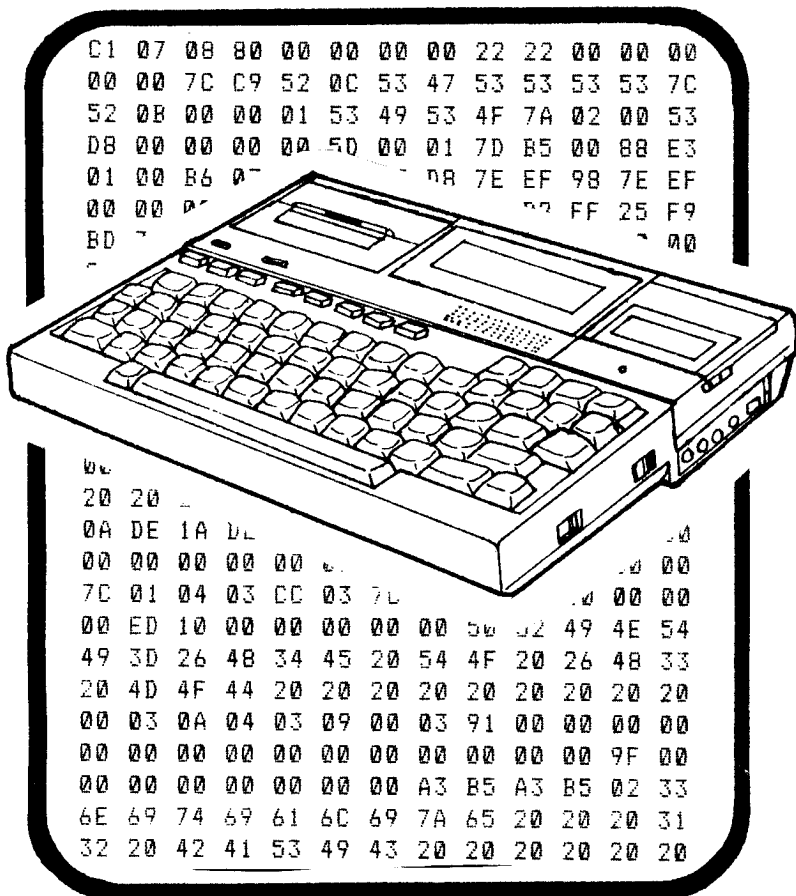


# HX-20 ASSEMBLER



```

C1 07 08 80 00 00 00 00 22 22 00 00 00
00 00 7C 09 52 0C 53 47 53 53 53 53 7C
52 0B 00 00 01 53 49 53 4F 7A 02 00 53
D8 00 00 00 00 50 00 01 7D B5 00 88 E3
01 00 B6 00 00 00 08 7E EF 98 7E EF
00 00 00 00 00 00 00 00 00 FF 25 F9
BD 00 00 00 00 00 00 00 00 00 00 00

```

```

00 20 20 00 00 00 00 00 00 00 00 00 00
0A DE 1A 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00
7C 01 04 03 CC 03 7C 00 00 00 00 00 00
00 ED 10 00 00 00 00 00 00 50 02 49 4E 54
49 3D 26 48 34 45 20 54 4F 20 26 48 33
20 4D 4F 44 20 20 20 20 20 20 20 20 20
00 03 0A 04 03 09 00 03 91 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 9F 00
00 00 00 00 00 00 00 00 A3 B5 A3 B5 02 33
6E 69 74 69 61 6C 69 7A 65 20 20 20 31
32 20 42 41 53 49 43 20 20 20 20 20 20

```

## MEMORY MAP

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# Section I

## Memory map

I/O Area (0 - &H40)

LABEL	BIT	7	6	5	4	3	2	1	0	ADDRESS
P1		INCASS	INPIN	INKBIRQ	NLOWPR	NEXIRQ	SLURW	INCTS	INDSR	2
P2					SERTX	SERRX	SLUSER	RSTX	BARCOD	3
TMRCR		ICF	OCF	TUF	EICI	EOCI	ETOI	IEDG	OLUL	8
TMCNT		TIMER VALUE (MSB)								9 RO
TMCNT+1		TIMER VALUE (LSB)								&HA RO
TMROCR		TIMER OUTPUT COMPARE VALUE (MSB)								&HB
TMROCR+1		TIMER OUTPUT COMPARE VALUE (LSB)								&HC
TMRICR		TIMER INPUT CAPTURE VALUE (MSB)								&HD RO
TMRICR+1		TIMER INPUT CAPTURE VALUE (LSB)								&HE RO
SIOHOD						0	1	SS1	SS0	&H10
SIOCSR		RDRF	OFE	TDRE	RIE	RE	TIE	TE	WU	&H11
RDR		SERIAL RECEIVE DATA								&H12 RO
TDR		SERIAL TRANSMIT DATA								&H13 WO
RAMCSR		RAME								&H14
NKSC		NKSC7	NKSC6	NKSC5	NKSC4	NKSC3	NKSC2	NKSC1	NKSC0	&H20 WO
NKRTN7_0		NKRTN7	NKRTN6	NKRTN5	NKRTN4	NKRTN3	NKRTN2	NKRTN1	NKRTN0	&H22 RO
P26		PLG2	PLG1	INPOUT	KVMASK	C_LND	LCDNO			&H26 WO
P28		NBY_SD	PSW					NKRTN9	NKRTN8	&H28 RO
LCDDAT		LCD TRANSMIT DATA								&H2A W+BR
BANK1		BANK 1 SELECT								&H30 WO
BANK0		BANK 0 SELECT								&H32 WO

