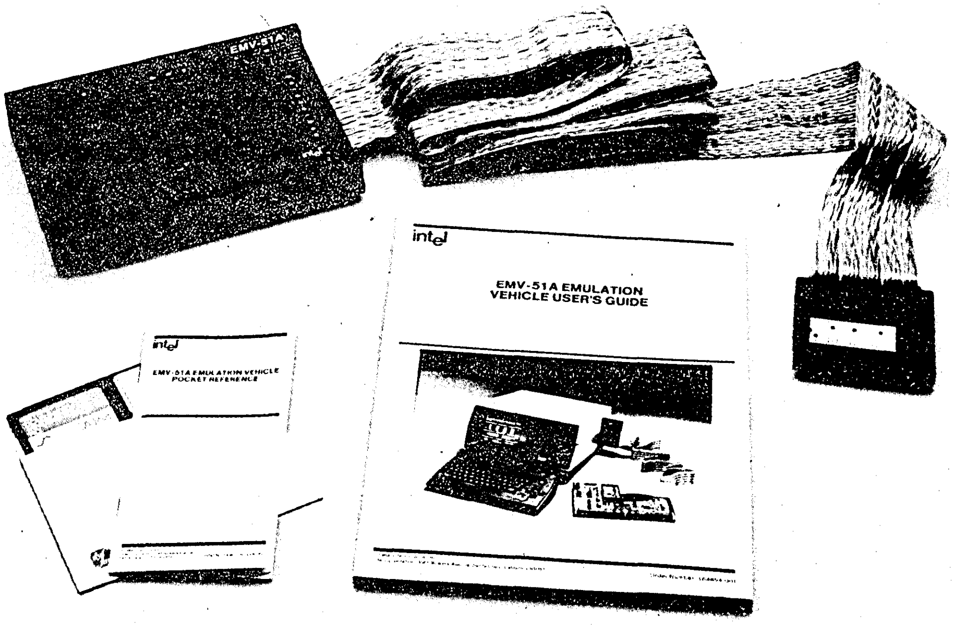
EMV-51A
8051A EMULATION VEHICLE

- **Precise, full-speed, real-time 8051 emulation**
  - **-Load, drive, timing characteristics**
  - **-Full-speed program RAM**
  - **-Serial and parallel ports**
- **Breakpoints/trace**
  - **-4 execution address breakpoints**
  - **-1 range breakpoint**
  - **-Branch and value breakpoints**
- **Full symbolic debugging**
- **Software debugging with or without user system**
- **Advanced, easy-to-use features**
  - **-Programmable function keys**
  - **-Macros**
- **Help facility: EMV-51A command reference at console**
- **Hosted on Intel's Personal Development System**

The EMV-51A system interfaces to any user-designed 8051 or 8052 system and assists in the debugging and development of that system. The EMV-51A consists of an emulator plug, serving as the direct communication link to the user system, an 80-inch cable, and a module hosted by an Intel Personal Development System (iPDS™). The electrical and timing characteristics of the user's 8051 are accurately emulated when using the EMV-51A system. A friendly human interface presents commands in a menu display, and organizes commands in an easy-to-learn fashion. The EMV-51A system allows the designer to emulate the system's 8051 in real-time or single-step mode. Breakpoints allow the user to stop emulation at user-specified conditions, and trace qualifiers allow for conditional display of trace information. Program memory can be displayed and altered using ASM51 mnemonics and symbolic references. Advanced capabilities allow for programmable keys, macros, and control constructs. The EMV-51A system may also be used in the debugging and development of 8052 systems through its ability to debug all of the 8052 features that are shared with the 8051 and the internal 8K ROM space provided in the 8052.


EMV-51A
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EMV-51A EMULATION VEHICLE USER'S GUIDE
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EMV-51A EMULATION VEHICLE POCKET REFERENCE

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Order Number: 280017-001

FUNCTIONAL DESCRIPTION

EMV-51A hardware consists of three parts: the controller, the emulator module, and the cable assembly. The controller contains all the logic to support break, trace, emulation, and communication with the host and the emulator module. The emulator module contains the hardware used to execute 8051 code and supplies all MCS®-51 signals to the user's system. This module connects to the controller via a six-foot cable, and the controller connects to an iPDS host through the EMV/PROM programming adapter board. This adapter board is required to use the EMV-51A on the iPDS.

