both executable program memory and data storage. Since this memory may be loaded under program control it becomes extremely useful for program development since it bypasses the steps of programming and erasing PROMs. Memory No. 3 is an imm6-26 PROM Memory Module. It may be composed of from one to sixteen 1702A PROMs or 1302 ROMs for from 256 to 4096 bytes of instruction. It may contain a user program or a utility program, such as an assembler.

Only one of the three memories may be selected as executable program memory at any one time and the imm4-72 Module controls this selection. In addition, the imm4-72 handles all read/write communication between processor and random access memory. Selection of a memory module also generates a master reset so that execution of program in the selected module begins at location zero. One further mode of operation is provided, that of direct access to memory. The imm4-72 allows the direct examination of any location of the selected memory. Altering locations in read/write RAM may also be accomplished through this direct access to memory. This permits loading and reading of the 4096 bytes of RAM directly.



imm6-28 RAM MEMORY MODULE

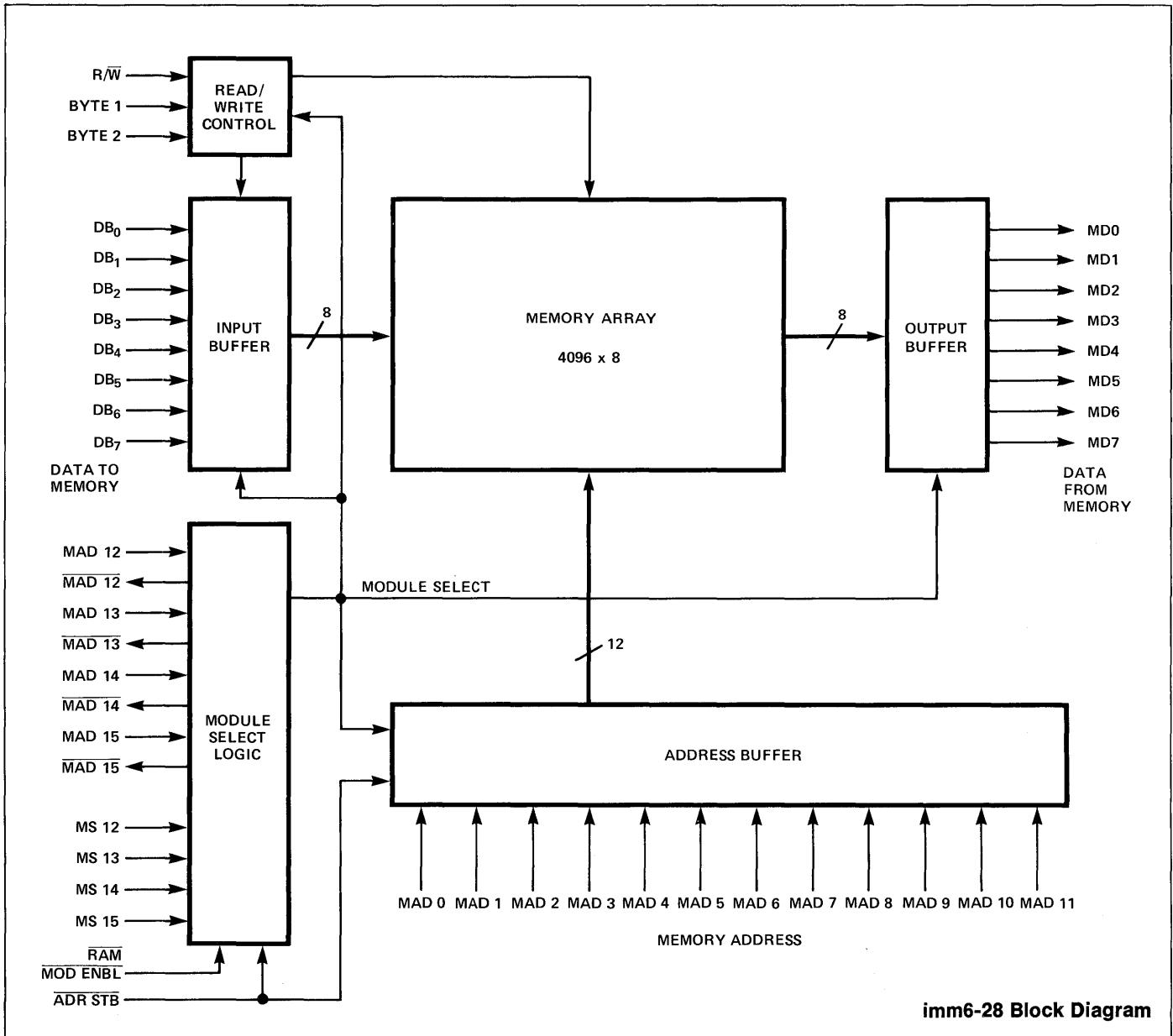
4096 8-bit bytes per module
Static memory, no clocks required
Interfaces with imm4-42 4-bit Central Processor Module
Single +5V power supply
Low power requirements
Provides Intellec 4 with 4K bytes of read/write program memory