LABEL	BIT	7	6	5	4	3	2	1	0	ADDRESS
SECONDS					SECONDS					&H40
SECALRM					SECONDS ALARM ( -1 = ANY TIME )					&H41
MINUTES					MINUTES					&H42
MINALRM					MINUTES ALARM ( -1 = ANY TIME )					&H43
HOURS					HOURS					&H44
HRSALRM					HOURS ALARM ( -1 = ANY TIME )					&H45
DYOFWK					DAY OF WEEK					&H46
MTHDAT					DAY IN MONTH					&H47
MNTH					MONTH					&H48
YEAR					YEAR IN CENTURY					&H49
RTC_A	UIP	INCNT	1	0	RS3	RS2	RS1	RS0		&H4A
RTC_B	TIMSET	PIE	AIE	UIE		0	1	0		&H4B
RTC_C	IRGF	IPF	IAF	IUF						&H4C RO
RTC_D	URT									&H4D RO

MCASS	M-CASSETTE COUNTER PULSE STATUS/WRITE PROTECT DETECT
NPIN	PIN VALUE FOR SERIAL I/F
NKBIRQ	0 IF KYBD INTERRUPT
NLOWPR	0 IF BATTERY LOW
NEXIRQ	0 IF EXTERNAL INTERRUPT
SLURW	1 DURING CASSETTE + RS232 IO
NCTS	CTS VALUE FOR RS232 I/F
NDSR	DSR VALUE FOR RS232 I/F
SERTX	SERIAL I/F TX LINE (USED BY MPU)
SERRX	SERIAL I/F RX LINE (USED BY MPU)
SLUSER	1=SERIAL -> SLAVE MPU 0=SERIAL -> SERIAL I/F
RSTX	RS232 I/F TX LINE (SOFTWARE GENERATED)
BARCOD	BARCODE READER DATA INPUT
ICF	1=INPUT CAPTURE VALUE MATCH
OCF	1=OUTPUT COMPARE VALUE MATCH
TVF	1=TIMER OVERFLOW (EVERY 1/9 SECOND)
EICI	1=ENABLE ICF INTERRUPT
EOCI	1=ENABLE OCF INTERRUPT
ETOI	1=ENABLE TVF INTERRUPT
IEDG	ICF EDGE VALUE (0=1->0, 1=0->1)
OLVL	OUTPUT VALUE TO RSTX ON OCF
SS1,SS0	SERIAL BAUD RATE:  00 - 38.4K BPS (SLAVE-MPU & SERIAL I/F) 01 - 4.8K BPS 10 - 600 BPS 11 - 150 BPS
RDRF	1=RECEIVE DATA REGISTER FULL
OFE	1=FRAMING ERROR
TDRE	1=TRANSMIT DATA REGISTER EMPTY
RIE	1=ENABLE RDRF INTERRUPT
RE	1=ENABLE RECEIVER
TIE	1=ENABLE TDRE INTERRUPT
TE	1=ENABLE TRANSMITTER
WU	1=ENABLE WAKE-UP MODE
RAME	1=ENABLE MPU RAM FROM &H00-&HFF 0=ENABLE EXTERNAL RAM
NKSC7 to NKSC0	KEYBOARD SCAN LINES, 0=ENABLE LINE
NKRTN9 to NKRTN0	KEYBOARD RETURN LINES, 0=KEY PRESSED

PLG2 PLUG2 VALUE ON M-CASSETTE I/F  
 PLG1 PLUG1 VALUE ON M-CASSETTE I/F  
 NPOUT POUT VALUE FOR SERIAL I/F  
 KYMASK 1=MASK KEYBOARD INTERRUPT  
 C\_LND 1=LCD COMMAND, 0=LCD DATA  
 LCDNO 0=ENABLE NONE, 1-6=ENABLE LCD:

DOT COLUMN:

0-39 40-79 80-119  
 +-----+-----+  
 | 1 | 2 | 3 | LINES 0,1  
 +-----+-----+  
 | 4 | 5 | 6 | LINES 2,3  
 +-----+-----+

NBV\_SO LCD BUSY & SERIAL DATA OUT  
 PSW 1=POWER SWITCH ON

UIP 1=RTC SECOND UPDATE IN PROGRESS  
 NCNTE 1=INHIBIT RTC COUNTING  
 RS3 - RS0 PERIODIC INTERRUPT RATE:

0000 NONE  
 0011 8192 HZ  
 0100 4096 HZ  
 : :  
 1110 4 HZ  
 1111 2 HZ

TIMSET 1=INHIBIT UPDATE CYCLE  
 PIE 1=ENABLE PERIODIC INTERRUPT  
 AIE 1=ENABLE ALARM INTERRUPT  
 UIE 1=ENABLE UPDATE CYCLE INTERRUPT

