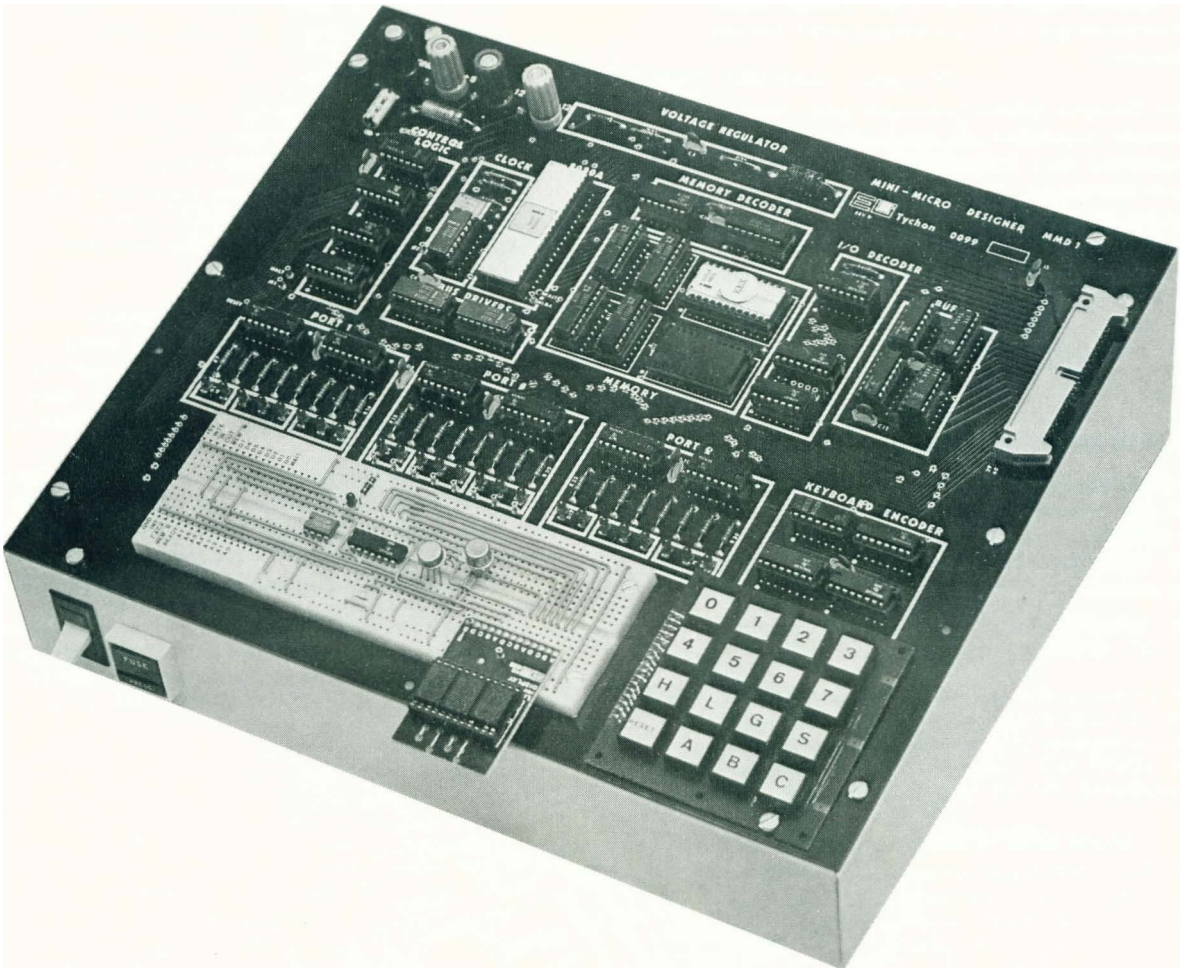
MMD-1
MINI-MICRO DESIGNER

EDUCATION AND DEVELOPMENT MICROCOMPUTER



- COMPLETE 8080A MICROPROCESSOR-BASED COMPUTER SUITABLE FOR EDUCATION AS WELL AS SOFTWARE AND SYSTEM DEVELOPMENT
- SIMPLE ENOUGH FOR SELF-INSTRUCTION AND YET COMPLETE ENOUGH FOR THE PROFESSIONAL SYSTEMS DESIGNER AND CLASSROOM TEACHING
- BASIC SYSTEM CONTAINS COMPLETE 8080A MPU SET INCLUDING MEMORIES WITH ADD-ON MEMORY AVAILABLE
- DIRECT KEYBOARD ENTRY OF DATA AND INSTRUCTIONS (NO DATA ENTRY TERMINAL NECESSARY)
- LIGHT EMITTING DIODE STATUS AND DATA INDICATORS
- INTEGRAL SOLDERLESS BREADBOARDING SOCKET WITH DIRECT BUFFERED ACCESS TO THE MICROPROCESSOR
- COMPLETE SELF CONTAINED POWER SUPPLY
- COMPLETE TUTORIAL DOCUMENTATION AND OPERATING MANUALS
- PROVISION FOR DIRECT TELEPRINTER OR CRT TERMINAL AND AUDIO CASSETTE INTERFACES