EMV-51A software contains all the control for user interaction. The software programs the controller, implements all emulator functions, and displays information to the user. This software is run on the iPDS host, and is packaged on a 5-¼ inch diskette. An additional software diagnostic routine, included on the disk, thoroughly checks the EMV-51A hardware.

EMV-51A software will accept and interpret commands entered by the user. These commands will be communicated as a set of micro-commands via a host interface to the controller. Command registers in the controller direct micro-operations to various sections of the break, map, or trace circuitry. Some commands control the emulator board, others determine whether the emulator will emulate the user system, while others interrogate the user system. When appropriate, the controller will pass information back to the host where the information will be processed and displayed to the user. See Figure 1 for a block diagram of the EMV-51A hardware.

The EMV-51A package includes the 8051 Macro Assembler and the 8051 Linker and Relocater (RL51). This assembler provides full macro capabilities, supports symbolic development for both code development and debugging, and supports modular code development with relocation features. RL51 will relocate, link, and generate loadable object files from the relocatable

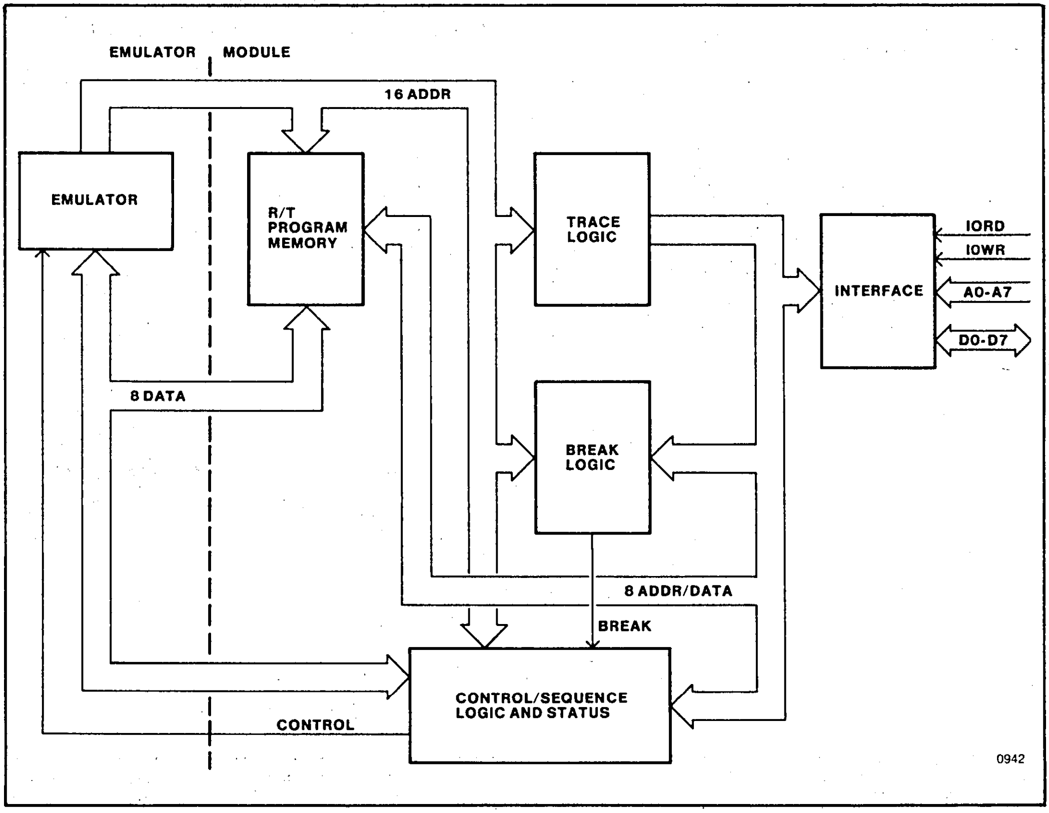


Figure 1. EMV-51A Block Diaqram

modules produced by the assembler. EMV-51A fully supports all mnemonics, object file formats, and symbolic references generated by ASM51 and RL51.

