

HX-20 General Specifications

CPU and Memory

Main CPU: CMOS 8 bit microprocessor 6301, 614 KHz clockrate
Slave CPU: CMOS 8 bit microprocessor 6301, 614 KHz clockrate
RAM: 16K (standard) expandable to 32K with expansion unit
ROM: 32K (standard) expandable to 40K internally;
to 64K with expansion unit

Built-in Peripherals

Display: Liquid crystal screen; 120 x 32 dot matrix;
20 x 4 character display; 5 x 7 font;
virtual width to 255 characters by BASIC "WIDTH" command
Printer: 24 column dot matrix impact microprinter;
graphic print rate: 42 lines per minute;
bit addressable graphics;
full ASCII upper and lower case character set;
cartridge ribbon
Clock: Time and Calendar, alarm, interval timer,
built-in CMOS battery backup

Tone Generator: Programmable pulse drive, four octaves with half-tones

Communications

RS-232C: Full/half duplex, 110 to 4800 baud rate, 8-pin DIN connector
Serial: Full/half duplex, 150, 600, 4800, 38.4K baud rate,
RS-232C level, 5-pin DIN connector

Peripheral Interfaces

Barcode Reader: HP barcode reader with special connector
Cassette: Standard audio cassette interface
System Bus: 16-bit address bus; 8-bit data bus and control lines;
40 pin connector
ROM Cartridge/Microcassette Interface:
I/O port with 3 input, 6 output lines

Switches, internal

4 bit DIP: 3 bits for international character set selection;
1 bit programmable

Switches, external

Main Power, Printer on/off, Reset

Power Supply

Four NiCd batteries, internal;
Sub C type, 1100 mA/H capacity;
50 hour capacity running BASIC (less depending on
use of RS-232 port, printer or optional microcassette)

Recharge: Full charge within 8 hours

Keyboard and Character Set

ASCII keyboard; interruptible; 68 keys, including
5 function keys and 13 special keys;
10 key pad simulator (locked in by [NUM] key);
graphic shift key for 32 graphic characters;
international character set (dip switch selectable)

Environmental Requirements

Temperatures

Operating: 5 to 35 degrees Celsius (41 to 95 Fahrenheit)

Charge: 5 to 35 degrees Celsius (41 to 95 Fahrenheit)

Data Integrity: -5 to 40 degrees Celsius (22 to 104 Fahrenheit)

Data Storage: -20 to 60 degrees Celsius (-5 to 140 Fahrenheit)

Humidity: Operating/Non-operating: 10% to 80% non-condensing

Physical Characteristics

Dimensions: 28.9 cm. x 21.6 cm x 4.44 cm;
Weight: 1.73 kg.

Options

Expansion Unit: 8K RAM plus 24K ROM or 16K RAM plus 16K ROM.
Total expansion is 32K

Microcassette: Uses standard microcassette tapes

HX-20 Expansion Unit

General information

The HX-20 memory expansion unit provides an additional 16K of RAM (random access memory) and/or 32K of ROM (read-only memory) space to the HX-20 portable microcomputer. The unit attaches directly to the HX-20, becoming an integral part of the system. It requires no special programming or separate power supply to function properly.

RAM and ROM capacity

The memory expansion unit comes equipped with 16K of RAM. This doubles the internal memory of the HX-20, giving the user more room for program instructions and variables. In addition to the RAM, the unit also provides the user with space for up to 32K of ROM. ROM is used for built-in programs, such as the Communications package and the RAX device (Random Access Cassette System)

ROM compatibility

The HX-20 can use HN613128 ROMs, SMM2365 Mask ROMs, MBM27C64 EPROMs, and any ROMs or EPROMs which are completely compatible. Installation of these ROMs should be performed only by a qualified Epson authorized service technician, because these devices are highly susceptible to breakage and static electricity.

Getting started

Before installing the unit, save any programs in memory that you wish to keep on cassette (regular or micro). Install the unit according to the instructions given in the installation guide. After installing the memory expansion unit, turn the power on, and press <CTRL-@> to initialize the system. After you have entered the date and time, press RETURN. The HX-20 will then begin to use the extra RAM and ROM memory that you have installed.

TF-20 Floppy Disk Drives

General information

The TF-20 is a dual 5-1/4" double-sided double-density floppy disk drive system designed for use with the HX-20 portable microcomputer. The TF-20 (referred to as a terminal floppy) drive system is composed of two slimline disk drives integrated into a single case and power supply unit. They connect to the HX-20 via the high-speed serial interface.

Disk BASIC

When the TF-20 drive is connected to the HX-20 and Disk BASIC is booted (loaded into memory), the HX-20 BASIC is enhanced with many additional commands used in disk drive operation. The additions to ROM BASIC include commands that handle random access files, disk system functions, and additional BASIC programming structures (WHILE...WEND).