E&l INSTRUMENTS, INCORPORATED

MINI .. MICRO DESIGNER

8080A BASED COMPUTER FOR TRAINING AND HARDWARE/ SOFTWARE DEVELOPMENT

E & L Instruments has introduced the first educational and engineering microcomputer that is simple and versatile enough to be used as a basic training system and yet has all of the features required for circuit design, interfacing experimentation and software development for the professional designer.

The Mini-Micro Designer (MMD-1) is a low cost, expandable system totally supported by the unique Bugbook educational materials. Well adapted for use as classroom texts or for self-instruction, the Bugbook concept is the ideal introduction to computers for beginners as well as those with considerable technical background and experience. The texts, which double as laboratory manuals, start with digital coding and microcomputer programming to involve the student rapidly in the practical aspects of microcomputer programming and interfacing.

DIRECT KEYBOARD ENTRY AND BREADBOARDING

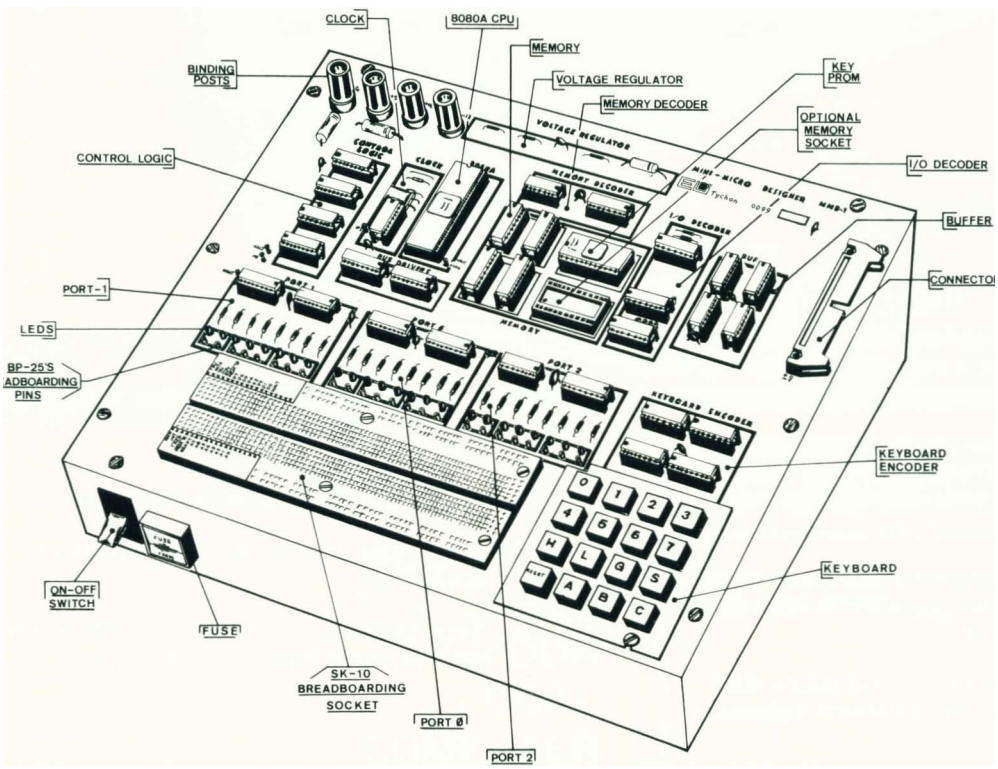
The MMD-1 features direct keyboard entry of data and instructions in easy to understand octal code. Immediate access to the 8080A central processor may be obtained with buffered input/output busses and the convenient breadboarding socket.

The breadboarding capability built directly into the MMD-1 system permits the student or experimenter to carry out over 60 experiments presented in the Bugbook text as well as many other circuit designs without the need for soldering or the construction of simple circuit functions.