EMV-51A documentation includes a comprehensive user's manual and a command dictionary reference guide.

FEATURE SET

The EMV-51A system provides fundamental capabilities for debugging an 8051 or an 8052 microprocessor system. These basic and general capabilities are described in the following sections.

Real-Time Breakpoints

The EMV-51A system allows the user system to execute user code at full clock speed, until a predefined condition occurs. The breakpoints may be a combination of four execution addresses or a combination of an execution address range and a single execution address. These break capabilities allow the user to stop the user system at various states in the normal processing cycle and to interrogate the state of the system.

Real-Time Memory

The EMV-51A system supplies 8K of high speed RAM memory. The RAM can be used to execute the user program and allows easy changes to the user code. This memory can be used either in place of the user's memory before the memory exists in the user system or used in lieu of the user's memory to ease the debugging effort.

Real-Time Trace

The EMV-51A system maintains an active real-time trace buffer that tracks the last two executed addresses from the user's system. This trace is collected in real-time during execution of the user system. This information can be used to discover where the user's program has been before breaking.

Software Break

During step mode, the EMV-51A system iteratively single steps, then executes a short software interrogation routine. This slow-down mode of operation continues until a register is set to a specific value, or any branch instruction occurs, or until a specified number of instructions have been executed. These additional break features provide users added execution control and microprocessor state information in exchange for real-time emulation.

Software Trace

The EMV-51A system will automatically query the 8051 or 8052 processor and optionally display up to 4 lines of information. This display can show execution address, disassembled code, current register values, or processor status information.

COMMANDS

The EMV-51A system has a friendly and easy-to-use human interface, and commands that are well organized and easy-to-learn. Menu displays prompt the user and assist in learning the different commands. Sample EMV-51A displays are shown in Figure 2. Commands fall into four categories: utility commands, display/modify commands, emulation commands, and advanced commands. Once these basic command categories are understood, locating any command becomes simple. Table 1 lists a summary of EMV-51A commands and the command categories.

The EMV-51A system is a full symbolic emulator, and hence all commands and displays allow for symbolic entry. Thus the EMV-51A system and users communicate by referring explicitly to symbols defined in the user's source program or symbols defined during the debugging session.

Utility Commands

Utility commands perform functions not directly related to the task of emulation and debugging. These commands access the iPDS resources and display information about the emulator. Some examples of utility commands are RESET, LOAD, HELP, and EVALUATE.

Display/Modify Commands

Display/modify commands change or display any register, port, or memory addressable by the 8051 processor chip, plus the internal 8K of ROM memory addressable by the 8052. Examples of display/modify commands include REGISTER, ASM/DASM, CBYTE, DBYTE, RBYTE, and PBYTE. A sample display using the REGISTER command is shown in Figure (3a).

Emulation Commands

All commands causing execution displays, or execution initiation, fall into the emulation category. Thus, the GO, BREAK, and TRACE commands are in this category along with BR0,1,2,3, BV, TR0,1,2,3, TS, and STEP.

Advanced Commands

The advanced commands offer the user an easy way to increase the power of the EMV-51A and thus increase the debugging capability of this product. These advanced features allow EMV-51A command sequences to be combined, executed, and stored. Examples of advanced commands include MACRO, FUNCTION, and control constructs. Figure (3b) shows a display with a macro.

EMULATION MODES

The EMV-51A system combines two approaches to emulation, real-time emulation and software emulation. Programs with time-critical sections of code or critical interrupt routines can be emulated, traced, and debugged in real time. Real-time emulation supports specific execution breakpoints or range breakpoints. The real-time trace will display up to two instruction addresses last executed. Real-time emulation mode is entered by initiating emulation with the GO command. All break and trace commands associated with the GO command act in real-time emulation mode.