IRQF 1=RTC INTERRUPT  
 PF 1=PERIODIC INTERRUPT  
 AF 1=ALARM INTERRUPT  
 UF 1=UPDATE INTERRUPT

URT 1=POWER OK

Page Zero Variables (&H4E - &H7F)

LABEL	BIT	7	6	5	4	3	2	1	0	ADDRESS
PURFLG	:	0	0	0	!DWN	0	0	0	!UP	&H4E
P26DAT	:	P26 DATA								&H4F
R0H	:									&H50
R0L	+									&H51
R1H	:									&H52
:	:	MAIN I/O VARIABLES								:
R6L	:									&H5D
R7H	+									&H5E
R7L	:									&H5F
M0H	:									&H60
M0L	+									&H61
M1H	:									&H62
:	:	MONITOR VARIABLES								:
M6L	:									&H6D
M7H	+									&H6E
M7L	:									&H6F
K0H	:									&H70
K0L	+									&H71
K0H	:	KEYBOARD INTERRUPT VARIABLES								&H72
K0L	+									&H73
S0H	:									&H74
S0L	+									&H75
S1H	:	SERIAL INTERRUPT VARIABLES								&H76
S1L	+									&H77



LABEL	BIT	7	6	5	4	3	2	1	0	ADDRESS
INIFLG		BASIC	REFRM	APN INITIALIZE FLAGS				MENU		&H78
PLGSTS		BRKRS				0	PLGIN	0 - PROM RDR 1 - UNDEFINED 2 - NONE 3 - UNDEFINED 4/5/6/7 - M-CASS		&H79
SRSTS		SER 0-READ E-CASS 1-READ M-CASS 2-READ RS232 3-READ SERIAL 4-WRITE E-CASS 5-WRITE M-CASS 6/7-WRITE SERIAL			SERPWR	RSPWR	RSPSE	RS 0-NONE 1-RD(INT) 2-RD(CHAR)		&H7A
RNMOD		LANG	ISCRN			NAM	0 - BASIC 1 - MENU 2-15 - USER NAMES		&H7B	
SIOSTS		SBRK	BRCD	CART	SPKR	RSRD	MCRW	ECRW	PRNTR	&H7C
MIOSTS		BRK	PAUSE	PWROFF	PWRLOW	CKINT	TRSER	TRSLV	TRLCD	&H7D
SDIPS1		PROTIO	BASBnk	MEMBnk	IUBnk	MCUVE	0-AUTO 1-NORM 2-REUSE		0-AUTO 1-NORM 2-REUSE	&H7E
SDIPS2		PTRON		PTRSEL		DIPSEL		SOFTDIP		&H7F
MENEXEC		EXECUTION ADDRESS FOR NEXT APPLICATION (MSB)								&H80
MENEXEC+1		EXECUTION ADDRESS FOR NEXT APPLICATION (LSB)								&H81
		BASIC VARIABLES				MENU VARIABLES				&H82 : &H92
										&H93 : &HFF

DWN	1=EXECUTE SUBROUTINE AT (DWNADDR,DWNADDR+1) ON POWER DOWN
UP	1=EXECUTE SUBROUTINE AT (WAKADDR,WAKADDR+1) ON POWER UP BY CLOCK INTERRUPT (NOT CURRENT VERSION)
BASIC	1=BASIC APN FILE EXISTS
REFRM	1=FILE REFORM SUBROUTINE EXISTS
MENU	1=MENU SYSTEM INITIALIZED
BRKRS	1=TURN RS232 POWER OFF ON BREAK
SERPWR	1=SERIAL I/F POWER ON
RSPWR	1=RS232 POWER ON
RSPSE	1=RS232 READ PAUSE (SLAVE BUSY)
LANG	1=INTERPRETER MOODE 0=MACHINE CODE MODE
SCRN	1=PHSICAL LCD SCREEN 0=VIRTUAL SCREEN
SBRK	1=SLAVE I/O BROKEN BY BREAK
BRCD	1=BARCODE POWER ON
CART	1=CARTRIDGE POWER ON
SPKR	1=BUZZER IN USE
RSRD	1=RS232 READING
MCRW	1=M-CASSETTE IN USE
ECRW	1=E-CASSETTE IN USE
PRNTR	1=M-PRINTER IN USE
BRK	1=BREAK KEY PRESSED
PAUSE	1=PAUSE KEY PRESSED
PWR0FF	1=POWER SWITCH TURNED OFF
PWRLOW	1=BATTERY LOW
CKINT	1=CLOCK INTERRUPT
TRSER	1=SERIAL I/F IN USE
TRSLV	1=COMMUNICATION WITH SLAVE MPU IN PROGRESS
TRLCD	1=COMMUNICATION WITH LCD IN PROGRESS
PROTIO	1=ENABLE ACCESS TO 0-8H40
BASBNK	MEMORY BANK FOR BASIC INTERPRETER
MENBNK	MEMORY BANK FOR MENU
IUBNK	CURRENT MEMORY BANK
PTRON	SOFTWARE PRINTER ON/OFF SWITCH
PTRSEL	1=SOFTWARE PRINTER SWITCH 0=HARDWARE PRINTER SWITCH
DIPSEL	1=SOFTWARE DIP SWITCH 0=HARDWARE DIP SWITCH
SOFTDIP	SOFTWARE DIP SWITCH