Keyboard entry eliminates the need for a teleprinter or other costly data terminals. The ease of access to the busses of the MMD-1 make it an excellent software development tool. Additional modules are available to expand the memory of the MMD-1, permit interfacing with teleprinters, cathode ray tube terminals and an audio cassette recorder.

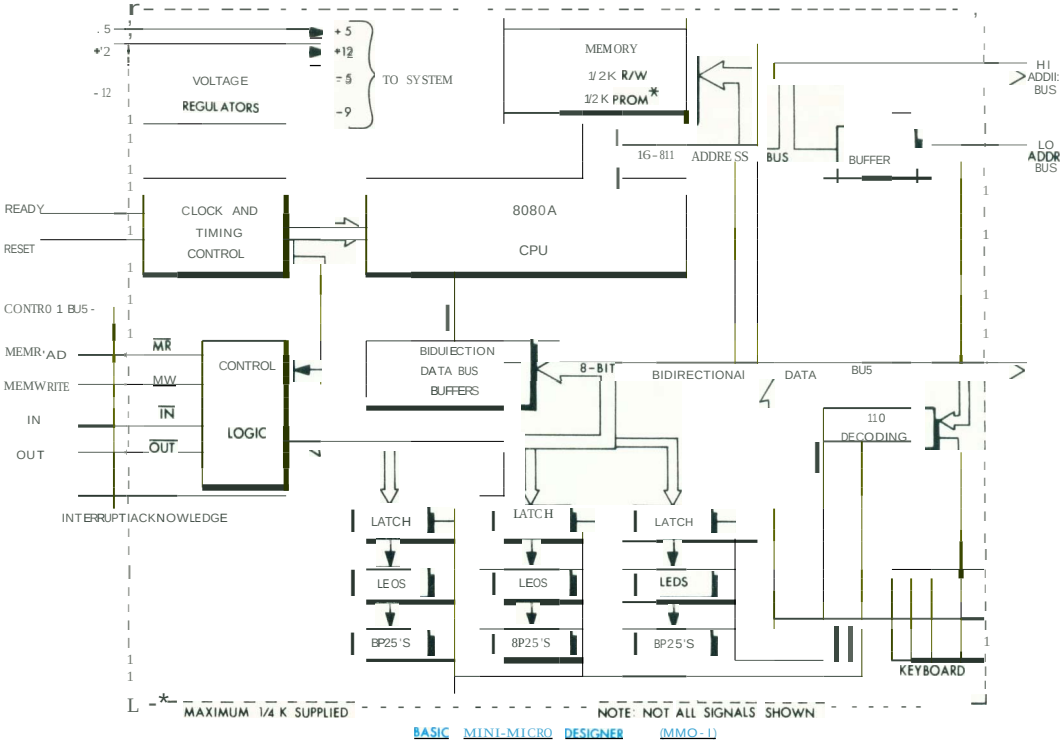
The MMD-1 is the only microcomputer system now on the market that permits the user to design his own interface in 10 to 20 minutes and implement the design with ordinary hookup wire and standard readily available 7400 series ICs. No special assembly tools are needed.

One of the unique features of the Mini-Micro Designer is the use of E & L's, standard, BP-25 Breadboarding Pins. These pins are directly linked to the three ports (LO, HI and DATA). They allow the user to output three distinct 8-bit bytes of latched data to peripheral circuitry.



CONTROLS, SOCKETS, CONNECTORS, AND CIRCUIT FUNCTIONS

FIGURE-1



BASIC MINI-MICRO DESIGNER (MMD-1)

FIGURE 2

BENCH-TOP CONVENIENCE

The essential features of the MMD-1 are shown in outline drawing, (Figure 1). The complete **basic** unit is self contained within a slope-front case that measures **12"** (30,5cm) long by **10" (25,4cm)** wide by **3½"** (8,gcm) high.

The 8080A microprocessor and its associated circuits are located on the top center part of the printed circuit panel. The related chip set includes clock and timing control, two bidirectional data bus buffers, four static MOS random-access memory (read/write) chips for a total of 512 8 bit words and one 256 by 8 bit UV erase-able PROM, pre-programmed to permit keyboard entry.

The keyboard permits direct entry of data and instructions. Immediate access to the 8080A is available with buffered input/output (I/O) busses and a convenient breadboarding socket.

Part of the socket is wired to the I/O bus and other critical control lines. Status and data are indicated with an array of lightemmitting diode (LED) lamps to permit monitoring the system.