Table 1. Summary of EMV-51A Commands and Command Categories

Emulation Commands

BREAK - Display breakpoint menu
BR0, 1, 2, 3 - Breakpoint register for execution address
BRR - Breakpoint register for execution range
BRB - Break on branch
BV - Break on value
BC - Clear all breaks
DTRACE - Display trace menu
TB0, 1, 2, 3 - Enable/disable display by bit value
TR0, 1, 2, 3 - Enable/disable display by execution address
TV - Enable/disable display by register value
TR - Enable/disable display of registers
TS - Enable/disable display of PSW
TD - Enable/disable display of code disassembly
STEP - Enter slow-down emulation mode
GO - Enter real-time emulation mode

Advanced Commands

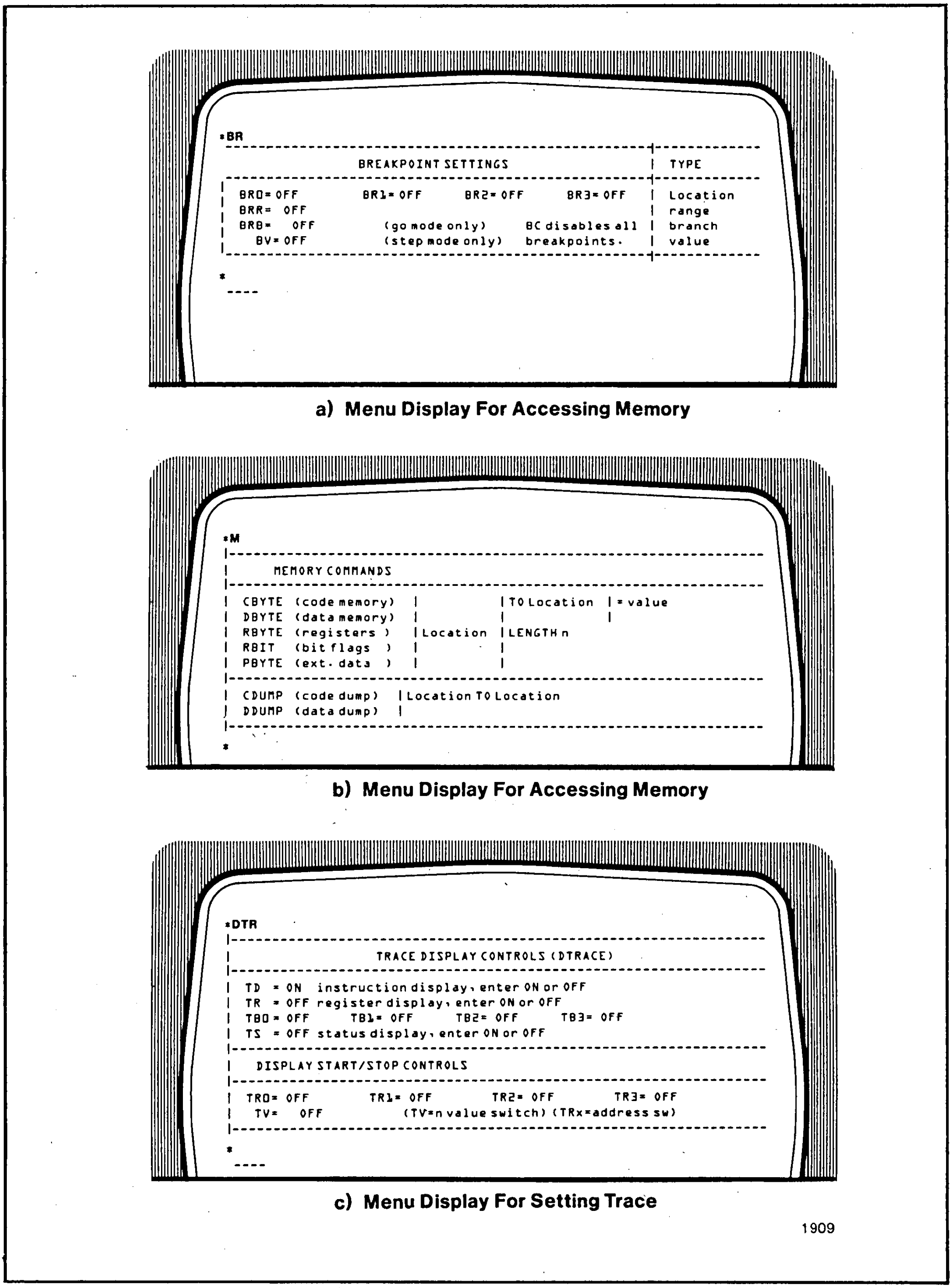
MACRO - Define, and display macro
IF THEN
COUNT
REPEAT - Control constructs
WHILE
UNTIL
FUNCTION - Invoke macro assigned to function key

