TECHNICAL SUPPORT MANUAL

Section 1

HX-20 INFORMATION

EPSON

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Foreword by the compiler and editor

Introduction

This booklet is the first and most up to date release of the HX-20 section of the second edition of the Technical Support Manual. The complete manual comprises both updated versions of the documents contained in the first edition and many other new documents.

Only information concerning the Epson HX-20 is contained herein. The documents are arranged in alphabetical order, with hardware information preceding software. Other booklets available are: PX-8 information, QX-10 information and interfacing, printer and software information. These can be purchased for a nominal charge from Epson UK Limited in Wembley.

If you consider that some useful information has been omitted, I should be grateful if you would pass on the relevant details to me. Otherwise, I should appreciate your views and opinions on the booklets; that is, have they been of great help, do they have their limitations ?, etc. Your ideas on the subject will prove to be invaluable when preparing future editions and will certainly influence the shape of things to come.

As the need arises, I shall produce new documents together with an up to date index. If you would like to receive updates, please send me your name and address.

In all instances, please write to me (marking the envelope Technical Support Manual) at:

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HA9 6UH
England

I hope that these booklets will be as well received as the first edition of the Technical Support Manual. I would like to acknowledge the assistance and support of John Sharp, the Technical Author.

Esther Bayer

1st March 1985

HX-20 index

HX-20 documents

Hardware

Software

Technical Support Document number 1a

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 Epson expansion unit
or 96k with P and M Data Services' 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, 38400 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

Display controller:
See Oval HO-80 and UD-80 display controller documents

Technical Support Document number 1a

Internal switches

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

External switches

Mains power, printer on/off, reset

Power supply

Four NiCd batteries, internal;
sub C type, 1100 mAh capacity;
50 hour capacity running BASIC (or less depending on
use of RS-232C 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 degrees Fahrenheit)

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

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

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

Humidity: Operating/nonoperating: 10 to 80% noncondensing

Physical characteristics

Dimensions: 28.9 cm x 21.6 cm x 4.44 cm;
weight: 1.73 kg

Options

Expansion units: Epson: Several combinations of ROM and RAM size (see p.4-34
of HX-20 Technical Manual). Total expansion is 32k.
P and M Data Services: Software switchable in banks
of 16k. Total expansion is either 48 or 96k.

Microcassette: Uses standard microcassette tapes

Technical Support Document number 2a

HX-20 serial port specifications

General information

The HX-20 has 2 serial ports available for use; the standard RS-232C port and the high speed serial port. The high speed serial port is used primarily for Epson peripheral products and interconnections; the TF-20 disk drive in particular. The following is an outline of the RS-232C port and how to use it.

Hardware connections

The HX-20 uses an 8 pin DIN connector for its RS-232C interface. The pin connections are as follows:

Signal pin number	Signal	Signal direction	Meaning of signal
1	GND	-	signal ground 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 ground level

Using the RS-232C port with BASIC

Through special BASIC commands and the COM0: device code, you can use the RS-232C port directly from BASIC. Information on how to do this is contained in the HX-20 Basic Reference manual, pp. 3-46 and 3-47.

Technical Support Document number 3a

HX-20 memory expansion units

Epson 16k 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 only be performed by a qualified Epson authorised service technician, because these devices are highly susceptible to breakage and static electricity.

Getting started

Before installing the unit, save any programs in memory which you wish to keep on cassette (ordinary 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 initialise 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 which you have installed.

P and M Data Services 96k expansion unit

General information

A 48 or 96k software switchable expansion unit consisting of either 3 or 6 banks of 16k ROMs has recently become available. For further details, ring P and M Data Services on: 0942 497123.

Technical Support Document number 4a

HX-20 barcode reader

General information

The Epson barcode reader (H00BRJA) is a hand held scanner designed to read all common barcode formats. It is a normal resolution scanner; that is, it has a minimum nominal bar width of 0.3 mm. The barcode reader comes equipped with a push to read switch which is used to activate the electronics in battery powered applications requiring lowest power consumption. Optimum performance will be obtained when the barcode reader is tilted at an angle of 10 to 20 degrees and when the tip of the reader is in contact with the tag. The barcode reader requires software to enable it to be used (see HX-20: version one barcode software document).

