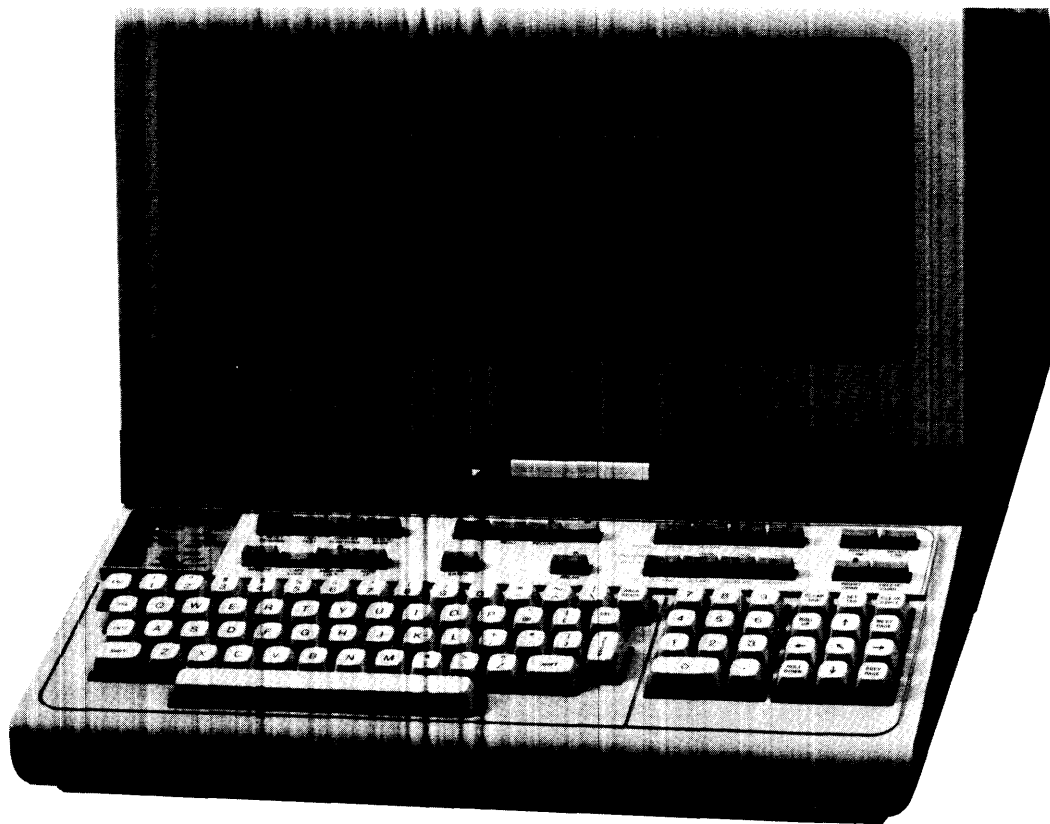




## HP 13290B Development Terminal



- **Complete Source Program Editing Capabilities**
  - Character or line insertion and deletion
  - Scrolling, page selection
  - Tabulation, movable margins, cursor positioning
- **Resident Program Assembly**
  - Free field source format
  - Logical input/output device selection
- **Resident Program Debug**
  - Extensive debugging facilities
  - Simplified command syntax
  - Choice of number bases
  - Mnemonic listing of instruction bytes
  - Separate user and debug display workspaces
- **Memory Bank Switching**
  - Expanded address space to 128K bytes
  - 64K bytes of RAM memory

The most time consuming aspect of developing typical micro-processor based applications is the firmware development and debugging cycle. For this reason, tools which can simplify this task have become increasingly more important to the firmware designer. The HP 13290B Development Terminal is a versatile development tool with features which will allow a user to save valuable time when developing applications firmware for the HP 2649A Terminal/Controller.

### COMPLETE SOURCE PROGRAM EDITING CAPABILITIES

The 22K bytes of editing firmware and integral dual cartridge tape drives which are included in the HP 13290B allow the user to easily create and edit source programs. The editing firmware supports character or line insert and delete, cursor positioning, tabulation, movable margins, page select and scrolling. Source programs of up to two hundred lines in length can be stored in the display memory of the HP 13290B while being edited. For larger source programs, the dual cartridge tape drives provide access up to an additional 220K bytes of tape storage.