The socket has been designed to accept either standard integrated circuits, and discrete components or pre-assembled functional plug-in modules available from E & L Instruments. The modules, called Outboards, are pre-designed, frequently used circuits that simplify interfacing and reduce the time required, for either the student or the professional designer, to breadboard the desired circuit. These Outboards are available either assembled or in kit form. (See General Catalogue for full line)

The pane! mounted 40 pin connector makes the **full** computer bus structure available for external use.

The breadboarding socket will accommodate up to five 16-pin IC's and a wide range of discrete components and outboards. All power supply voltages are available at the binding posts on the panel. The +5Vdc and. ground are also available on the SK-10 Breadboarding Socket.

The MMD-1 is available in three forms:

*MMD-1/A: Factory assembled and ready for use, comes with operating manual and complete self teaching microcomputer training course (Bugbooks).

*MMD-1/K: Kit form, requiring assembly and **soldering** of components to form a complete **unit.** Kit comes with operating manual and complete self-teaching microcomputer training course (Bugbooks).

MMD-1CBK: Circuit Board Kit that includes main and power supply P.C. boards, a premounted SK-10 interfaced breadboarding socket, the keyboard, operating manual, and complete self-teaching microcomputer training course (Bugbooks). Non-standard components necessary to build the unit are listed, with manufacturer's name and part number, in the Parts List of the operating manual.

Also available, for the CBK users, is the MMD-1/IC. This is the computer chip set (See Back Page).

- The Assembled or Kit Form may be purchased in either 115V dc or 230V dc operation.

MINI-MICRO – ACCESSO RIES ADD

INTEGRATED EDUCATIONAL SYSTEM

The Mini Micro Designer is designed to be an integral part of a complete educational system for the beginner as well as the experienced digital circuit designer. While the educational texts supplied with the basic MMD-l emphasize the role of the microcomputer in machine and process control applications, it will nevertheless provide an excellent background for the understanding of all computer and data processing systems.

COMPLETE OPERATING MANUAL

Each MMD-l, complete or in kit form is supplied with a 34-page operating manual. This manual contains a general description, specifications and parts list as well as schematics. It also contains instructions for constructing and testing the main board as well as the power supply.

PROVEN MODULAR EDUCATIONAL TEXTS

The educational texts furnished with the MMD-l are prepared for use by all students, regardless of educational background, for self-instruction or in a classroom situation. The text is completely coordinated with the MMD-l hardware and it permits the student to move at his own pace without supplementary text books or references.

The educational approach employed is that of the famed E & L Instruments Bugbooks; paperback texts that emphasize the practical aspects of digital circuitry and integrated electronics. Unlike other texts, the student is not first required to master or review analog electronics before being introduced to digital electronics and the course material in non-mathematical.

Also, unlike other so-called educational texts, with the E & L Bugbooks, the student is not required to study material prepared by semiconductor manufacturers with experienced digital circuit designers in mind.

The standard text furnished with the MMD-l can serve as home-study or classroom laboratory manuals. The series is collectively entitled. Introductory Experiments in Digital Electronics, and 8080A Microcomputer Programming and 8080A Microcomputer Interfacing.

The subjects of digital electronics, microcomputer interfacing and microcomputer programming are unified in a single course divided into chapters or units. The units begin with Digital Codes and An Introduction to Microcomputer Programming and progress through to the 8080A Instruction Set.

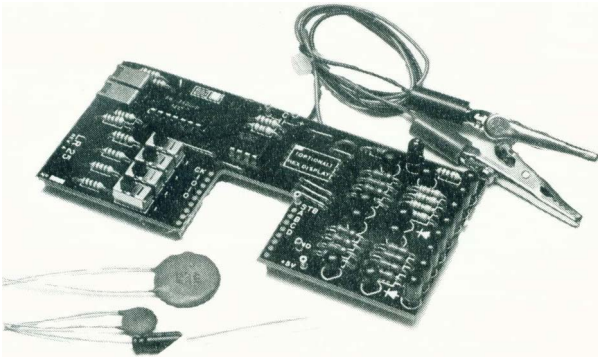
Among the topics covered are:

1. Digital Codes
2. An Introduction to Microcomputer Programming
3. Some 8080A Microcomputer Instructions
4. The MMD-l Microcomputer
5. Some Simple 8080A Microcomputer Programs
6. Registers and Register Instructions
7. Logic Gates and Truth Tables
8. Logical Instructions
9. An introduction to Breadboarding
10. Integrated Circuit Chips
11. Flip-Flops and Latches
12. Decoders
13. Counters
14. Gating Digital Signals
15. Astable and Monostable Multivibrators
16. Device Select Pulses
17. The 8080A Instruction Set