Specifications

Resolution: 0.3 mm

Scan velocity: 76 to 760 mm/s

PCS (contrast): 70%

Temperature: Storage temperature; -25 to 70 degrees Celsius
(-13 to 158 degrees Fahrenheit)
Operating temperature; -25 to 55 degrees Celsius
(-13 to 131 degrees Fahrenheit)

Humidity: 0 to 95%

Power consumption:

2.5 W; that is, 500 mA maximum at 5 V

Supply voltage: 3.6 to 5.75 V

Tilt angle: 0 to 30 degrees

Clearance: 0.5 mm maximum

Peak light emission wavelength:
700 nm

Technical Support Document number 5a

HX-20 microcassette drive

General information

The microcassette is controlled by the main and slave CPUs. Its operation is regulated by storing the commands sent from the slave CPU as serial data into an instruction register. A counter circuit employing a photoreflector is provided, so that it is possible to feed the tape fast to the required area by using this counter.

The microcassette consists of a power supply, motor drive circuit block, read/write control block, motor speed control block, etc and is designed to turn power on only when it is used. The tape is fed at a speed of 2.4 cm/s by a 2400 rev/min capstan motor. Data is read or written at about 1300 bits/s and about 50 kbytes of data can be input to a 30 min cassette.

Specifications

Tape:	Microcassette MC-30 or MC-60
Tape drive:	Centre capstan
Tape speed:	2.4 cm/s
Maximum charge:	100 mAh

Technical Support Document number 6a

HO-80 Oval display controller

General information

The HO-80 display controller from Oval Automation Ltd (0903 725225) can produce 80 column monochrome alphanumerics, a keystroke line, block and symbol graphics only on either a monitor or a television screen. It also offers a 40 column mode and an HO-20 emulating 32 column mode, so that software written for the HO-20, a display controller which has been discontinued, will run on the HO-80, provided that no graphics commands have been used.

The HO-80 should only be used with the HX-20.
It is not suitable for use with the PX-8.

Technical Support Document number 7a

UD-80 Oval universal display controller (for the HX-20 and the PX-8)

General information

The new UD-80 universal display controller from Oval Automation Ltd (0903 725225) offers 40 or 80 column operation with colour or monochrome outputs. It supports 50 or 60 Hz frame rate video, interlaced or noninterlaced, PAL or NTSC coding, "BBC" or "IBM" type RGB output and will operate from 110, 120, or 240 V and 50 or 60 Hz mains supplies.
Its internally defined character set covers ASCII, has many special European language characters, permits six different types of accents, supports mosaic or separated semigraphic characters and also has a set of graphics characters, offering diagonal as well as vertical and horizontal lines.
Additionally, up to 100 user defined characters may be downloaded from the host computer to cover characters not internally provided, such as nonEuropean languages, or symbols and pictographs.
It has a serial input capable of supporting normal ASCII at 4800 baud and responding to the standard Epson family of cursor and screen control codes. This allows faster display operation from within applications programs using the serial output of the PX-8.
Although primarily intended for use with the PX-8, limited functionality can be obtained with the HX-20 using a special console output redirection utility, but full feature operation is not possible.
For the PX-8, a special utility program will be supplied to redirect the console output to the serial line. Note that Operating System Revision B or later is required.

Options

The basic UD-80 is supplied with only 2 kbytes of video memory; enough for 40 column operation with limited attributes and 80 column monochrome operation with no attributes.
Additionally, a plug in video memory module will be available, allowing expansion to 16 kbytes, giving a corresponding level of improvement in performance. A 16 kbyte unit, for example, supports multiple pages, full attributes and user defined characters.
Also available as plug in modules will be colour coders and modulators, providing composite and RF outputs, specific to particular national standards. Initially, modules will be available for PAL and NTSC with UHF and RF output. Other modules will be made available at a later date, depending on requirements.

Provisional specifications

Screen formats: 25 lines of 40 characters or 25 lines of 80 characters;
(only 21 lines in 60 Hz video);
50 or 60 Hz video frame rate;
interlaced or noninterlaced operation

Technical Support Document number 7a

Characters:	128 internally defined alphanumeric characters; 128 internally defined semigraphic characters; user definable alphanumeric or semigraphic characters (downloadable from host computer)
Attributes:	80 character mode; colour, underline, blink, reverse 40 character mode; foreground and background colour, double height and width, underline, blink, reverse, accentuation
Input/Output:	8 pin DIN socket using PX-8 compatible voltage levels
Outputs:	RGB, BBC or IBM type (factory selected) composite video (or monochrome); (optional PAL or NBC coded video and UHF/VHF RF output to suit different countries)

Technical Support Document number 8a

HX-20 microcassette azimuth alignment procedure

Requirements

1)10 MHz oscilloscope;
2)azimuth test tape (part number B777600101)
3)jeweller's screwdriver set;
4)sharp knife.