### RESIDENT PROGRAM ASSEMBLY

Once source programs have been prepared, they may be assembled using the HP 13290B. The resident Assembler accepts source programs written in 8080 assembly language. Source programs may be composed in a free field format with a single space for the delimiter between the label, instruction and operand fields. The Assembler will produce 8080 compatible absolute object code as well as program and symbol cross-reference listings. The listing output may be directed to an optional hard copy device if one is

present. During assembly, source programs are input to the Assembler via one tape cartridge while the object code is output via another tape cartridge.

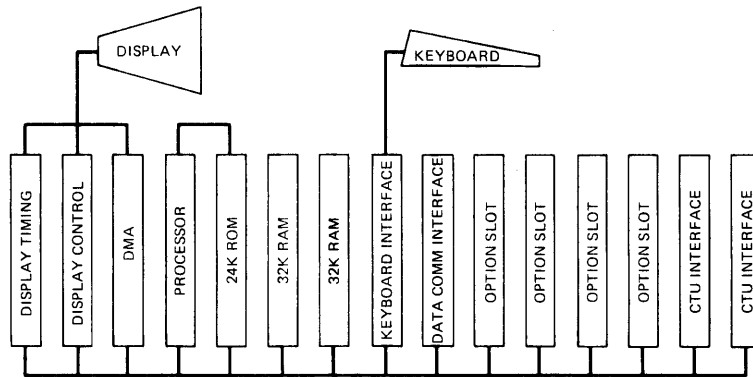
The Assembler will not support conditional assembly, macro instructions, the SET pseudo instruction or evaluated register specifications.

### RESIDENT PROGRAM DEBUG

After application programs have been assembled, they may be loaded into the HP 13290B and debugged. The Debug Program for the HP 13290B provides the user with a wide range of debugging facilities. These include displaying/changing memory, displaying/changing registers/flags, setting/clearing breakpoints, tracing program execution,

loading/dumping programs from/to cartridge tape and invoking user subroutines. The user interface to the debug program has been made "friendly" through the use of a simplified command syntax, choice of number bases for addresses/data and mnemonic representations of program instructions.

An important feature of the Debug Program is the separate user and debug displays. Using this feature, the display data accumulated while interacting with the Debug Program is stored in a different workspace than the display data generated by user programs. The user may then select which workspace is to be viewed by entering a simple command to the debug program. The two workspaces may be alternatively viewed without losing any data.

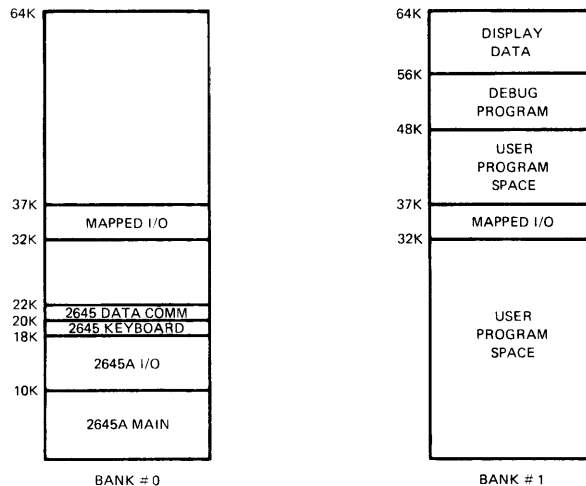


BLOCK DIAGRAM OF 13290B

### MEMORY BANK SWITCHING

Memory bank switching is a unique feature which provides the user with access to an additional 64K<sub>10</sub> of address space for programs or data. This feature has been implemented through the use of a memory bank switch which is dynamically alterable under program control. In the HP 13290B, one bank of memory (bank #0) is used for the editing firmware while another bank (bank #1)

is used for storage of user programs/data, the debug program, the assembler and display data. The bank switching feature combined with the 64K<sub>10</sub> bytes of RAM in the HP 13290B enable it to concurrently support user developed programs with storage requirements of up to 43K<sub>10</sub> bytes, the Debug Program and approximately 7K<sub>10</sub> bytes of display data.