Utility Commands

HELP - Display command syntax
LOAD - Load object file in mapped memory
LIST - Generate copy of emulation work session
DEFINE - Define symbol or macro
SYMBOL - Display symbols
REMOVE - Delete symbol or macro
ENABLE/DISABLE - Control for expanded display
EVALUATE - Evaluate any expression
SUFFIX/BASE - Set input and display numeric base
SAVE - Save code memory to file
RESET - Reset emulation processor
EXIT - Terminate EMV-51A session

Display / Modify Commands

REGISTER - Change/display 8051 registers
INTERRUPT - Change/display interrupt status
MEMORY - Display menu
CBYTE
DBYTE - Change/display memory
PBYTE
RBYTE
RBIT - Change/display bit memory
CDUMP - Display memory as ASCII and
DDUMP hexadecimal
ASM/DASM - Change/display code memory as assembly language mnemonics



```
*BR
-------------------------------------------------------+-------------
                BREAKPOINT SETTINGS                    |  TYPE
-------------------------------------------------------+-------------
|
|  BR0= OFF        BR1= OFF      BR2= OFF      BR3= OFF  |  Location
|  BRR=  OFF                                             |  range
|  BRB=   OFF          (go mode only)    BC disables all |  branch
|    BV= OFF           (step mode only)  breakpoints.    |  value
|------------------------------------------------------+-------------
*
 ----
```

a) Menu Display For Accessing Memory

```
*M
|--------------------------------------------------------------------
|      MEMORY COMMANDS
|--------------------------------------------------------------------
|  CBYTE  (code memory)   |           |TO Location   | = value
|  DBYTE  (data memory)   |           |              |
|  RBYTE  (registers )    |Location   |LENGTH n
|  RBIT   (bit flags  )   |           |
|  PBYTE  (ext. data  )   |           |
|--------------------------------------------------------------------
|  CDUMP  (code dump)   |Location TO Location
|  DDUMP  (data dump)   |
|--------------------------------------------------------------------
*
```

b) Menu Display For Accessing Memory

```
*DTR
|--------------------------------------------------------------------
|                  TRACE DISPLAY CONTROLS (DTRACE)
|--------------------------------------------------------------------
|  TD  = ON   instruction display, enter ON or OFF
|  TR  = OFF register display, enter ON or OFF
|  TB0 = OFF      TB1= OFF      TB2= OFF      TB3= OFF
|  TS  = OFF status display, enter ON or OFF
|--------------------------------------------------------------------
|   DISPLAY START/STOP CONTROLS
|--------------------------------------------------------------------
|  TR0= OFF        TR1= OFF        TR2= OFF        TR3= OFF
|   TV=   OFF            (TV=n value switch) (TRx=address sw)
|--------------------------------------------------------------------
*
 ----
```

c) Menu Display For Setting Trace

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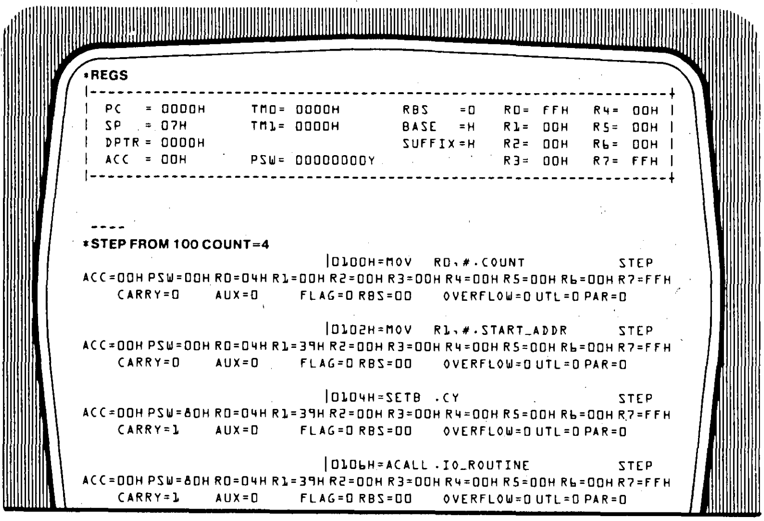
Figure 2. Typical EMV-51A Menu Displays

When full-speed emulation is not critical to the debuggging effort, the EMV-51A system will emulate one instruction, check for a variety of breakpoint and trace point conditions, display trace information, and continue with another instruction. This slow-down mode of operation provides enhanced break and trace facilities at the expense of non-real-time execution. Slow-down-mode emulation is entered by initiating emulation with the STEP command. Figure (3a) shows a display for the single-stepping mode.