With the power turned off, remove the microcassette unit from the HX-20.
Remove the two retaining screws on the lower case of the microcassette and then the lower case itself.
Locate TP3 and TP4 on the microcassette printed circuit board. Solder a six inch piece of insulated wire onto TP3 and another piece of similar length onto TP4.
Remove the azimuth adjustment window using the sharp knife and place the azimuth tape into the microcassette unit.
Set the oscilloscope to the following:
Volts per division: 20 mV (using an X10 probe)
Time per division: 0.1 ms
Fit the X10 probe onto the two insulated wires; attach the tip to TP3 and attach earth to TP4.
Switch on the HX-20 and go into BASIC (option 2 on the menu). Type WIND and hit ⟨RETURN⟩. When the HX-20 has rewound the tape, type LOAD and hit ⟨RETURN⟩.
In approximately 30 seconds you should see the 3 kHz sine wave displayed on the oscilloscope. If not, check your connections.
Insert a small flat blade screwdriver (jeweller's type) into the hole under the window cover on the microcassette unit. Adjust the peak to peak amplitude of the sine wave for maximum output. This may require some fine adjustment.
The signal levels must exceed 0.6 V peak to peak. If the signal is less than this, the microcassette is faulty. The maximum value obtainable is 0.9 to 1.0 V peak to peak. This can be achieved with some fine adjustment.
When you have adjusted the azimuth to maximum, press the ⟨BREAK⟩ key to stop the tape, switch off the HX-20 and replace the azimuth window, remove the two insulated leads from the microcassette unit and replace the bottom cover.
Note: during adjustment, take care not to damage the azimuth screw.

Technical Support Document number 51a

HX-20 BASIC filefinder program

General information

FILEFINDER is a BASIC program which when run will search one complete side of a microcassette tape and pick out and list all the files found. The program listing is given below.

FILEFINDER listing

```
10  TITLE "FILEFIND"
20  WIDTH 20,8,1
30  MSG$="Insert tape & return":GOSUB 330
32  A$=INKEY$:IF A$=CHR$(13) THEN 40 ELSE 32
40  LPRINT"     FILEFINDER"
50  LPRINT
60  LPRINT"File Name     Location"
70  LPRINT
80  WIND
90  MSG$="Searching tape":GOSUB 330
100 CLOSE
110 ON ERROR GOTO 240
120 OPEN "I",#1,"CAS0:"
130 IF ERCOUNT>0 THEN LPRINT USING "IO Error #####";((TAPCNT-25)/10)*10
    :ERCOUNT=0
140 ON ERROR GOTO 0
150 MSG$="Found a file":GOSUB 330
160 FILNAM$=""
170 FOR I=&H032C TO &H0336
180 FILNAM$=FILNAM$+CHR$(PEEK(I))
190 NEXT I
200 IF RIGHT$(FILNAM$,3) = "" THEN 220
210 FILNAM$=LEFT$(FILNAM$,8)+"."+RIGHT$(FILNAM$,3)
220 LPRINT USING"\           \   #####";FILNAM$,((TAPCNT-25)/10)*10
230 GOTO 90
240 IF ERR = 53 THEN 260
250 RESUME 130
260 ERCOUNT = ERCOUNT + 1
270 IF ERCOUNT > 3 THEN GOTO 300
280 MSG$="IO Error":GOSUB 330
290 RESUME 90
300 MSG$="End of tape":GOSUB 330
310 LPRINT USING"End of tape     #####";TAPCNT
320 CLOSE:END
330 CLS:LOCATE 0,0,0:SCROLL,0:PRINT"* * FILEFINDER * *"
340 IF MSG$<>"" THEN PRINT:PRINT SPC(10-LEN(MSG$)/2);MSG$;
350 RETURN
```

Technical Support Document number 52a

HX-20 BASIC programming 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 versions of BASIC, as well as features designed exclusively for the HX-20.

Extended features

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

IF...THEN...ELSE - two way conditional statements

INPUT$ (X) - inputs X characters and places them in a character string

INSTR - checks for the occurrence of a substring with a string

LINE INPUT - inputs a line of text exactly as typed including commas, quotes, etc

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.

Technical Support Document number 53a

HX-20 battery temperature test

General information

This document contains the results of a temperature test for the HX-20's battery. It was carried out in the USA using Sanyo and GE batteries.

Procedure

The HX-20 was connected to an HX charger and left on continuous charge for a period of two months. A digital temperature probe was attached to the HX-20's battery (Sanyo 1100 mA) and the temperature was measured at regular intervals during each working day. Room temperature was also recorded. The HX-20 was periodically tested for proper operation during this test to determine if the continuous charge caused any operational failure.