Hardware configuration

The TF-20 disk drive incorporates a central processing unit (CPU), 64K of memory and various I/O devices. These resident devices reduce the workload of the HX-20 by controlling file manipulation and handling the input/output routines between the HX-20 and TF-20. The 64K in the TF-20 also reduces the amount of memory space needed in the HX-20 for the drives and Disk BASIC to operate.

Environmental Requirements

Temperature:	Operating state	: 5 to 28 degrees Celsius
	Non-operating	: -30 to 65 degrees Celsius
Humidity:	Operating state	: 20% to 80% (non-condensing)
	Non-operating	: 5% to 85% (non-condensing)

Power requirements

Requires 120VAC, 49.5 to 60.5Hz, 40W.

Outline dimensions

120mm (W) x 350mm (D) x 165mm (H), 6 kg.

HX-20 Serial Port Specifications

General information

The HX-20 has 2 serial ports available for use; the standard RS232C port, and the high-speed serial port. The high speed serial port is used primarily by Epson peripheral products and interconnections. The following, therefore, is an outline of the RS232C port, and how to use it.

Hardware connections

The HX-20 uses an 8-pin DIN connector for its RS232C interface. The following are the pin connections:

Signal Pin no.	Signal	Signal Direction	Meaning of Signal
1	GND	-	Signal GND level
2	TXD	OUT	Transmitting data
3	RXD	IN	Receiving data
4	RTS	OUT	Request to send
5	CTS	IN	Clear to send
6	DSR	IN	Data set ready
7	DTR	OUT	Data terminal ready
8	CD	IN	Carrier detect
E	FG	-	Case GND level (Ground)

Using the RS232C port with BASIC

Through special BASIC commands and the COM0: device code, you can use the RS232C port directly from BASIC. Information on how to do this is contained in the HX-20 Basic Reference manual, pages 3-46 and 3-47.

HX-20 Machine Code Monitor

General information

The HX-20 contains on ROM a machine language monitor designed as a software tool for machine-code programmers. The monitor includes commands used to directly modify memory, look at memory and the systems-level status registers, and execute machine language routines. The monitor uses hexadecimal notation when dealing with numeric quantities or machine language addresses.

The monitor is entered from BASIC by typing the keyword MON. Upon entry to the monitor program, the current value of the system registers will appear on the screen. Note: the monitor does not use the virtual screen; therefore cursor controls, the SCRNL command and the insert command are unusable.

Monitor functions

When you have entered the monitor, the following one-letter commands are at your disposal:

- B - Return to caller
- K - Respond to keystack sequence
- D - Dump memory 15 bytes at a time
- G - Call subroutine
- S - Set memory
- X - Display and/or change the value of a 6301 register.
- R - Read object file into memory
- V - Verify an object file saved on a device
- W - Write an object file to device
- A - Provides read and write addresses when reading or writing files

For a detailed explanation of these commands and their parameters see pages 9-3 to 9-13 of the HX-20 Operation Manual.

When you call the monitor from BASIC and want to return, type B and press RETURN. You should then be back in the BASIC language. If you call the monitor from the initial start-up menu, press MENU to return to normal operation.

HX-20 BASIC Language

Overview

The HX-20 portable microcomputer package includes a powerful version of the BASIC computer language resident in read-only memory (ROM). HX-20 ROM BASIC contains many features not found in other BASICs, as well as features designed exclusively for the HX-20.

Extended features

In addition to statements common to BASIC, the HX-20 ROM BASIC contains the following features:

- IF-THEN-ELSE: Two-way conditional statements
- LINE INPUT : Inputs a line of text exactly as typed, including commas, quotes, etc.
- INPUT\$ (X) : Inputs X characters, and places them in a character string.
- INSTR: : Checks for an occurrence of a substring with a string.

HX-20 special BASIC features

ROM BASIC also contains statements and functions unique to the HX-20 and its special capabilities. From ROM BASIC, you can tell the HX-20 to play you a tune, mix text with screen graphics, move the virtual screen around, and store/retrieve programs using your cassette recorder. You can also set the HX-20 internal real-time clock, create RAM files to move variables from one program to another, and many other things.

Getting started

To get started using HX-20 ROM BASIC, simply turn on the power, choose BASIC from the initial menu, and you are there. For detailed instructions on BASIC programming, see the HX-20 Basic Reference Manual or HX-20 Easy Basic.

HX-20 Program Protection

Disabling the Keyboard

The following POKES can be used to disable and enable various keys and functions. Using these effectively disables the keyboard almost completely.

POKE 125,4	Disables BREAK
X=PEEK(123)	Saves RUN mode for later reset
POKE 123,65	Disables function keys
POKE 290,249	
POKE 291,202	Disables MENU
POKE 127,160	Enables printer even when switched off
POKE 123,X	Goes back to BASIC, re-enables function keys
POKE 290,255	
POKE 291,37	Re-enables MENU
POKE 125,0	Re-enables BREAK
POKE 127,0	Resets printer

Autostarting

To auto-start a program when the HX-20 is switched on, follow this procedure:

1. LOAD the program and TITLE it.
2. Go back to the menu and select option 1 (Monitor).
3. Type in K n CTRL-@ where n = the option number of the program on the menu.
4. Switch the HX-20 off then on.
5. The computer will automatically run the program when it is switched on.
6. To remove the autostart, hit BREAK the moment you switch on the computer. Go into Monitor and type K CTRL-@, then switch the computer off and on again.