13290B MEMORY MAP

## SUMMARY OF DEBUG COMMANDS

### MEMORY MANAGEMENT COMMANDS:

SET REGISTER <A/B/C/D/E/F/L/CY/P/S/Z> <value>

Set the registers and flags in the 8080 to a specified value before branching to user program.

### REGISTERS

Display the contents of the registers and flags in the 8080.

DISPLAY <starting address> <ending address>

Display the contents of memory between the specified starting and ending addresses. The ASCII equivalent of the data is also displayed.

TYPE <starting address> <ending address>

Display the contents of memory between the specified starting and ending addresses.

NEMONIC <starting address> <ending address>

Display the assembly language equivalent of the contents of memory between the specified starting and ending addresses.

/ <address>

Display the contents of memory at the specified address and optically set it to a new value.

### SP

Display the contents of the stack and the stack pointer register.

### PROGRAM EXECUTION COMMANDS:

GO <address>

Transfer execution to user program at specified address.

CALL <address>

Transfer execution to user subroutine at specified address and return to the debug program.

BREAK <address>

Set or clear a breakpoint at the specified address.

STEP <number of instructions> <starting address>

Transfer execution to user program or specified address and execute the specified number of instructions. Display assembly language equivalent, register contents and program counter after each instruction is executed.

CYCLE <number of cycles> <address>

Transfer execution to user program and display assembly language equivalent, register contents and program counter after instruction at the specified address is executed. Continue until the instruction at the specified address has been executed for the specified number of times.

STEP UNTIL <PC/BC/DE/HL/A/B/C/D/E> = <value>

Transfer execution to user program and display assembly language equivalent, register contents and program counter after each instruction is executed. Continue execution until specified condition is satisfied.

CYCLE UNTIL <PC/BC/DE/HL/A/B/C/D/E> = <value>

Transfer execution to user program and display assembly language equivalent, register contents and program counter after instruction at the specified address is executed. Continue execution until specified condition is satisfied.

STEP QUIETLY <number of instructions> <starting address>

Transfer execution to user program at specified address and execute the specified number of instructions. Display the assembly language equivalent, register contents and program counter only after execution of the last instruction.

CYCLE QUIETLY <number of cycles> <address>

Transfer execution to user program and continue execution for the specified number of cycle. Display the assembly language equivalent, register contents and program counter after the instruction at the specified address is executed during the last cycle.

### PROGRAM LOAD/SAVE COMMANDS:

LOAD <starting address> <ending address>

Copy programs and/or data in binary format from a cartridge tape into the specified area of memory.

SAVE <starting address> <ending address>

Copy the contents of the specified area of memory onto a cartridge tape in binary format.

SAVE LOADER <starting address> <ending address>

Copy the contents of the specified area of memory onto a cartridge tape in ASCII loader format.

COMPARE <starting address> <ending address>  
<file number>

Compare the contents of the specified area of memory to the contents of a specified cartridge tape file.

MODE <HEX/OCT/TEN>

Set the default number base for data and addresses specified in debug commands.

### SWAP

Change from the debug display to the user display or, if user display currently in effect, change to the debug display.

### SAVE USER

Save Alternate I/O pointers to user program.

## PUT USER

Restore Alternate I/O pointers to user program.

## TAPE UTILITY COMMANDS:

### DUMP CARTRIDGE

List a record from the cartridge tape on the display.

### LIST FILES

Search a tape and display the file number and first record of each file on the display.

## 13290B SPECIFICATIONS

### GENERAL

Screen Size: 127 mm (5 inches) X 254 mm (10 inches)

Screen Capacity: 24 lines X 80 columns (1,920 character)

Character Generation: 7 X 9 enhanced dot matrix; 9 X 15 dot character cell; non-interlaced raster scan

Character Size: 2.46 mm (.097 inches) X 3.175 mm (.125 inches)

Character Set: 128 character upper-case Roman

Cursor: Blinking-Underline

Display Modes: White on Black; Black on White (Inverse Video)

Refresh Rate: 60 Hz (50 Hz optional)

Tube Phosphor: P4

Implosion Protection: Bonded implosion panel

Memory: MOS, ROM: 22K bytes (program); RAM: 64K bytes

Keyboard: Detachable, full ASCII code keyboard, user-defined soft keys, and 18 additional control and editing keys; ten-key numeric pad; cursor pad; multi-speed auto-repeat, N-key roll-over; 1.22m. (4 foot cable).