RAM Memory Module

The imm6-28 RAM Memory Module is a standard 4K x 8 memory module designed for use with the Intellec 4 Microcomputer Development System. This module contains address and data buffers, read/write timing circuits and is implemented with Intel's 2102 1K x 1 static RAM. This basic memory module is organized as 4096 x 8.

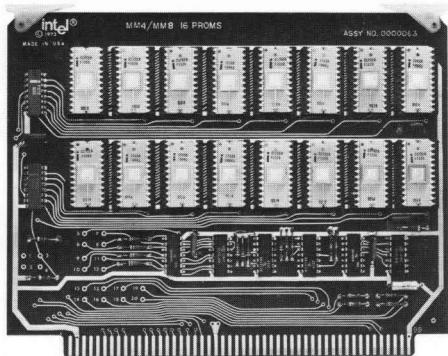
When used with the imm4-42 4-bit Central Processor Module in the Intellec 4, the imm6-28 becomes a read/write program memory. This feature in the Intellec 4 greatly enhances the user's ability to quickly develop programs and bypasses the step of programming PROMs.



imm6-28 Block Diagram

imm6-26 PROM MEMORY MODULE

**Provides sockets for up to sixteen
PROMs (4096 x 8)**
Static memory, no clocks required
**Interfaces directly with imm4-42 4-bit
Central Processor Module**
**Accepts Intel 1602A or 1702A PROMs
or 1302 ROMs**