## System Variables (&H100- &H139,&H21B)

CLKVECT	EQU &H100	;CLOCK INTERRUPT VECTOR
EXTVECT	EQU &H103	;EXTERNAL INTERRUPT VECTOR
TRPVECT	EQU &H106	;TRAP INTERRUPT VECTOR
SCIVECT	EQU &H109	;SERIAL INTERRUPT VECTOR
TUFVECT	EQU &H10C	;TIMER TUF INTERRUPT VECTOR
OCFVECT	EQU &H10F	;TIMER OCF INTERRUPT VECTOR
ICFVECT	EQU &H112	;TIMER ICF INTERRUPT VECTOR
IRQVECT	EQU &H115	;IRQ1 INTERRUPT VECTOR
SWIVECT	EQU &H118	;SWI VECTOR
NMIVECT	EQU &H11B	;NMI INTERRUPT VECTOR
FONTGPN	EQU &H11E	;ADDRESS OF FONTS FOR &HE0-&HFF
BRKADR	EQU &H120	;ADDRESS OF BREAK SUBROUTINE (LANG=0)
MENADR	EQU &H122	;ADDRESS OF MENU SUBROUTINE (LANG=0)
PAUADR	EQU &H124	;ADDRESS OF PAUSE SUBROUTINE (LANG=0)
CT3ADR	EQU &H126	;ADDRESS OF ^PF3 SUBROUTINE
CT4ADR	EQU &H128	;ADDRESS OF ^PF4 SUBROUTINE
CTSADR	EQU &H12A	;ADDRESS OF ^PF5 SUBROUTINE
RAMADR	EQU &H12C	;TOP OF RAM + 1
PRMCNT	EQU &H12E	;AMOUNT OF DATA IN PROM FILE
WAKADR	EQU &H130	;ADDRESS OF POWER UP SUBROUTINE
DUNADR	EQU &H132	;ADDRESS OF POWER DOWN SUBROUTINE
BASICA	EQU &H134	;ADDRESS OF 1ST APN FILE
BASICP	EQU &H136	;ADDRESS OF BASIC PROGRAMS
RFMRADR	EQU &H138	;ADDRESS OF FILE REFORM SUBROUTINE
SERSIOSTS	EQU &H21B	;SERIAL INTERRUPT COPY OF SIOSTS

## Menu Variables (&H13A-&H13F)

LABEL	BIT 7	6	5	4	3	2	1	0	ADDRESS
BITMP0	&HE000 &HC000 &HA000 &H8000 &H6000 &H4000 &H2000 &H0								&H13A
	----- ----- ----- ----- ----- ----- ----- -----								
	----- ----- ----- ----- ----- ----- ----- -----								
	----- ----- ----- ----- ----- ----- ----- -----								
	----- ----- ----- ----- ----- ----- ----- -----								
	----- ----- ----- ----- ----- ----- ----- -----								
BITMP1	&HE000 &HC000 &HA000 &H8000 &H6000 &H4000 &H2000 &H0								&H13B
	----- ----- ----- ----- ----- ----- ----- -----								
	----- ----- ----- ----- ----- ----- ----- -----								
	----- ----- ----- ----- ----- ----- ----- -----								
	----- ----- ----- ----- ----- ----- ----- -----								
LNKTBL	----- ----- ----- ----- ----- ----- ----- -----								&H13C
	----- ----- ----- ----- ----- ----- ----- -----								
LNKTBL+1	ADRFLG LNKFLG "A" - APN FILE, "B" - BASIC, "E" - END								&H13D
	1=REL								
	0=ABS								
	----- ----- ----- ----- ----- ----- ----- -----								
LNKTBL+2	----- ----- ----- ----- ----- ----- ----- -----								&H13E
	----- ----- ----- ----- ----- ----- ----- -----								
	----- ----- ----- ----- ----- ----- ----- -----								
LNKTBL+3	----- ----- ----- ----- ----- ----- ----- -----								&H13F
	----- ----- ----- ----- ----- ----- ----- -----								

## Keyboard Locations

```

KSTKSZ      EQU &H140      ;KEY STACK SIZE 1-15
KICNT1      EQU &H141      ;TIME TO AUTO REPEAT x (KICNTM)
KICNT2      EQU &H142      ;AUTO REPEAT TIME INTERVAL x (KICNTM)
KICNTM      EQU &H143      ;SAMPLING TIME x CLOCK PERIOD
NKVYTB      EQU &H145      ;KEY SCAN TABLE
OLDKTB      EQU &H14F      ;PREVIOUS SCAN TABLE
CHKKTB      EQU &H159      ;NEW KEY PRESS SCAN TABLE
KYISAD      EQU &H163      ;POWER ON KEY INPUT ADDRESS
KYISFL      EQU &H165      ;POWER ON KEY STACK STATUS
;
; &HA - DATA IN STACK, END FETCH
; &HB - DATA IN STACK, FETCH
; ELSE - NO DATA IN STACK
;NO OF CHARS IN POWER ON STACK 0 - 255
KYISCN      EQU &H166      ;NO OF CHARS INPUT FROM PWR ON STACK
KYISPN      EQU &H167      ;NO OF CHARS IN KEYBOARD STACK
STKCNT      EQU &H168      ;MODE:
KYIMOD      EQU &H169
;MODE:
.MBPPF      EQU &H80       ;B7 1 = BREAK, PAUSE OR PF KEY INPUT
.CTRL       EQU &H40       ;B6 1 = CTRL INPUT
.SHIFT      EQU &H20       ;B5 1 = SHIFT INPUT
.GRPHIC     EQU &H10       ;B4 1 = GRAPHIC INPUT
.LWRLET     EQU 4          ;B2 1 = LOWER CASE MODE
.NUMKEY     EQU 2          ;B1 1 = NUMERIC MODE
KYISTS      EQU &H16A      ;KEY STATUS 0 - INHIBIT
;
; 1 - AUTO REPEAT
; -1 - ENABLE
;AUTO REPEAT SCAN COUNT
KYRPF      EQU &H16B      ;AUTO REPEAT SCAN POSITION
KYIRPK      EQU &H16C      ;KEY CODE (PF KEY IS 2 BYTES)
CKVRD      EQU &H16D      ;POWER ON KEY STACK (18 BYTES)
PKVSTK      EQU &H16F      ;KEY STACK (15 BYTES)
KYISTK      EQU &H181