Results

The continuous charge had no effect on the operation of the HX-20.
The continuous charge had no apparent effect on the operation of the battery. A resultant change of overall battery life was not determined. However, the factory (Sanyo) predicted an expected reduction in battery life if charged in excess of 60 days of up to 40% loss after one year. GE indicated that no appreciable loss in battery life should be experienced due to overcharge for 60 days, with a loss of up to 20% after one year.

The battery temperature varied proportionally with room temperature. The actual length of time of charge had no effect on the temperature. The battery temperature was on average 8 degrees Celsius above room temperature. The actual temperature varied betwen 7 and 10 degrees Celsius.

Recommendations

Continuous charge of the HX-20 will not have any detrimental effect on the computer or its batteries for a period of up to 60 days. After 60 days, the Sanyo battery's life may decrease by up to 40% after one year. The GE battery's life may decrease by up to a loss of 20% after one year. Neither battery exhibited a temperature problem caused by continuous charge.

The HX-20 may be operated in the continuous charge mode for a period of at least 60 days without any detrimental effect to either the computer or the battery.

Those concerned about battery life problems should contact G.S. Smith and Associates in Delaware, USA. Their telephone number is 0101-302 738 7308. They provide an external charging unit for the HX-20 which can be plugged in for longer than 60 days without damaging the computer. Please bear in mind that a step up transformer will have to be added to the system in the UK, in order to be able to operate at 240 V. In the USA, the mains voltage operates at 120 V.