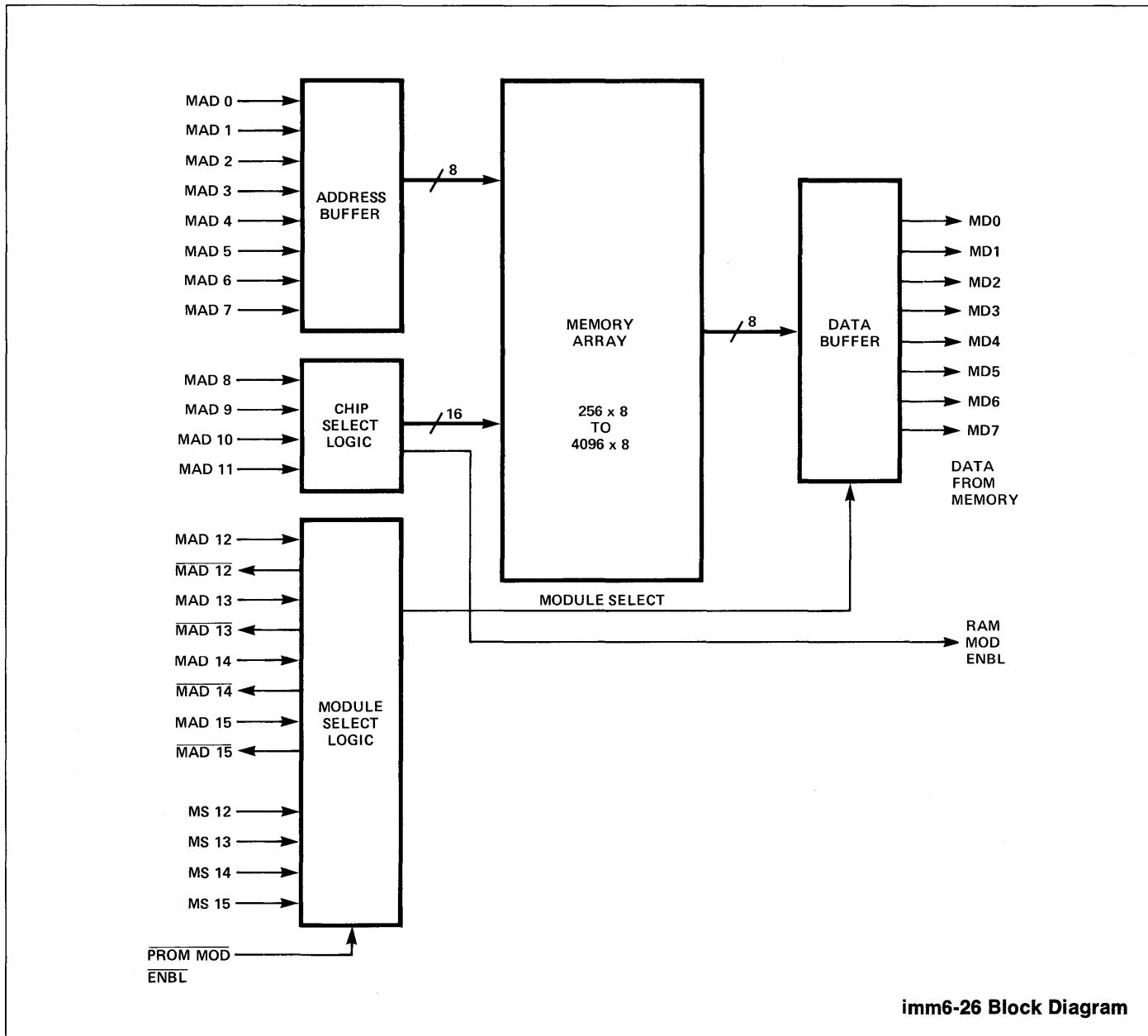
PROM Memory Module

The imm6-26 PROM Memory Module provides a capacity for up to 4096 instructions for MCS-4 systems. It interfaces directly with the imm4-42 4-bit Central Processor Module.

Each PROM Memory Module has sockets for from one to sixteen of Intel's 1602A or 1702A PROMs. In addition, the 1302 mask programmed ROM may be used in place of the PROMs in OEM applications.

PROM MEMORY MODULE
specifications

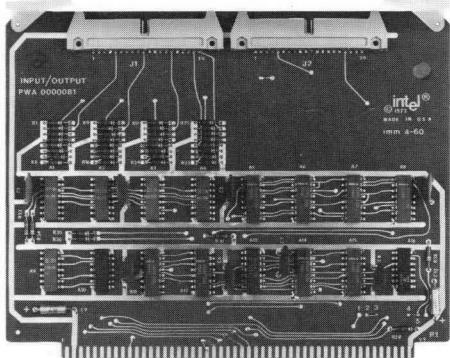
Memory Size:	4K bytes	Board Dimensions:	6.18" x 8.0" x 0.062". Board to be on 0.5" centers min.
Word Length:	8 bits		
Interface:	TTL compatible inputs; open collector outputs (positive true logic)		
Capacity:	256 to 4096 bytes in 256 byte increments		
Connector:	Dual 50-pin on 0.125" centers. Connectors in rack must be positioned on 0.5" centers min. Wirewrap P/N C800100 from SAE P/N VPB01C50E00A1 from CDC	Operating Temperature: DC Power Requirement:	0°C to 55°C $V_{CC} = +5V \pm 5\%$ $I_{CC} = 1.6A$ max., 1.1A typical ¹ $V_{DD} = -10V \pm 5\%$ $I_{DD} = 1.6A$ max., 1.0A typical ¹
			¹ Board loaded with all 16 PROMs. ² PROMs or ROMs not included with board.



imm6-26 Block Diagram

**imm4-60 INPUT/OUTPUT
MODULE**

Eight 4-Bit Input Ports (32 lines)
Eight 4-Bit Latching Output Ports (32 lines)
TTL Compatible
Direct Interface with imm4-42 Central Processor Module
Easy Expansion to Full Complement of I/O with On-board Decoding
I/O Expansion without Additional Memory