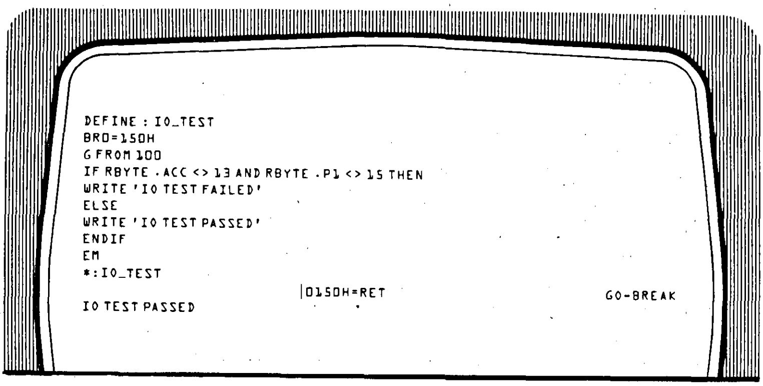
INTENDED USE

The EMV-51A system is particularly well suited to assist in debugging small- to medium-sized



```
*REGS
|---------------------------------------------------------------+
| PC   = 0000H        TM0= 0000H         RBS    =0    R0= FFH    R4= 00H |
| SP   = 07H          TM1= 0000H         BASE   =H    R1= 00H    R5= 00H |
| DPTR = 0000H                           SUFFIX =H    R2= 00H    R6= 00H |
| ACC  = 00H          PSW= 00000000Y                  R3= 00H    R7= FFH |
|---------------------------------------------------------------+


----
*STEP FROM 100 COUNT=4
                              |0100H=MOV   R0,#.COUNT               STEP
ACC=00H PSW=00H R0=04H R1=00H R2=00H R3=00H R4=00H R5=00H R6=00H R7=FFH
    CARRY=0     AUX=0      FLAG=0 RBS=00     OVERFLOW=0 UTL=0 PAR=0

                              |0102H=MOV   R1,#.START_ADDR          STEP
ACC=00H PSW=00H R0=04H R1=39H R2=00H R3=00H R4=00H R5=00H R6=00H R7=FFH
    CARRY=0     AUX=0      FLAG=0 RBS=00     OVERFLOW=0 UTL=0 PAR=0

                              |0104H=SETB  .CY                      STEP
ACC=00H PSW=80H R0=04H R1=39H R2=00H R3=00H R4=00H R5=00H R6=00H R7=FFH
    CARRY=1     AUX=0      FLAG=0 RBS=00     OVERFLOW=0 UTL=0 PAR=0

                              |0106H=ACALL .IO_ROUTINE              STEP
ACC=00H PSW=80H R0=04H R1=39H R2=00H R3=00H R4=00H R5=00H R6=00H R7=FFH
    CARRY=1     AUX=0      FLAG=0 RBS=00     OVERFLOW=0 UTL=0 PAR=0
```

a) Display of (1) Registers and (2) Single Stepping through a Portion of a User's Program (Using Symbolics with Selective Trace of Processor and Register Status Information)



```
DEFINE : IO_TEST
BR0=150H
G FROM 100
IF RBYTE .ACC <> 13 AND RBYTE .P1 <> 15 THEN
WRITE 'IO TEST FAILED'
ELSE
WRITE 'IO TEST PASSED'
ENDIF
EM
*:IO_TEST
                          |0150H=RET                              GO-BREAK
IO TEST PASSED
```

b) Display Showing Macro Capability for Debugging System Hardware and Software

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Figure 3. Sample Emulation Displays