Technical Support Document number 54a

HX-20 character defining program

Use this program on your HX-20 to create your own character set.

```
1     REM User defined character utility for use on the HX-20.
2     REM This program will NOT work on any other computer.
3     REM
4     REM Use this program to design your own characters and then
5     REM copy the first non REM line of this program into your
6     REM program in order to use the characters you designed.
7     REM To print the characters: PRINT CHR$(n); ' n=224 --> 255
8     REM Note: this program uses the first 192 bytes of the RAM
9     REM file to store your characters.
10    POKE &H11E,PEEK(&H5A2):POKE &H11F,PEEK(&H5A3)
20    WIDTH 20,16:DEFINT  A-Z:DEFFIL 1,0:S$=SPACE$(4)
30    PRINT "Push SPACE if you"
40    PRINT "need help, or RETURN"
50    PRINT "if you do not"
60    PRINT "need it. :";
70    IF INPUT$(1)="" THEN GOSUB 860
80    'CLEAR SCREEN, DISPLAY CHARACTERS
90    CLS
100   FOR I=0 TO 24 STEP 8
110   FOR J=0 TO 7:PRINT CHR$(I+J+224);:NEXT J
120   IF I<>24 THEN PRINT
130   NEXT I
140   LOCATE 13,0:PRINT "Select"
150   LOCATE 13,1:PRINT "a char"
160   LOCATE 13,2:PRINT "& push"
170   LOCATE 13,3:PRINT "RETURN";
180   X=0:Y=0:LX=7:LY=3:CMD=0
190   ' MOVE THE CURSOR AND DISPLAY THE CHARACTER IT IS POINTING TO.
200   CH=Y*8+X
210   LOCATE 9,0:PRINT USING "###";CH+224;
220   LOCATE 10,1:PRINT CHR$(156);
230   LOCATE 10,3:PRINT CHR$(155);
240   LOCATE 10,2:PRINT CHR$(CH+224);
250   LOCATE X,Y,1:GOSUB 760
260   IF A$<>CHR$(13) THEN 200
270   LOCATE 12,0:PRINT " CR";S$
280   LOCATE 12,1:PRINT CHR$(155);" ";CHR$(156);S$
290   LOCATE 12,2:PRINT "(-)";S$
300   LOCATE 12,3:PRINT "] [";S$;
310   LOCATE X,Y,1
```

```
320  'THE CHARACTER IS SELECTED, PUT IT INTO THE EDIT BUFFER.
330  FOR I=0 TO 7:PSET(96,I*3+5):PSET(115),I*3+5):NEXT I
340  FOR I=0 TO 5
350  PSET(I*3+98,3):PSET(I*3+98,28)
360  FOR J=0 TO 7
370  P=POINT(I+60,J+16)
380  FOR K=0 TO 2
390  LINE(I*3+97,J*3+4+K)-(I*3+99,J*3+4+K),PSET,P
400  NEXT K,J,I
410  X=0:Y=0:LX=5:LY=7:CMD=1
420  ' DISPLAY THE CROSSHAIRS FOR THE DOT.
430  LINE (92,Y*3+5)-(95,Y*3+5),PSET
440  LINE (116,Y*3+5)-(119,Y*3+5),PSET
450  LINE (X*3+98,0)-(X*3+98,2),PSET
460  LINE (X*3+98,29)-(X*3+98,31),PSET
470  P=POINT(X*3+97,Y*3+4)
480  LINE(X*3+98,Y*3+5)-(X*3+98,Y*3+5),PSET,1-P
490  X2=X:Y2=Y:GOSUB 760
500  LINE (92,Y2*3+5)-(95,Y2*3+5),PRESET
510  LINE (116,Y2*3+5)-(119,Y2*3+5),PRESET
520  LINE (X2*3+98,0)-(X2*3+98,2),PRESET
530  LINE (X2*3+98,29)-(X2:3+98,31),PRESET
540  P=POINT(X2+60,Y2+16)
550  LINE(X2*3+98,Y2*3+5),PSET,P
560  'SELECT ACTION FOR A USER'S COMMAND
570  IF A$="[" OR A$="]" THEN GOTO 700
580  IF A$>CHR$(13) AND A$<" " THEN GOTO 430
590  IF A$<>CHR$(13) THEN SOUND 1,1:GOTO 430
600  ' PUT THE NEW CHARACTER INTO THE CHARACTER ARRAY.
610  FOR I=0 TO 5
620  C=0
630  FOR J=7 TO 0 STEP -1
640  C=C*2+POINT(I+60,J+16)
650  NEXT J
660  PUT% CH*6+I,CHR$(C)
670  NEXT I
680  GOTO 90
690  ' DRAW THE DOT
700  FOR K=0 TO 2
710  LINE(X*3+97,Y*3+4+K)-(X*3+99,Y*3+4+K),PSET,A$="[" AND 1
720  NEXT K
730  PSET(X+60,Y+16),A$="[" AND 1
740  GOTO 430
750  ' READ IN A COMMAND.
760  A$=INPUT$(1)
770  IF A$="Q" OR A$="q" THEN CLS:END
780  IF A$>" " AND CMD>0 THEN RETURN
790  IF A$=CHR$(13) THEN RETURN
800  IF A$=CHR$(28) AND X<LX THEN X=X+1:RETURN
810  IF A$=CHR$(29) AND X>0 THEN X=X-1:RETURN
820  IF A$=CHR$(30) AND Y>0 THEN Y=Y-1:RETURN
830  IF A$=CHR$(31) AND Y<LY THEN Y=Y+1:RETURN
840  SOUND 1,1:GOTO 760
```

```
850  ' HELP INSTRUCTIONS
860  PRINT "Turn on the micro-"
870  PRINT "printer and press"
880  PRINT "RETURN"
890  A$=INPUT$(1)
900  LPRINT
910  LPRINT "User defn char utility"
920  LPRINT "program, written Nov 83,"
930  LPRINT
940  LPRINT "CHAR SELECTION FUNCTs:"
950  LPRINT
960  LPRINT "Use the arrow keys to"
970  LPRINT "select the character."
980  LPRINT "(The chars ASCII code"
990  LPRINT "is shown on the top"
1000 LPRINT "line of the LCD.)"
1010 LPRINT
1020 LPRINT "Return selects the char"
1030 LPRINT "to edit."
1040 LPRINT "Note: the program takes"
1050 LPRINT "10 seconds to enter the"
1060 LPRINT "character into the edit"
1070 LPRINT "buffer"
1080 LPRINT
1090 LPRINT "EDIT FUNCTIONs"
1100 LPRINT
1110 LPRINT "Use the arrow keys to"
1120 LPRINT "move the crosshairs and"
1130 LPRINT "select a dot position."
1140 LPRINT
1150 LPRINT "[ Turns on a given dot."
1160 LPRINT
1170 LPRINT "] Turns off a given dot."
1180 LPRINT
1190 LPRINT "Return enters the char"
1200 LPRINT "into the user defn char"
1210 LPRINT "set."
1220 LPRINT:LPRINT
1230 LPRINT "Q exits the program at"
1240 LPRINT "any time."
1250 FOR I=1 TO 5:LPRINT:NEXT I
1260 RETURN
```

Technical Support Document number 55a

HX-20: comparison of HX-20 BASIC and PX-8 BASIC

The PX-8 and the HX-20 both contain powerful BASIC languages. However, there are substantial differences between the two versions and these differences are identified below.