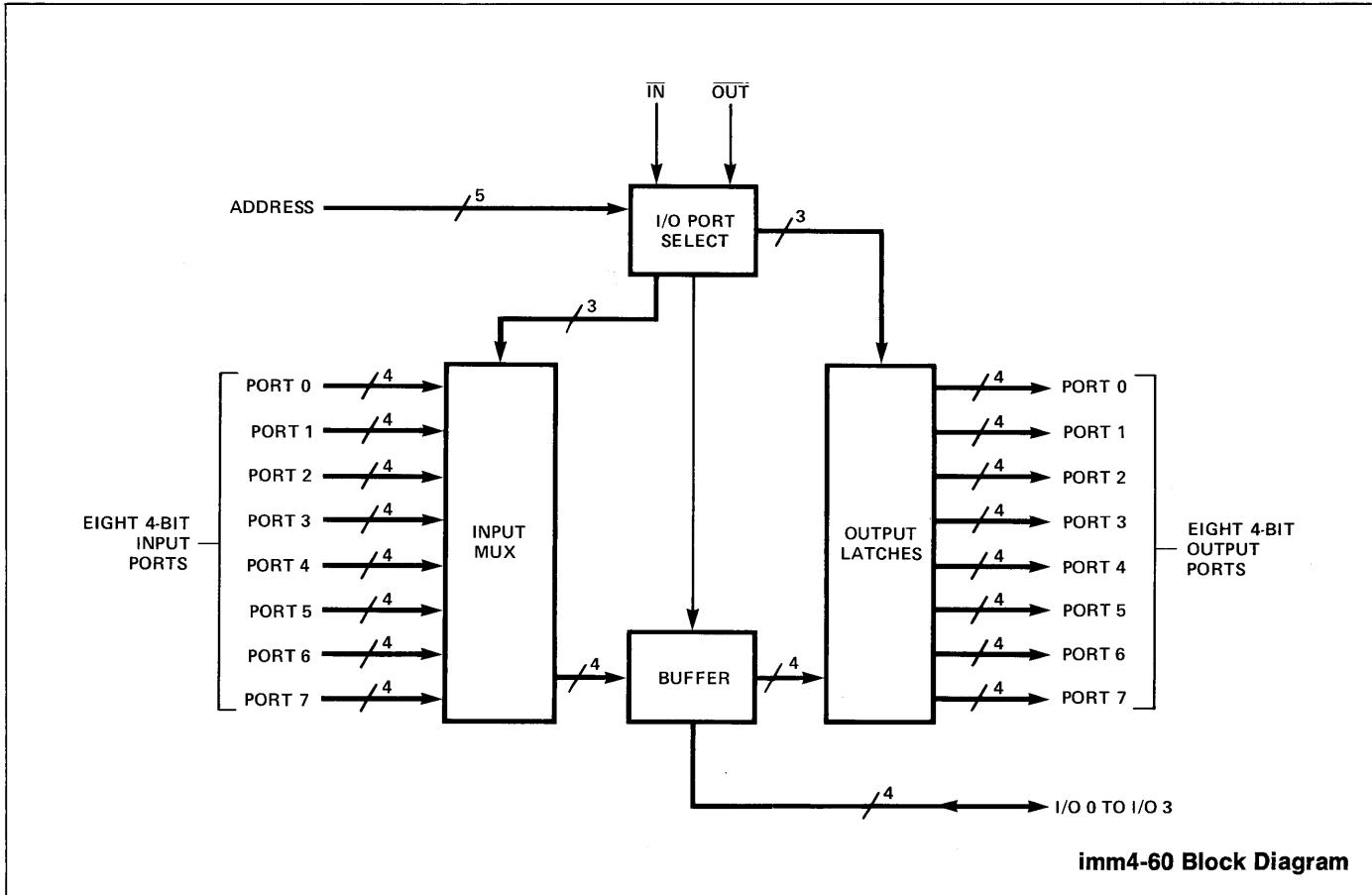


Input/Output Module

The imm4-60 Input/Output Module provides eight 4-bit input ports and eight 4-bit latching output ports for use with the imm4-42 Central Processor Module. This module allows expansion of I/O capability of an Intellec 4 or custom MCS-4 system without additional memory. On-board decoding permits a maximum of two I/O modules to be interfaced with the imm4-42 Central Processor Module for up to sixteen 4-bit input ports and sixteen 4-bit latching output ports. In this configuration the lower four input and output ports on one I/O module are suppressed because the ports located on the imm4-42 take precedence. All I/O lines are available at the top of the module and all are TTL compatible.