Cartridge Tape: Two mechanisms

Read/Write Speed: 10 ips

Search/Rewind Speed: 60 ips

Recording: 800 bpi

Mini Cartridge: 110 kilobyte capacity (maximum per cartridge)

### DATA COMMUNICATIONS

Data Rate: 110, 150, 300, 1200, 2400, 4800, 9600 baud, and external. Switch selectable. (110 selects two stop bits). Operation above 2400 baud may require nulls or handshake protocol to insure data integrity.

Standard Asynchronous Communications Interface:

EIA standard RS232C; fully compatible with Bell 103A modems; compatible with Bell 202C/D/S/T modems.

Choice of main channel or reverse channel line turnaround for half duplex operation.

Transmission Modes: Full or half-duplex, asynchronous

Operating Modes: On-Line; Off-line; Character, Block

Parity: Switch selectable; Even, Odd, None

### ENVIRONMENTAL CONDITIONS

Temperature, Free Space Ambient:

Non-Operating: -40 to +75°C (-40 to +167°F)

Operating: 0 to 55°C (+32 to +131°F)

Temperature, Free Space Ambient (Tape):

Non-Operating: -10 to +60°C (-15 to +140°F)

Operating: 5 to +40°C (+41 to +104°F)

Humidity: 20 to 80% (non-condensing)

Altitude:

Non-Operating: Sea level to 7620 metres (25,000 feet)

Operating: Sea level to 4572 metres (15,000 feet)

Vibration and Shock (Type tested to qualify for normal shipping and handling):

Vibration: .30 mm (0.012") pp, 10 to 55 Hz, 3 axis

Shock: 30g, 11ms, 1/2 sine

### PHYSICAL SPECIFICATIONS

Display Monitor Weight: 19.6kg (43 pounds)

Keyboard Weight: 3.2kg (7 pounds)

Display Monitor Dimensions: 444 mmW X 457 mmD X

342 mmH (17.5"W X 18"D X 13.5"H)

(648 mmD (25.5"D) including keyboard)

Keyboard Dimensions: 444 mmW X 216 mmD X 90 mmH

(17.5"W X 8.5"D X 3.5"H)

### POWER REQUIREMENTS

Input Voltage: 115 (+10%-23%) at 60 Hz (±0.2%)

230 (+10%-15%) at 50 Hz (±0.2%)

Power Consumption: 140W

### PRODUCT SAFETY

Product meets:

UL Requirements for: EDP equipment, office appliances, teaching equipment

CSA Requirements for: EDP equipment

U.L. and CSA labels are applied to equipment shipped to the U.S. and Canada, SEV Switzerland, FTZ (RFI) Germany, FTZ (Data Comm) Germany, GPO (Data Comm) U.K.

### PRODUCT SUPPORT

#### WARRANTY

90 day on-site parts and labor warranty

#### HARDWARE SUPPLIED

13290B Development Terminal

2645A Object Code Mini Cartridge

Assembler/Debug Object Code Mini Cartridge

8500-1251 Tape Head Cleaning Solvent

9162-0061 Data Cartridge (five)