BASIC commands unique to the HX-20

COLOR
DEFFIL
DEFUSR
EXEC
GCLS
LOAD?
LOADM
LOCATES
MEMSET
MON
MOTOR
SAVEM
SCROLL
SWAP

BASIC commands unique to the PX-8

ALARM
ALARM$
AUTO START
BEEP
CALL
CHAIN
COMMON
CVI/CVS/CVD
DSKF
EDIT
FIELD
INP
KILL
LOC
LPOS
LSET/RSET
MENU
MKI$/MKS$,MKD$
MOUNT
OPTION COUNTRY
OPTION CURRENCY
OUT
POWER

REMOVE
RESET
STOP
SYSTEM
WAIT
WHILE...WEND
WRITE
WRITE#

Different ways of saving files

The PX-8 does not save files in RAM like the HX-20. The PX-8 will lose programs if care is not taken when saving files. In order to save programs to the program areas on the PX-8 so that they are retained in memory, you need to use the menu function to make BASIC resident in the computer. This will retain programs unless .COM files are executed at the system level.

Conclusion

The PX-8 has many more extensions to BASIC than the HX-20. There are some subtle differences in the BASIC between the two machines. For example, the screen command is not exactly the same between the two machines. The HX-20 supports an external monitor and the PX-8 supports both an external monitor and multiple screen modes.

The PX-8 has two useful commands which help you to write structured BASIC programs; the WHILE and WEND commands. PX-8 BASIC is also constructed for operation within the CP/M operating system and therefore has extensions. For example, the microcassette drive is supported as if it were a disk drive. The PX-8 also supports operation of the timer function, so that it is possible to control the powered status of the machine from within BASIC.

The PX-8 cannot directly read an HX-20 BASIC program which has been written on a microcassette tape, since the HX-20 tape does not have a directory which the PX-8 can read.

Technical Support Document number 56a

HX-20: creating user definable characters

The hexadecimal character codes E0 to FF are not defined for the HX-20, but may be used to create your own custom character set.

When the system is cold booted, hexadecimal locations 11E and 11F are set to 0000. These two locations point to an alternate user defined character set. This character set may be placed anywhere in the user RAM space, but must be below the value set using the MEMSET command.

To use this feature, you must first define a 6 x 8 character set on paper. Each character is 6 bytes wide by 5 bits high.

A character would be designed as follows:

```
            ...00. bit 0
            ..0..0
            ..0...
            .000..
            ..0...
            ..0...
            .00000
            ...... bit 7
      byte 1
           2
            3
             4
              5
               6
```

As an example of placing a custom character set in RAM, let us decide to start our character set at hex memory location 2000. There should be enough room for 32 characters (E0 to FF). Each character takes up 6 bytes. 6 x 32 = 192, so it will take 192 bytes to define our character set. We need to add C0 hex (192 decimal) to our starting point of 2000 hex. 2000 hex + C0 hex = 20C0 hex. Using the MEMSET command, set the low memory point to 20C0 hex. Now set locations 11E and 11F to 20 hex and 00 hex. These locations may be changed using the BASIC poke command or from the system monitor. Now you may enter your custom character set starting at location 2000 hex. Any time you enter the codes E0 to FF hex, your custom characters will be displayed.

The value of low memory set by MEMSET is not changed when the system is turned on and turned off. A character set will remain in the HX-20 until it is deleted. The pointers at locations 11E hex and 11F hex will also remain set until you change them or do a cold boot.

The system uses codes FC hex and FE hex as special codes for the menu key and for function keys. If you want to use these codes as redefined characters, you should not use the keyboard to send these codes. You must use the CHR$ command of BASIC.

There is a utility program for defining characters on the HX-20 in the 'HX-20 character defining program' document.

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HX-20: downloading to the HX-20 from the TRS-80 model 1

General information

This document contains the procedure for downloading files to the HX-20 from a Tandy TRS-80 model 1. You will need the following:

Hardware: TRS-80 model 1 with RS-232C board and cable;
HX-20 with number 714 RS-232C cable;
cable with female to female DB-25 connectors.

Software: TRS-80 operating with Omniterm, terminal software;
HX-20: none.

Before entering Omniterm, convert all files to be transferred to ASCII format on disk. Load the BASIC file into memory and then save it to disk. For example: SAVE "NAME/BAS:0",A

Enter Omniterm, specify the RS-232C as the modem, set the baud rate to 4800, word length to 8 bits, 2 stop bits and no parity.