INPUT/OUTPUT MODULE specifications

Word Size:	4 bits	Board Dimensions:	6.18" x 8.0" x 0.062". Board to be on 0.5" centers min.
Capacity:	Eight 4-bit input ports; eight 4-bit latching output ports		
Interface:	TTL compatible	Operating Temperature:	0°C to 55°C
Connector:	Dual 50-pin on 0.125" centers. Connectors in rack must be positioned on 0.5" centers min. Wirewrap P/N C800100 from SAE P/N VPB01C50E-00A1 from CDC Ribbon Type P/N 3417 from 3M	DC Power Requirement:	$V_{CC} = +5V \pm 5\%$, $I_{CC} = 0.9 A$ max., 0.5 A typical



imm4-60 Block Diagram

imm6-76 PROM PROGRAMMER MODULE

**High speed programming of Intel's
1702A or 1602A PROM**
**All necessary timing and level shifting
included**
**Direct interface with Intel's Intellec 4
Micro computer Development System**

The imm6-76 PROM Programmer Module provides all necessary hardware for PROM programming capability for the Intellec 4 micro computer development system.

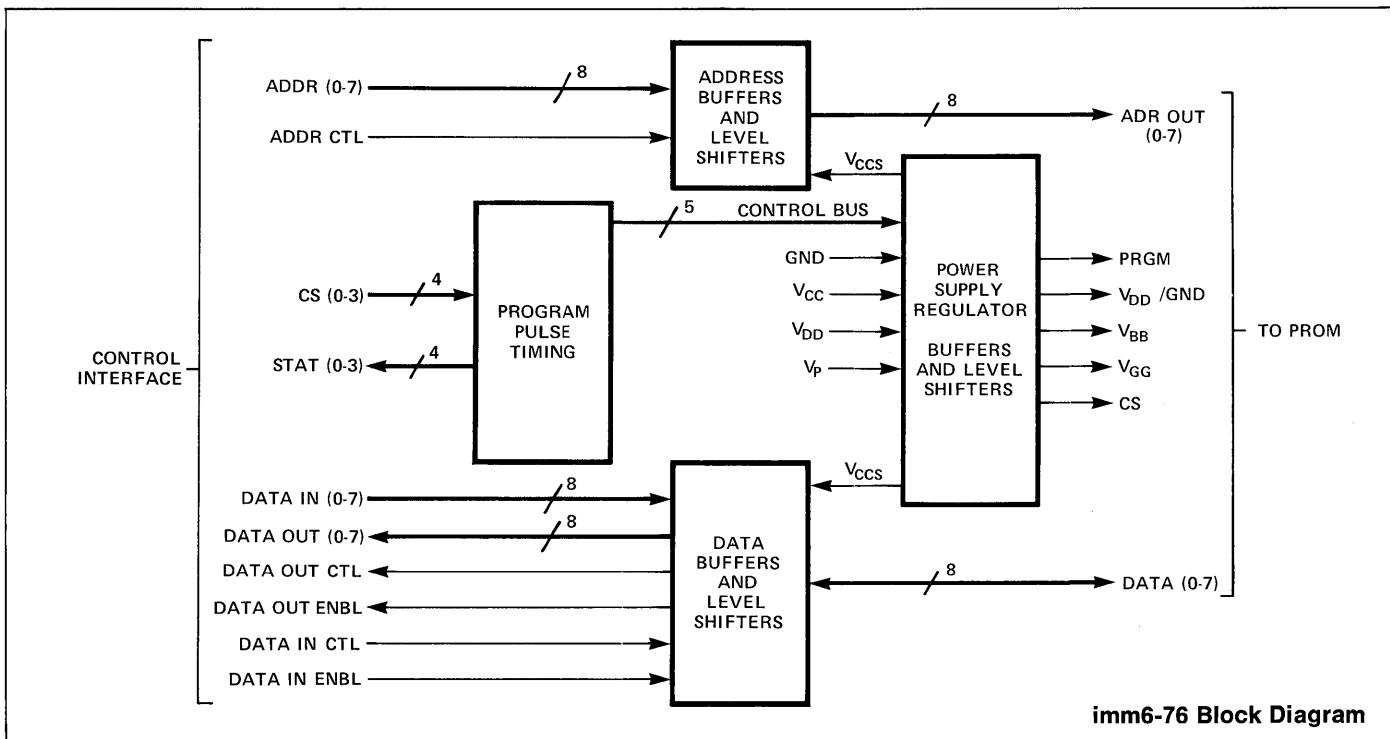
This module slips into the Intellec 4 and provides all connections to the zero insertion force socket on the front panel. All required timing and level shifting is accomplished on the module utilizing the high voltage power supply already located in the Intellec 4.