9300-0468 Tape Head Cleaning Swabs

13232C Cable

13232N Cable

#### DOCUMENTATION SUPPLIED

Assembler/Debug Reference Manual

13290A Reference Manual

2645A User Manual, Reference Manual, Service Manual, User Instruction Tape

```

15      6020      .      .      .      ;*
16      6020      .      .      .      ;***  ENTRY POINT FROM ESCAPE PROCESSOR
17      6020      .      .      .      ;*
18      6020      CD  4F  0          CALL ESCEND      ;RESET RANGE TABLES, ETC.
19      6023      21  18  61        LXI H,WRDTBL     ;SET POINTER TO START
20      6026      22  16  61        SHLD TBLPTR     ; OF WORD TABLE
21      6029      E   0   .          MVI C,0         ;SET WORD COUNTER TO 0
22      602B      6   0   .          MVI B,0         ;SET COLUMN POINTER TO
23      602D      C5   .   .          PUSH B          ; START OF LINE
24      602E      3E  20  .          MVI A,SPACE     ;SET PREVIOUS CHAR
25      6030      32  12  61        STA PRVCHR      ; TO A SPACE
26      6033      CD  85  0          CALL INITD0     ;INITIALIZE DISPLAY POINTERS
27      6036      .      .      .      ;*
28      6036      .      .      .      ;***  SCAN LINE FOR SPACES AND NOTE COLUMNS
29      6036      .      .      .      ;*          WHERE THEY APPEAR
30      6036      .      .      .      ;*
31      6036      CD  88  0  NXTCHR CALL GETDSP     ;GET CHAR FROM DISPLAY
32      6039      DA  5D  60        JC ENDLIN      ;IF END OF LINE, GO PROCESS
33      603C      C1   .   .          POP B          ;GET COLUMN POINTER
34      603D      FE  20  .          CPI SPACE      ;IF CHAR IS NOT A SPACE, GO
35      603F      C2  55  60        JNZ UPDATE    ; UPDATE COLUMN POINTER
36      6042      3A  12  61        LDA PRVCHR     ;IF PREVIOUS CHAR WAS ALSO
37      6045      FE  20  .          CPI SPACE      ; A SPACE, DON'T COUNT THE
38      6047      CA  55  60        JZ UPDATE     ; CURRENT SPACE
39      604A      2A  16  61        LHLD TBLPTR    ;SET THE COLUMN NUMBER IN
40      604D      70   .   .          MCV M,E       ; THE WORD TABLE
41      604E      23   .   .          INX H         ;STEP TABLE POINTER AND SAVE
42      604F      22  16  61        SHLD TBLPTR    ; FOR NEXT WORD
43      6052      C   .   .          INK C         ;STEP THE WORD COUNTER
44      6053      3E  20  .          MVI A,SPACE    ;RESET CHAR TO SPACE
45      6055      .      .      .      ;
46      6055      32  12  61  UPDATE STA PRVCHR     ;SAVE CURRENT CHAR
47      6058      4   .   .          INK B         ;INCREMENT COLUMN POINTER
48      6059      C5   .   .          PUSH B        ; AND SAVE FOR NEXT CHAR
49      605A      C3  36  60        JMP NXTCHR     ;GO GET NEXT CHAR
50      605L      .      .      .      ;*
51      605D      .      .      .      ;***  END OF LINE FOUND, DETERMINE NUMBER OF
52      605D      .      .      .      ;*          SPACES REMAINING
53      605D      .      .      .      ;*
54      605D      C1   .   .  ENDLIN POP B         ;GET THE COLUMN POINTER
55      605E      3E  4C  .          MVI A,76      ;DETERMINE NUMBER OF SPACES

```

Example of HP 13290B Assembler Program Listing

```

HP 264X DEBUG 1/1/78
OK>MODE OCT
OK>NEM 60250 60260
 60250  SUB A
 60251  MOV H,B
 60252  STA 60425
 60255  POP B
 60256  DCR C
 60257  JM 60405

```

OK>BR 60255

PC	INSTRUCTION	INT	S	Z	P	CY	AC	REGS:	A	B	C	D	E	H	L
60255	POP B	1	0	1	1	0	1		42	42	11	42	204	377	157

OK>ST 10 60256

60262	PUSH B	1	0	0	0	0	1		42	42	10	42	204	377	157
60263	LHLD 60426	1	0	0	0	0	1		42	42	10	42	204	141	41
60266	DCX H	1	0	0	0	0	1		42	42	10	42	204	141	40
60267	MOV D,M	1	0	0	0	0	1		42	42	10	42	204	141	40
60270	SHLD 60426	1	0	0	0	0	1		42	42	10	42	204	141	40
60273	LDA 60425	1	0	0	0	0	1		42	42	10	42	204	141	40

Example of User Interaction with Debug Program

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