```

## Micro Printer Locations

```
PRTFNT      EQU &H190      ;6 BYTE FONT WORK AREA
PRTCNT      EQU &H196      ;COUNT OF CHARACTERS IN
PRTBUF      EQU &H197      ;PRINTER BUFFER 0..24
                                ;24 BYTE BUFFER
```

## RS232 Locations

```
RSBAUD      EQU &H1AF      ;RS232 TX BIT TIME:
                                ;300 BPS = &H000
                                ;4800 BPS = &H00
RSCRC       EQU &H1B1      ;CRC POLYNOMIAL:
                                ;CCIT = &H0400
                                ;CRC-16 = &H0001
                                ;CRC VALUE 0=OK
RSBCC       EQU &H1B3      ;WORD LENGTH 5..8
RSWDL       EQU &H1B5
RSMOD       EQU &H1B6      ;MODE:
.PRTY       EQU &H40
                                ;B7,6 = 2/3 NO PARITY
                                ;          1 ODD PARITY
                                ;          0 EVEN PARITY
.CKCTS      EQU &H20      ;B5 = 1 DO NOT CHECK CTS
.CKDSR      EQU &H10      ;B4 = 1 DO NOT CHECK DSR
.RTSON      EQU 8         ;B3 = 1 RTS ON
.CHKCD      EQU 4         ;B2 = 1 DO NOT CHECK CD
.STPBIT     EQU 1         ;B1,0 = STOP BITS 1..3
RSSTS       EQU &H1B7      ;STATUS:
.RBO        EQU &H00      ;B7 = 1 RECEIVE BUFFER OVERFLOW
.TXE        EQU &H40      ;B6 = 1 TRANSMIT ERROR
.RXE        EQU &H20      ;B5 = 1 RECEIVE ERROR
.RXOVR      EQU 4         ;B2 = 1 OVERRUN ERROR
.PTVE       EQU 2         ;B1 = 1 PARITY ERROR
.CDOFF      EQU 1         ;B0 = 1 CARRIER DISCONNECTION
RSBFAD      EQU &H1B8      ;RECEIVE BUFFER ADDRESS
RSBFPT      EQU &H1BA      ;END OF RECEIVE BUFFER ADDRESS + 1
RSBFSZ      EQU &H1BC      ;RECEIVE BUFFER SIZE
RSIPTR      EQU &H1BE      ;RECEIVE INPUT POINTER
RSOPTR      EQU &H1C0      ;POINTER TO LAST DATA FETCHED
RSDCNT      EQU &H1C2      ;NUMBER OF DATA IN RECEIVE BUFFER
```

## Serial I/F Locations

```

SRFMT      EQU &H1C4      ;FMT DATA
SRSDEV     EQU &H1C5      ;DID DATA
SRDDEV     EQU &H1C6      ;SID DATA
SRFNC      EQU &H1C7      ;FNC DATA
SRSIZ      EQU &H1C8      ;SIZ DATA
SRACK      EQU &H1C9      ;ACK FROM DESTN DEV
SRTRC      EQU &H1CA      ;BLOCK TX COUNT
SRTIM      EQU &H1CB      ;TIME OUT FOR CHAR (mS)
SRBTM      EQU &H1CC      ;TIME OUT FOR BLOCK (mS)
SRATM      EQU &H1CD      ;TIME OUT FOR ACK (mS)
SRMOD      EQU &H1CE      ;0 - MASTER, 1 - SLAVE
SREIT      EQU &H1CF      ;IDLE TIME AFTER EOT (mS)
SRBCN      EQU &H1D0      ;NO OF RECEIVED DATA
SREMD      EQU &H1D1      ;ERROR FLAG
SRRVL      EQU &H1D2      ;RESERVED
SRPTR      EQU &H1D3      ;ADDRESS OF RECEIVE DATA BLOCK