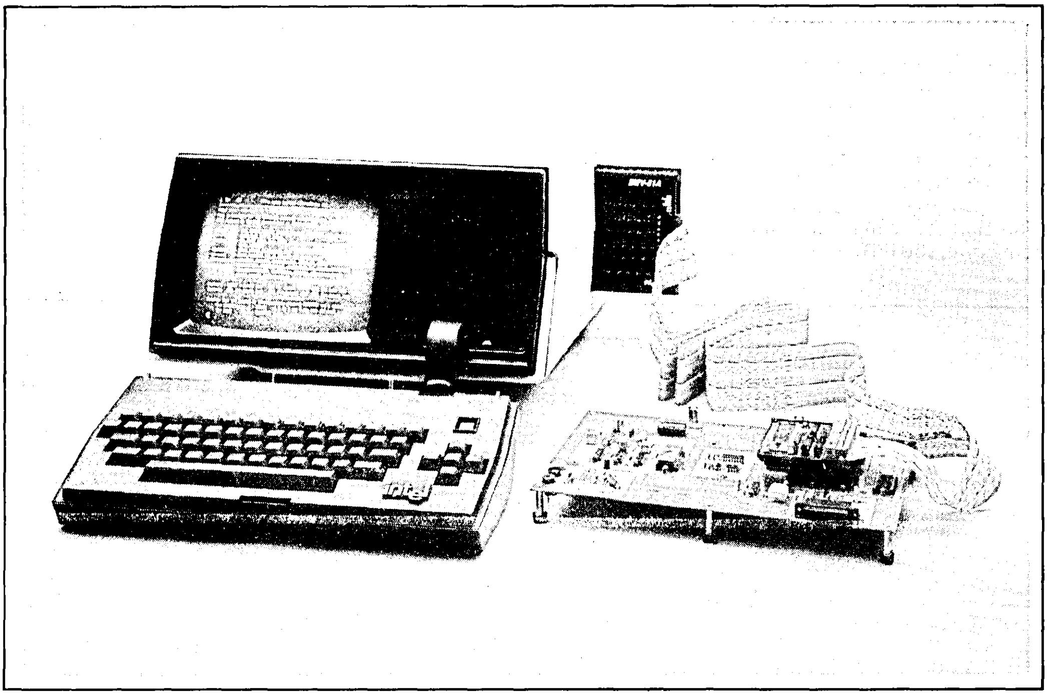

Figure 4. EMV-51A in iPDS™ Debugging Environment

programs whose program complexity is low to moderate in terms of interrupts, program nesting, and execution flow.

8051 and 8052 Debugging

The EMV-51A system can debug both the internal 8K of ROM space provided by the 8052 and the space provided by the features that the 8052 shares with the 8051. (The extra timer and extra data RAM of the 8052 are not emulated by the EMV-51A system.)

SPECIFICATIONS

EMV-51A System Operating Requirements

The EMV-51A system operates with an iPDS system. The iPDS system must be configured with the EMV/iUP adapter option, iPDS-140.

Equipment Supplied

- EMV-51A emulator
- User's manual
- Pocket reference
- EMV-51A software and diagnostic diskette
- 8051 software development package

Emulation Clock Rate

User's system: 1.2 to 12 MHz
EMV-supplied crystal: 12 MHz

Environmental Characteristics

Operating temperature: 0-40° C
Operating humidity: 50-90% RH, non-condensing

Physical Characteristics

Controller: 7.8 in. x 1.5 in. x 5.8 in. (19.8 cm. x 3.8 cm. x 14.7 cm.)

Emulator: 3.3 in. x 3.3 in. x 1.5 in. (8.4 cm. x 8.4 cm. x 3.8 cm.)

Total Weight: 1 lb. 7 oz. (0.65 kg.)

Electrical Characteristics

Power requirements from iPDS: +5V ± 5% @ 1.9A
*Power requirements from user system: +5V ± 5% @ 200 ma MAX
Characteristics of user socket: Same as 8031, 8051, 8052, or 8751

*The emulator can be strapped to draw its power from either the iPDS unit or the user system.

Ordering Information

Part Number	Description
iPDS-EMV-51A	Emulation vehicle for 8051 microcontroller with diskette and documentation