Stopping the Fiddler

RENUMBER the program starting at 100 or higher - this stops the fiddler who usually types his program starting at line 10.

Safety First

Copy the program into another page or two of memory so if the program does get corrupted you can run it again in another area.

Using a Loader

Use a BASIC loader program so that the user must type RUN"PROGNAME" instead of just LOAD. This, coupled with keyboard disable and setting the protection byte will ensure the user never gets into BASIC in the same LOGIN area as the program.

Setting the Protection Byte

at the protection byte:

```
POKE &H7E,128 (deprotects RAM protection byte)
POKE(PEEK(&H4B5)*256+PEEK(&H4B6)+10),255
    (sets Program protection byte)
POKE &H7E,0 (resets RAM protection byte)
```

To deprotect:

```
POKE &H7E,128
POKE (PEEK(&H4B5)*256+PEEK(&H4B6)+10),0
POKE &H7E,0
```

Using the Expansion Unit

Installation

Refer to the 'Expansion Unit Mounting Procedure' booklet supplied with the unit for physical attachment to the HX-20. After mounting the unit you MUST cold start the machine by pressing CTRL-@ the first time you use the machine. A cold start must also be done when the expansion unit is removed or the configuration changed.

RAM and ROM Options

There are three basic configurations for the expansion unit, as follows:

1. 16k RAM + 18k ROM: With the expansion unit configured this way the internal optional expansion ROM is disabled and cannot be used. This is particularly relevant to those users who wish to use the packages that contain the COMMS or RAX ROMS.
2. 8k RAM + 24k ROM: The internal optional expansion ROM is useable.
3. 32k ROM: The internal optional expansion ROM is useable.

In addition to being able to select the RAM/ROM combination for the expansion unit you can also select the type of ROM that is used within the expansion unit. The types of ROM available for use are as follows:

1. MBM 27C64 CMOS EPROM
SMM 2365 masked ROM
2. NM613128
MBM 27C128

NOTE:- CMOS EPROMS should be used, otherwise battery life will be reduced from the normal 50 hours.

Setting the Options

The options described above are selected as follows:

1. RAM/ROM mixture:

Option	Switches		Configuration
	1	2	
1	ON	OFF	16k RAM + 16k ROM
2	OFF	ON	8k RAM + 24k ROM (when using RAX or COMMS)
3	OFF	OFF	32k ROM

2. ROM type:

ROM Type	Switches		Jumpers	
	3	4	1	2
27C64	OFF	ON	B	B
128	ON	OFF	A	A

Bank Switching

When ROM is installed in both the main HX-20 and the expansion unit, it must be possible to switch between the banks of ROMs. This should only be done from machine code - the locations are as follows:

\$30 or \$31 Selects bank 1 - the expansion unit ROMs

\$32 or \$33 Selects bank 0 - the HX-20 main ROMs

Loading RAM Files in Binary Form

The RAM files used by BASIC can be saved to and loaded from tape quickly by using the SAVEM and LOADM commands. However, any attempt to load the RAM file back in will produce a BD (Bad Data) error. This may be overcome by using the program listed below:

```
10 CLS
20 DEFFIL 25,0
30 A$ = "This is record 0"
40 PUT% 0,A$
50 GET% 0,B$
60 PRINT B$
70 RFS = PEEK(&H5A2)*256+PEEK(&H5A3)
80 RFL = PEEK(&H4FE)*256+PEEK(&H4FF)
90 WIND:SAVEM "RAMFILE",RFS,RFS+RFL-1,RFS
100 A$ = "This will be erased"
110 PUT% 0,A$
120 GET% 0,B$
130 PRINT B$
140 TVH = PEEK(&H500):TVL = PEEK(&H501)
150 POKE &H500,PEEK(&H4B2):POKE &H501,PEEK(&H4B3)
160 WIND:LOADM "RAMFILE"
170 POKE &H500,TVH:POKE &H501,TVL
180 GET% 0,B$
190 PRINT B$
```

NOTE:- This program will produce odd effects and probably will crash if the length of the RAM file is decreased before loading it from cassette.

The program works as follows:

Line no.	Purpose
10-60	Initialise RAM files record size and demo of setting a record
70	Obtains starting address of RAM file
80	Obtains length of RAM file
90	Saves the complete file in binary format
100-130	Demo of setting a record to a value that will be overwritten once the RAM file is reloaded

- 140 Obtains the original value of the highest address
 in memory that LOADM can use
- 150 Sets the highest address that LOADM can use to the
 highest address that BASIC can use
- 160 Loads the complete RAM file
- 170 Restores the highest address that LOADM can use
 back to its original value
- 180-190 Proof that it works by getting the record written
 in Line 40