VERSATILITY TO YOUR - DESIGNER

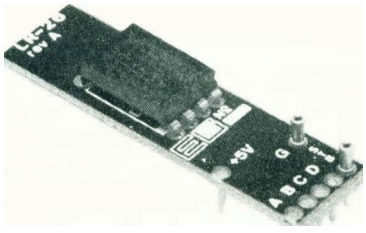
LR-25 BREADBOARDING STATION OUTBOARD

The LR-25 is an Outboard that provides the most commonly used digital circuit functions to aid in the breadboarding of interfaces and other circuits. Included on the Outboard are: a variable frequency clock, pulsers (bounce free switches), eight light-emitting diode (LED) indicators for data display, slide switches for programming or status changes and an optional hexadecimal display.



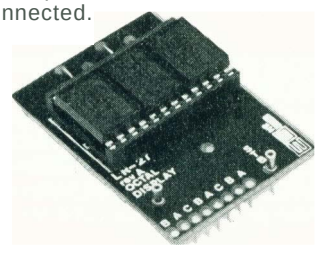
LR-26 DISPLAY OUTBOARD

The LR-26 uses a single hexadecimal display with built-in decoder, driver and latch. Decodes 0-9 and A-F.



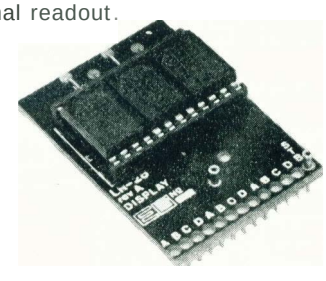
LR-27 OCTAL LATCH OUTBOARD

The LR-27 uses three hexadecimal displays. It is designed to directly accept hexadecimal code. The "D" pins are grounded together to provide Octal readout and all strobe inputs are interconnected.



LR-28 THREE DIGIT LATCH OUTBOARD

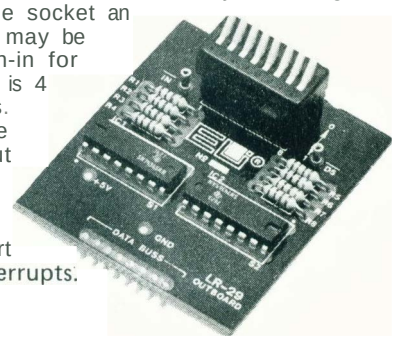
The LR-28 like the LR-27, uses three hexadecimal displays. Each display is independent of the other except that the strobe inputs are interconnected. This outboard provides a hexadecimal readout.



ALL OUTBOARDS, SHOWN HERE, MAY BE PURCHASED EITHER ASSEMBLED OR IN KIT FORM

LR-29 GENERAL INPUT PORT OUTBOARD

The LR-29 uses two tri-state buffer circuits to provide an 8-bit gated input buffer function. The buffer is enabled when both the IN and DS inputs are low (logic 0). The inputs to the gated buffer may be derived onboard by using the DIP switch to generate logic levels or the inputs may come from an external source. By removing the DIP switch from the socket an external logic level may be substituted. The fan-in for the external inputs is 4 standard TTL loads. Applications for the LR-29 include input of general data, status or sense switches and the generation of restart instructions for interrupts.



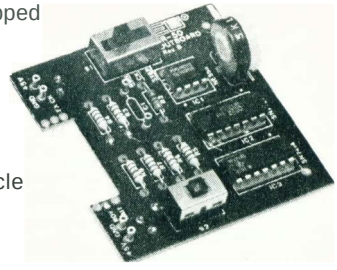
LR-50 SINGLE STEP OUTBOARD

The LR-50 is used to "single step" the Mini-Micro Designer. All of the electronics necessary to permit the user to step the computer one machine cycle at a time is contained on a single circuit board.

It may be used to monitor the data bus, address bus and status latch during each machine cycle. Input and output pulses, memory data, device addresses, as well as other signals may be observed by lamp monitors rather than expensive oscilloscopes or logic analyzers.

The LR-50 operates in three modes: Run, Clock and Step. These modes are selected by a three position slide switch. In the Run mode the MMD-1 will operate at its full clock speed; this is the normal operating mode. In the clock mode the computer is stepped automatically by an on board 555 timer contained on the module. The frequency of the timer and the computer execution speed may be easily varied. The EX CK (external clock) input mode is used when the computer is to be synchronized with an external clock.

The computer may be stepped manually when the three-position switch is in the Step mode. A second switch is provided on the Outboard in order to allow the user to step the computer one machine-cycle at a time.