Load the buffer from disk with the desired file to transfer. Open the buffer for output, type Enter (default of none) for the Prompt string question and enter 10 for the number of zeros between characters. Before pressing Enter, during the zeros question, type LOAD "COM0:" on the HX-20.

Omniterm will tell you when output is complete. Then press (BREAK) on the HX-20. The program should then be resident in the HX-20.

Conversion statements encountered

PRINT@ - remove the @ sign or use LOCATE X,Y:PRINT

IF A=5 GOSUB 120 - insert THEN between 5 and GOSUB
(HX-20 BASIC will not accept an implied THEN)

IF A$="HELLO" THEN GOTO 100 - the lack of spaces behind logical operators and THEN statements will sometimes cause syntax errors. Use: IF A$="HELLO" THEN GOTO 100

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HX-20: Epson user group

There is only one Epson user group in Great Britain and it is located in London. The full address, telephone number and contact is:

Address: Epson user group
25 Sawyers Lawn
Drayton Bridge Road
London W13

Telephone: 01-998 1494

Contact: Mr. T. Ronson

Technical Support Document number 59a

HX-20 machine code program copy

General information

Several HX-20 programs consist of sections of machine code which cannot be saved to cassette by the simple SAVE command. In such cases you must use the SAVEM command and specify the start, end and run addresses. For all the programs listed below, the start and run addresses are the same. Thus the general BASIC command (with optional verification) would be:

SAVEM "filename",start address,end address,run address[,V]

Name of program	Name of program section	Start address	End address	Use SAVE or SAVEM
CARD INDEX	CARD	loader		SAVE
	CARD1.HEX	&H0A40	&H0AA0	SAVEM
	CARD2.HEX	&H1870	&H3270	SAVEM
	CARDI.BAS			SAVE
FORMAT (used with CARD INDEX, DIARY and MLIST)	FORMAT	loader		SAVE
	FMTDATA.HEX	&H0AC0	&H0AEF	SAVEM
	FMTPROG.HEX	&H1810	&H182F	SAVEM
	FORMI.BAS			SAVE
MLIST	MLIST	loader		SAVE
	MAIL1.HEX	&H0A40	&H0AA0	SAVEM
	MAIL2.HEX	&H1870	&H33C0	SAVEM
	MAILI.BAS			SAVEM
CORR20	CORR20	loader		SAVE
	CORR1.HEX	&H0A40	&H13FF	SAVEM
	CORR2.BAS			SAVE
DIARY	DIARY	loader		SAVE
	DIARY1.HEX	&H0A40	&H0FFF	SAVEM
	DIARY2.HEX	&H1870	&H3869	SAVEM
	DIARY.BAS			SAVE
PROTECT	PROTECT.BIN	&H0A40	&H0C64	SAVEM
DBLFUN	DBLFUN.BIN	&H0A40	&H1054	SAVEM
DIY	RUNTIM.BIN	&H0A40	&H17A8	SAVEM

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HX-20 machine language 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. On entering the monitor program, the current value of the system registers will appear on the screen. (Note: the monitor does not use the virtual screen; thus the cursor controls, the SCRN command and the insert command are unusable.)

Monitor functions

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

A - provides read and write addresses when reading or writing files
B - return to caller
D - dump memory 15 bytes at a time
G - call subroutine
K - respond to keystack sequence
R - read object file into memory
S - set memory
V - verify an object file saved on a device
W - write an object file to device
X - display and/or change the value of a 6301 register

For a detailed explanation of these commands and their parameters see pp. 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.

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HX-20 power consumption

General information

This document defines the power consumption of the HX-20 in different modes of operation. The amount of power which the HX-20 uses varies according to the I/O operations being performed. Even when the computer is off, power is being drawn from the batteries.

Sleep mode

Configuration	Current [mA]
HX-20 only	10
HX-20 with serial	83
HX-20 with RS-232C	95
HX-20 with serial and RS-232C	100
HX-20 with Epson expansion unit	11.5

Operators mode

Configuration	Current [mA]
Key input approx.	5-10
Slave CPU operation approx.	3
Microprinter approx.	500-1100
Microcassette approx.	120
RS-232C transmission approx.	5

Backup current

Configuration	Current [μA]
HX-20 only	20
HX-20 Epson expansion unit	1.5

The current value shown above is the current drawn at a battery voltage of +5.0 V. In actual operation, a difference of approximately +10% may exist depending on the battery voltage. The total current is calculated by adding "sleep mode" and "operational mode" current. For example, the RS-232C current drawn on operation is 95 + 5 = 100 mA.