```

## Cassette and MicroCassette Locations

Note: External Cassette locations are labelled with names starting with "CAS". Microcassette locations are labelled with names starting with "MCS".

```

CASMOD     EQU &H1D5      ;MODE:                +0
MCSMOD     EQU &H1EC      ;
. IOSTS    EQU 4         ;B3,2 = 2 OPEN FOR OUTPUT
;          ;          1 OPEN FOR INPUT
;          ;          0 NOT OPEN
.FMTSTS    EQU 1         ;B1,0 = 0 EPSON FORMAT
CASBLK     EQU &H1D6      ;BLOCK NUMBER         +1
MCSBLK     EQU &H1ED      ;
CASBCC     EQU &H1D8      ;CRC VALUE FOR BLOCK  +3
MCSBCC     EQU &H1EF      ;
CASTMP     EQU &H1DA      ;UNUSED                +5
MCSTMP     EQU &H1F1      ;
CASGSM     EQU &H1DC      ;GAP STOP MODE:      +7
MCSGSM     EQU &H1F3      ;
;          ;          0 - TAPE STOPS AT GAP
;          ;          1 - TAPE DOES NOT STOP
CASSTS     EQU &H1DD      ;STATUS:                +8
MCSSTS     EQU &H1F4      ;
.IOBFO     EQU &H00      ;B7 = 1 BUFFER OVERFLOW
.IORDE     EQU &H40      ;B6 = 1 READ ERROR
.IOWRE     EQU &H20      ;B5 = 1 WRITE ERROR
.MCSCNU     EQU &H10      ;B4 = 1 MCS COUNTER NOT UPDATED
.IOEOF     EQU 1         ;B0 = 1 EOF
CASBUF     EQU &H1DE      ;START OF BUFFER      +9
MCSBUF     EQU &H1F5      ;

```

```

CASBFT      EQU &H1E0      ;END + 1 OF BUFFER      +&HB
MCSBFT      EQU &H1F7      ;
CASBSZ      EQU &H1E2      ;SIZE OF BUFFER        +&HD
MCSBSZ      EQU &H1F9      ;
CASRPTR     EQU &H1E4      ;NEXT ADDR TO STORE IN BUF +&HF
MCSRPTTR    EQU &H1FB      ;
CASWPTR     EQU &H1E6      ;LAST ADDR FETCHED FROM BUF +&H11
MCSWPTR     EQU &H1FD      ;
CASBCNT     EQU &H1EB      ;NO OF BYTES IN BUFFER   +&H13
MCSBCNT     EQU &H1FF      ;
CASRTRY     EQU &H1EA      ;MAX NO OF READ RETRIES  +&H15
MCSRTRY     EQU &H201      ;
CASRYCT     EQU &H1EB      ;NO OF RETRIES          +&H16
MCSRCT      EQU &H202      ;
MCSNTR      EQU &H203      ;M-CASSETTE COUNTER     +&H17
MCSLUC      EQU &H205      ;TAPE STOP MODE        +&H19
MCSSTIOM    EQU &H206      ;TIME OUT FOR TIMER x 1/9S +&H1A
MCSPLSE     EQU &H207      ;B7 = PULSE STATUS      +&H1B

```

#### Header Locations

```

CASBHID     EQU &H2D0      ;HEADER AREA START; DATA - "H"
MCSBHID     EQU &H324      ;
CASBNO      EQU &H2D1      ;BLOCK NUMBER (0-65535)
MCSBNO      EQU &H325      ;
CASBRNO     EQU &H2D3      ;REPEAT BLOCK NO (0 OR 1)
MCSRBNO     EQU &H327      ;
CASID       EQU &H2D4      ;"HDR1"
MCSID       EQU &H328      ;
CASFNAM     EQU &H2D8      ;8 BYTE FILENAME
MCSFNAM     EQU &H32C      ;
CASFTYP     EQU &H2E0      ;8 BYTE FILETYPE
MCSFTYP     EQU &H334      ;
CASRTYP     EQU &H2E8      ;RECORD TYPE:
MCSRTYP     EQU &H33C      ;
; "F" FIXED LENGTH:
; "V" VARIABLE LENGTH
; "2" WRITTEN TWICE
CASBMOD     EQU &H2E9      ;BLOCK MODE:
MCSBMOD     EQU &H33D      ;
; "S" - SHORT GAP
; "L" - LONG GAP
; " " - STOP BETWEEN BLOCKS
CASBLNG     EQU &H2EA      ;5 DIGIT ASCII BLOCK LENGTH EG " 256"
MCSBLNG     EQU &H33E      ;
CASDATE     EQU &H2F4      ;DATE (MMDDYY) 6 BYTE ASCII
MCSDATE     EQU &H348      ;
CASTIME     EQU &H2FA      ;TIME (HHMMSS) 6 BYTE ASCII
MCSIME      EQU &H34E      ;
CASVOLN     EQU &H306      ;VOLUME NO
MCSVOLN     EQU &H35A      ;
CASSNAM     EQU &H308      ;SYSTEM NAME "HX-20  "
MCSNAM      EQU &H35C      ;

```

## PROM Cartridge Locations

PRMSTS	EQU &H208	; PROM CARTRIDGE STATUS: ; B7 = 1 IF POWER ON ; B0 = 1 IF OPEN
PRMADR	EQU &H209	; PROM ADDRESS
PRMSAD	EQU &H20B	; PROM FILE START ADDRESS
PRMEAD	EQU &H20D	; PROM FILE END ADDRESS + 1