KEX *LID* PROM

An advanced version of KEX that performs data entry and assigns start address. Contains cassette load and dump program and linkage to Monitor Prom. An exchange policy with the standard KEX Prom supplied is available for a nominal reprogramming charge.

MONITOR PROM

A NEW pre-programmed PROM, for your MMD-1, that allows single instruction execution and examination of all registers including status flags. Requires KEX LID PROM for operation and plugs into PROM location number 1 on MMD-1 panel.

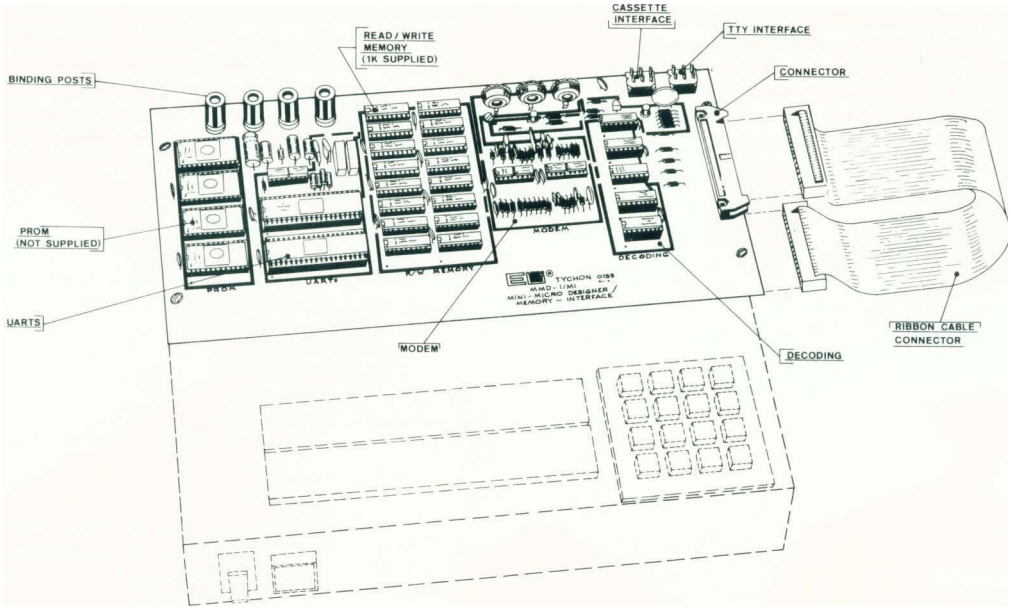
COMING SOON

PROM PROGRAMMER

An inexpensive 1702A PROM PROGRAMMER, designed for use with your MMD-1, or other 8080A based systems.

Available after Apr. 1, '77 from your local computer store.

MMD 1/MI
MEMORY-INTERFACE BOARD
FOR AUDIO RECORDER AND TELEPRINTER



CONTROLS, CONNECTORS AND CIRCUIT FUNCTIONS
FIGURE-3

The Memory and Interface Board (M/I) is an accessory designed to permit hardware and software development to be performed on the MMD-1 microcomputer system. The M/I board may be purchased factory assembled or in kit form.

The M/I board provides additional memory and teleprinter and audio cassette recorder interface. The use of an Audio Cassette Recorder allows for low cost storage of data in the course of software development.

The M/I board, illustrated in figure 3, is designed for simple assembly to the master board of the MMD-1 by means of screws and threaded standoffs. Electrical connections from the M/I board to the MMD-1 are made by means of ribbon cable and a 40-pin connector.

The M/I board, shown schematically in figure 4 provides up to 1024 words of programmable read-only memory (PROM) (none supplied) and 2048 words of read/write random access memory (RAM). (1024 words supplied)

The M/I board uses two universal asynchronous receiver transmitters (UART) for synchronization, formatting and parallel series conversions necessary for communications with teleprinters. The UARTS handle data in blocks of 8-bits. The American National Standard Code for Information Interchange (ASCII) is employed in the 8-bit data block.

The M/I board contains a relay driver circuit for use with a teleprinter paper tape reader relay. This option permits software control of all reader start/stop operations.

No restrictions are placed on the format for communications with the audio recorder as the recorder need not be directly interfaced with any other terminal for printing or display of readout.