The software to control this module is contained in the four existing PROMs of the executive monitor. This software is specifically written for the Intellec 4 and allows both programming and verification of 1602A and 1702A PROMs. In addition, the contents of any PROM may be listed or loaded into memory for duplication.

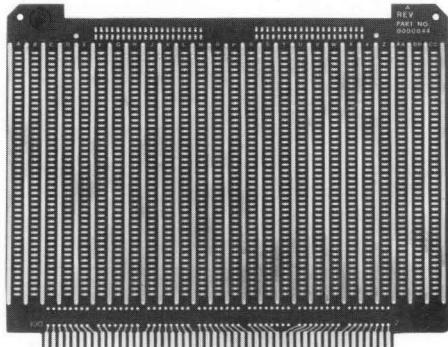
The imm6-76 may also be used as a stand alone PROM programmer with toggle switches or with another computer providing data address and control signals.

PROM PROGRAMMER MODULE specifications

System Interface:	All inputs and outputs are TTL compatible and available at the ribbon connector at the top of the module. Control for either "True" or "False" data is provided. Direct interface to Intellec 4.	Connector:	Dual 50-pin on 0.125" centers. Connectors in rack must be positioned on 0.5" centers min. Wirewrap P/N C800100 from SAE P/N VPB01C50E00A1 from CDC Ribbon Type P/N 3417 from 3M
Control Software:	Contained in the Intellec 4 executive monitor.	Board Dimensions:	6.18" x 8.0" x 0.062". Board to be on 0.5" centers min.
		Operating Temperature:	0°C to +55°C
		DC Power Requirements:	$V_{CC} = +5V \pm 5\%$, $I_{CC} = 0.8A$ max., 0.5A typical
			$V_{DD} = -9V \pm 5\%$, $I_{DD} = 0.1A$ max., 0.08A typical
		A.C. Power Requirement:	$V_p = 50V_{RMS}$ $I_p = 1.0A$ max.



imm6-70 UNIVERSAL PROTOTYPE MODULE



Universal Prototype Module

Provides breadboard capability for developing custom interfaces
Standard size of all micro computer modules
3M 40-pin ribbon connector on top of module provides direct I/O connections
Will accept standard wirewrap sockets with 0.1 in. x 0.3 in. or 0.1 in. x 0.6 in. lead spacing

Capacity for 60 16-pin or 14-pin sockets or 24 24-pin sockets

All power is bused on board. Pins on PC connector and pins to individual sockets are uncommitted for maximum flexibility

The imm6-70 Universal Prototype Module is a standard size microcomputer module with power buses which interface with the Intellec 4. It provides a standard format for prototyping both customer interface and system control. I/O interface is provided through ribbon-type connectors on the top of the module.

The module will accept dual in-line packaged components having pin center-to-center dimensions of 0.100 inch by 0.300 inch or 0.100 inch by 0.600 inch. These parts should be mounted in standard wirewrap sockets.

UNIVERSAL PROTOTYPE MODULE specifications

Capacity:	60 16-pin or 14-pin sockets or 24 24-pin sockets. Standard wirewrap sockets with pins on 0.100" by 0.300" centers or 0.100" by 0.600" centers. Board spacing dependent on components and sockets used.
Connector:	Dual 50-pin on 0.125" centers. Wirewrap P/N C800100 from SAE P/N VPB01C50E00A1 from CDC Ribbon Type P/N 3417 from 3M
Board Dimensions:	6.18" x 8.0" x 0.062". Board to be on 0.5" centers min.

**imm6-72 MODULE
EXTENDER**

**Allows any module to be extended
for ease of debugging, testing, and
maintenance**

**Standard dual 50-pin configuration
for use with all micro computer
modules**



Module Extender

The imm6-72 Module Extender is designed to be used with the Intellec 4. It allows the operator to extend any module out of the cage for servicing while maintaining all electrical connections.

**MODULE EXTENDER
specifications**

Connector:	Dual 50-pin on 0.125" centers. Connectors in rack must be positioned on 0.5" centers min. Wirewrap P/N C800100 from SAE P/N VPB01C50E-00A1 from CDC Extending connector is mounted on board.
Board Dimensions:	6.18" x 8.0" x 0.062". Board to be on 0.5" centers min.



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