## Memory Dump/Load Locations

DLDSADR	EQU &H20F	; FIRST ADDRESS
DLDEADR	EQU &H211	; LAST ADDRESS
DLDOFF	EQU &H213	; OFFSET
DLDSTR	EQU &H215	; EXECUTION ADDRESS
DLDDVCE	EQU &H217	; DEVICE NAME
DLDSTS	EQU &H218	; STATUS
DLDPTR	EQU &H219	; DEVICE TABLE POINTER: ; + 0,1 WORK AREA ADDRESS ; + 2,3 OPEN READ ADDRESS ; + 4,5 OPEN SEARCH ADDRESS ; + 6,7 READ BYTE ADDRESS ; + 8,9 CLOSE ADDRESS ; + 10,11 OPEN WRITE ADDRESS ; + 12,13 WRITE BYTE ADDRESS

## Screen Locations

PSBUF	EQU &H220	; 80 BYTE PHYSICAL SCREEN BUFFER
SCRTOP	EQU &H270	; ADDRESS OF VIRTUAL SCREEN BUF
SCRBOT	EQU &H272	; END OF VIRTUAL BUFFER + 1
DISTOP	EQU &H274	; ADDR OF PHYS SCR ON VIR SCRNM
VSCRX	EQU &H276	; VIR SCR WIDTH
VSCRY	EQU &H277	; VIR SCR DEPTH
CURX	EQU &H278	; CURSOR X COORD
CURY	EQU &H279	; CURSOR Y COORD
SCRLX	EQU &H27A	; SCROLL STEP X
SCRLY	EQU &H27B	; SCROLL STEP Y
CURMG	EQU &H27C	; SCROLL MARGIN
VSPD	EQU &H27D	; SCROLL SPEED
DISPX	EQU &H27E	; PHYSICAL SCREEN X
DISPY	EQU &H27F	; PHYSICAL SCREEN Y
DISSTS	EQU &H280	; STATUS: ; B7 1 = UPDATE ENTIRE SCREEN ; B6 1 = CURSOR ON ; B5 1 = ENABLE CURSOR ; B4 1 = DELAY DURING SCROLLING ; B0 1 = DISABLE L/R SCROLLING
.SCRWR	EQU &H80	; 5 BYTE WORK AREA
.CSRON	EQU &H40	; 6 BYTE FONT WORK AREA
.CSREN	EQU &H20	
.SCRW	EQU &H10	
.SCRLD	EQU 1	
LCDTMP	EQU &H281	
CHFONT	EQU &H286	



## Monitor

BRKADR	EQU &H2A0	; BREAKPOINT ADDRESS
BRKINS	EQU &H2A2	; BREAKPOINT INSTRUCTION
MNDISSTS	EQU &H2A3	; STORES DISSTS ON ENTRY
MNWRK	EQU &H2A4	; 23 BYTE WORK AREA
MNPC	EQU &H2BF	; PC VALUE
MNRTNADR	EQU &H2C1	; B CMD RETURN ADDRESS
MNPSBUF	EQU &H2C3	; ADDR OF END OF LINE OF PSBUF
MNROPT	EQU &H2C5	; FLAG FOR R OPTION
MNTMP	EQU &H2C6	; 10 BYTE WORK AREA

## ROM Vectors

RUNUKYTB	EQU &HFFD0	; ADDRESS OF NUKYTB
RUPRTCNT	EQU &HFFD2	; ADDRESS OF PRTCNT
RUCASCNT	EQU &HFFD4	; ADDRESS OF CASCNT
RUMCSCNT	EQU &HFFD6	; ADDRESS OF MCSCNT
RURSDCNT	EQU &HFFD8	; ADDRESS OF RSDCNT
RULCDPS	EQU &HFFDA	; ADDRESS OF PSBUF
RUIOBUF	EQU &HFFDC	; ADDRESS OF 260 BYTE BUFFER
RUUSPD	EQU &HFFDE	; ADDRESS OF USPD
RUCASHDR	EQU &HFFE0	; ADDRESS OF CASHDR
RUMCSHDR	EQU &HFFE2	; ADDRESS OF MCSDR
RUKYINOD	EQU &HFFE4	; ADDRESS OF KYINOD
RUTRAP	EQU &HFFEE	; TRAP INTERRUPT ADDRESS
RVSCI	EQU &HFFF0	; SCI INTERRUPT ADDRESS
RVTDF	EQU &HFFF2	; TOF INTERRUPT ADDRESS
RVOCF	EQU &HFFF4	; OCF INTERRUPT ADDRESS
RVICF	EQU &HFFF6	; ICF INTERRUPT ADDRESS
RUIRQ1	EQU &HFFF8	; IRQ1 INTERRUPT ADDRESS
RUSWI	EQU &HFFFA	; SWI INTERRUPT ADDRESS
RUNMI	EQU &HFFFC	; NMI INTERRUPT ADDRESS
RURESET	EQU &HFFFE	; RESET ADDRESS
RJMPCLK	EQU &HFFB5	; 3 BYTE CLK INT VECTOR
RJMPEXT	EQU &HFFB8	; 3 BYTE EXT INT VECTOR
RJMPTRP	EQU &HFFB8	; 3 BYTE TRAP INT VECTOR
RJMPSER	EQU &HFFBE	; 3 BYTE SCI INT VECTOR
RJMPTOF	EQU &HFFC1	; 3 BYTE TOF INT VECTOR
RJMPOCF	EQU &HFFC4	; 3 BYTE OCF INT VECTOR
RJMPICF	EQU &HFFC7	; 3 BYTE ICF INT VECTOR
RJMPIRQ	EQU &HFFCA	; 3 BYTE IRQ INT VECTOR