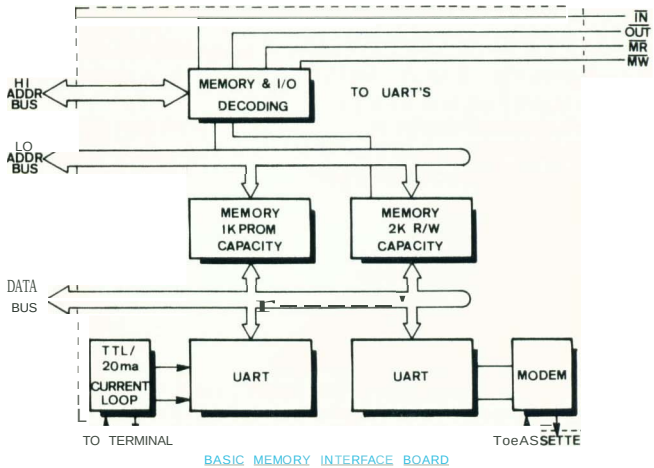
FIRMWARE ACCESSORIES

LOAD AND DUMP PROM (MMD-1 L/D PROM)

A single 256 word by 8-bit PROM contains the necessary program to load and dump data to and from an audio recorder. The PROM interacts with the MMD-1 keyboard and requires that the operator spend only about 2 seconds to set up the microcomputer for loading and dumping tapes.

D·BUG PROM SET (MMD-DBUG PROM)

This set of four PROMs contains a convenient octal oriented program for debugging. It permits the operator to create and modify programs, establish start address, set built-in breakpoints and continue function, load and dump punched paper tapes, and interact with ASCII-coded teleprinter or cathode ray tube terminals.



BASIC MEMORY INTERFACE BOARD
FIGURE 4

SPECIFICATIONS

MMD-1

- CENTRAL PROCESSOR
  8080A or equivalent

- MEMORY
  Read/Write. Random Access (RAM); 512 words by 8 bits furnished on main MMD-1 circuit board.

  Expandable up to a total of 65,536 words. (Additional power required over 2500 words.)

  Programmable Read Only (PROM) programmed to permit keyboard entry of data in octal code; keyboard executive program (KEX) 256 words by 8 bits.

  (Open socket on board permits an additional 256 words.)

- DISPLAY
  Light-emitting diode lamps (LEOs); three groups of eight individually latched and addressable under software control.

  LEOs display low address, high address and memory contents.

- DATA ENTRY
  Keyboard; 16-switch with keys organized in octal code 0 to 7, Hi address (H), Lo address (L), go (G), reset (RESET), examine/deposit (S) and three optional keys (A, B, and C).

- INTERFACE SOCKET
  E & L SK-10/1 F 18. Direct interface connection includes Do - 07; A_0 - A7; $\overline{In}$, $\overline{Out}$, MEMW, +5, GND $\overline{MEMR}$, INT, INTE, WAIT, READY, IACK.

  Open area on socket will take up to five 16-pin ICs and discrete components with 20 to 26 AWG wire leads.

- RIBBON CABLE CONNECTOR
  Dual, 20-pin wired the same as the SK-10 interface socket with A8 thru A15 added.

- INTERNAL POWER SUPPLY
  Line Voltage - 115V or 230V ac, fused

- OUTPUTS
  + 5V dc @1.5A
  +12V dc @150mA
  - 12V dc @ 150mA

- MICROPROCESSOR CHIP SET

1	8224	Clock Generator and Driver
4	8111-2	1024-bit (256 by 4) static MOS RAM
2	8216	4-bit parallel bidirectional bus drivers.
	1702	2048-bit (256 by 8) programmable read only memory (PROM) (Factory programmed as KEX PROM)

- DIMENSIONS
  12" (30,5cm) by 10" (25,4cm) by 3½" (8.9cm)

- WEIGHT
  6.3 pounds (2,86kg.)

MMD-1/MI

- POWER CONSUMPTION (with maximum memory installed)
  +5Vdc@1A
  +12Vdc@0.1A
  - 12V dc @0.25A

- MEMORY
  Read/Write (RAM) 2048 words capacity. (1024 words supplied)

  Programmable ROM (PROM) 1048 word capacity (non supplied)

- TELEPRINTER INTERFACE
  Full Duplex, 20 mA current loop
  110 Baud
  Reader Relay Control

- AUDIO RECORDER INTERFACE
  Software controlled
  Two-tone audio 2125 Hz/2975 Hz (FSK)

  UART formatted
  300 Baud Data Rate

  Output Impedance: 47K ohms

  Output Signal: 1 volt ac (2V P-to-P)