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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
POKE 125,0	re-enables BREAK
X=PEEK(123)	saves original RUN mode for later reset
POKE 123,65	disables function keys
POKE 123,X	restores original situation and re-enables function keys
POKE 290,249 POKE 291,202	disables MENU
POKE 290,255 POKE 291,37	re-enables MENU
POKE 127,160	enables printer even when switched off
POKE 127,0	resets printer

Autostarting

To autostart 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 and 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, type K CTRL @ and then switch the computer off and on again.

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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 that 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 that the user never gets into BASIC in the same LOGIN area as the program.

Setting the protection byte

Set 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
```

Technical Support Document number 63a

HX-20 ROM cartridge: file format

General information

The HX-20 ROM cartridge can hold up to 31 files. Each file is composed of a 32 byte header and a data block.

The headers for all the files are grouped together at the top of the ROM with the data blocks following after the last header. To separate headers from data a dummy header block is used; see the table below, which gives the composition of the header.

Byte number	Contents of memory locations
0-7	file name in ASCII. If byte 0 is hex FF, then this is the dummy header before the file data and the next 31 bytes are ignored. If byte 0 is hex 00, this is an erased file and the data block is disregarded.
8-10	file name extension in ASCII
11-12	byte 11; 00 - BASIC program 01 - BASIC data 02 - machine code program byte 12; 00 - binary file FF - ASCII file
13-15	all zeros
16-19	file start address within the ROM in hex; 4 ASCII digits
20-23	file end address +1 within the ROM in hex; 4 ASCII digits
24-29	creation date if required; 6 ASCII characters/digits
30-31	unused; can be used for ROM version etc if required

The files themselves follow after the last header and their structures are described below.

BASIC programs and data; ASCII format

Each character in each line of text (BASIC line numbers included) is coded with the corresponding ASCII byte, with the two bytes 0D and 0A hex added at the end of each line of BASIC for carriage return and line feed. Obviously data files do not need line numbering and CR/LF.

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BASIC programs; internal binary format

The first byte is hex FF; this is followed by two bytes for the program length (number of bytes in binary). Thereafter, each line of binary is coded as follows:

1)two bytes dummy data (nonzero);
2)two bytes for the line number (binary);
3)the BASIC program line coded as it would be stored in memory;
4)a single byte 00 hex to mark the end of the line.

The file is terminated with two bytes 00 hex after the last line.

Machine code files; binary format

Machine code programs are split up into records of 16 bytes. Each record is coded as follows:

Byte numbers	Contents of memory locations
1	number of bytes in this record; always 16 (hex 10) except for the last record
2,3	address into which the bytes in this record are to be loaded, coded as a two byte binary number
4-15	the bytes making up the machine code
16	checksum; sum of bytes 1-15 subtracted from zero

The last record is coded slightly differently as follows:

Byte numbers	Contents of memory locations
1	00 hex
2,3	program entry address, coded as a two byte binary number
4-15	00 hex
16	checksum, coded as above

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Example 1: Opening for data transfer

Sending side	Receiving side
10 OPEN "I",#1,"COM0:(68N2B)"	10 OPEN "O",#2,"COM0:(68N2B)"
20 OPEN "O",#2,"COM0:(68N2B)"	20 OPEN "I",#1,"COM0:(68N2B)"
30 PRINT 32,"A";	30 IF LOF(1)=0 THEN 30
40 FOR I=1 TO 300: NEXT I	40 A$=INPUT$(LOF(1),1)
50 IF LOF(1)=0 THEN 30	50 IF A$<>"A" THEN 30
60 A$=INPUT$ (LOF(1),1)	60 PRINT #2,"A";
70 IF A$<>"A" THEN 30	

Another method is for both the sending and receiving sides to check one another's status before beginning data communications. This is shown in Example 2.

Example 2

Sending side	Receiving side
10 OPEN "I",#1,"COM0:(68N2B)"	10 OPEN "O",#2,"COM0:(68N2B)"
20 A$=INPUT$(1) (waits for key input)	20 A$=INPUT$(1) (waits for key input)
30 OPEN "O",#2,"COM0:(68N2B)"	30 OPEN "I",#1,"COM0:(68N2B)"

Here data transfer begins after a key has been pressed on both the sending and receiving sides. Voltage fluctuation when power is first applied to the line can affect the RTS and DTR control lines in a similar manner.

All operations of the slave CPU are controlled by commands from the main CPU. For this reason, some operations cannot be performed simultaneously. For example, data input through the RS-232C port will be interrupted if data is output to the printer.