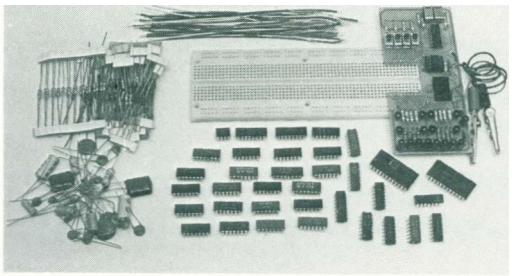
  Imput Impedance: 10K ohms

  Input Signal: 1 volt ac (2V P-toP)

- RIBBON CABLE CONNECTOR
  Dual, 20-pin wired to full computer bus. (Interconnecting cable supplied - 6" long)

MMD-1/SS

In addition to the MMD-1 system, you might find it useful to purchase the MMD-1/SS. This package of electronic components and breadboarding equipment can be used when working with the Bugbook Series. The MMD-1/SS includes an LR-25 Universal Breadboarding Station, an SK-10 Breadboarding Socket, a 28 pin dual interconnect cable, to bring the computer bus to the blank socket, I.C.'s resistors, capacitors and 22 gage wire. The package will make it possible to do the basic experiments in the Bugbooks. You will find it necessary to purchase other components to do all the experiments in the books.



THE STUDENT STATION INCLUDES THE FOLLOWING:

One	28 Pin Dual Interconnect Cable (not shown)								
One	LR-25 Universal Breadboarding Socket								
One	Miscellaneous Wire Package								
One	Components package (resistors and capacitors)								
One	P8212 In/Out Port Chip								
Two	SN7400	One	SN7430	One	-	SN7486	One	SN74154	
Two	SN7402	One	SN7432	One	-	SN7489	One	SN74LS155	
Two	SN7404	One	SN74L42	Four	-	SN7490	One	SN74174	
One	SN74L04	Two	SN7474	Two		SN7493	One	SN74193	
Two	SN7408	Two	SN7475	One		SN74123	Two	DM8095	
One	SN7410	One	SN7476	One	-	SN74148	One	NE555	

ITEM DESCRIPTION AND LOCATION

E & L PIN	CAT. DESIG.	DESCRIPTION	PAGE
341-0050	MMD-1/A	Mini-Micro Designer - Factory Assembled Form	2&3
341-1200	MMD-1/K	Mini-Micro Designer - Kit Form	2&3
341-1000	MMD-1/CBK	Mini-Micro Designer - P.C. Boards, Socket & Keyboard	2&3
341-1300	MMD-1/IC	Mini-Micor Designer - Computer Chip Set	
341-2000	MMD-1/256 BIT PROM	Blank Prom	
341-3100	MMD-1/MI-A	Memory-Interface Board - Factory Assembled Form	6
341-3000	MMD-1/MI-K	Memory-Interface Board - Kit Form	6
341-3350	MMD-1/MI-RAM	Additional 1K of RAM for the M/I Board	
341-3400	MMD-1/MI-PROM	Blank PROM - includes I.C. Socket and Filter Cap	
341-3450	MMD-1/MI . L/D PROM	PROM - Preprogrammed for Loading and Dumping	6
335-1025	LR-25/A	Uniyersal Breadboarding Station - Assembled Form	5
335-2025	LR-25/K	Universal Breadboarding Station - Kit Form	5
335-1026	LR-26/A	Display Outboard - Assembled Form	5
335-2026	LR-26/K	Display Outboard - Kit Form	5
335-1027	LR-27/A	Octal Latch Outboard - Assembled Form	5
335-2027	LR-27/K	Octal Latch Outboard - Kit Form	5
335-1028	LR-28/A	Three Digit Latch Outboard - Assembled Form	5
335-2028	LR-28/K	Three Digit Latch Outboard - Kit Form	5
335-1029	LR-29/A	General Input Port Outboard - Assembled Form	5
335-2029	LR-29/K	General Input Port Outboard - Kit Form	5
335-1050	LR-50/A	Single Step Outboard - Assembled Form	5
335-2050	LR-50/K	Single Step Outboard - Kit Form	5
341-4000	KEX L/D PROM	Advanced Version of the Standard KEX PROM	5
341-4001	MONITOR PROM	Monitor PROM - Allows Single Instruction Execution	5
342-0500	PROM PROGRAMMER	1702A PROM PROGRAMMER - AVAILABLE APRIL 1, 1977	5
345-1014	IS-SW8	Complete Self-Teaching Micro-Computer Training Course	4
341-6530	MMD-DBUG PROM	DBUG PROM - Set of Four Pre-Programmed I.C.'s	6

ALL ITEMS AVAILABLE AT YOUR LOCAL COMPUTER STORE

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