## Section 2

### ROM calls

## Keyboard ROM Calls

LABEL	ADDRESS	DESCRIPTION
INITKY	&HFFA0	INITIALIZE KEY INPUT
		ENTRY: NONE
		EXIT: NONE
		PRESERVED: NONE
KVSTS	&HFF90	READ KEY STATUS
		ENTRY: NONE
		EXIT: (A) NO OF CHARS IN KEY STACK C IO ERROR FLAG 1=ERROR Z 1 IF (A)=0
		PRESERVED: (B), (X)
KYIN	&HFF9A	GET KEY INPUT
		ENTRY: NONE
		EXIT: (A) KEY INPUT (1 BYTE CODES) (D) KEY INPUT (PF1 - PF10) C IO ERROR FLAG 1=ERROR
		PRESERVED: (X)
KYSCH	&HFF6A	SCAN KEY MATRIX
		ENTRY: NONE
		EXIT: NUKYTB IS UPDATED
		PRESERVED: NONE
INIPKY	&HFF22	INITIALIZE POWER ON KEY STACK
		ENTRY: (X) ADDR OF POWER ON STRING (B) NO OF CHARS IN STRING
		EXIT: NONE
		PRESERVED: NONE

## LCD ROM Calls

LABEL	ADDRESS	DESCRIPTION
DSPLCN	&HFF49	DISPLAY ON LCD OR CLEAR LCD ENTRY: (B) NUMBER OF CHARACTERS CLEAR SCREEN IF (B)=0 (X) IF (B)>0 ADDRESS OF DATA +0 X CO-ORDINATE 0..19 +1 Y CO-ORDINATE 0..3 +2 -> DISPLAY DATA EXIT: NONE PRESERVED: NONE
DSPLCH	&HFF4C	DISPLAY A CHARACTER ON PHYSICAL SCREEN AND UPDATE PHYSICAL SCREEN BUFFER ENTRY: (A) DISPLAY DATA (X) X-COORD : Y-COORD EXIT: (X) UPDATED DISPLAY POSITION PRESERVED: (A), (B)
DISPIT	&HFF5B	DISPLAY A CHARACTER ON PHYSICAL SCREEN THE PHYSICAL SCREEN BUFFER IS NOT USED ENTRY: (A) DISPLAY DATA (X) X-COORD : Y-COORD EXIT: (X) UPDATED DISPLAY POSITION PRESERVED: (A), (B)
RD CFNT	&HFF67	READ FONT PATTERN ENTRY: (A) CHARACTER CODE (X) ADDRESS OF 6 BYTE WORK AREA EXIT: FONT PATTERN IN WORK AREA PRESERVED: NONE

LABEL	ADDRESS	DESCRIPTION
LCDADDR	&HFF52	SELECT LCD CHIP IN COMMAND MODE
		ENTRY: (A) DOT COLUMN 0..119 (B) ROW 0..3
		EXIT: (A) DOT COLUMN + BANK NO (B) CHIP NO + 8
		PRESERVED: (X)
TXRXLC	&HFF55	TRANSMIT COMMAND OR DATA TO LCD
		ENTRY: (A) COMMAND/DATA BYTE
		EXIT: NONE
		PRESERVED: (A), (B), (X)
LCDMOD	&HFF58	DESELECT LCD OR CHANGE MODE
		ENTRY: (D) &H800 SELECT DATA MODE &H808 SELECT COMMAND MODE &HF08 DESELECT LCD
		EXIT: NONE
		PRESERVED: NONE
VIRSCR	&HFF5E &HDF4	VIRTUAL SCREEN ROUTINE
		ENTRY: (X) ADDRESS OF DATA PACKET
		EXIT: DATA PACKET MAY BE UPDATED
		PRESERVED: NONE
RCULCD	&HFF61 &HDFEE	RECOVER VIRTUAL SCREEN
		ENTRY: NONE
		EXIT: NONE
		PRESERVED: NONE

## Serial I/F ROM Calls

LABEL	ADDRESS	DESCRIPTION
SRONF	&HFF73	TURN SERIAL I/F POWER ON OR OFF ENTRY: (A) 0 - TURN POWER OFF 1 - TURN POWER ON EXIT: (A) ERROR CODE - 0 OK C IO ERROR 1=ERROR Z 1 IF (A)=0 PRESERVED: (B),(X)
SROUT	&HFF70	SERIAL I/F BLOCK TRANSMISSION ENTRY: (A) 0 - TRANSMIT ONLY 1 - TRANSMIT & RECEIVE (X) ADDRESS OF PACKET EXIT: PACKET MAY BE UPDATED (A) ERROR CODE 0 - OK C IO ERROR 1=ERROR Z 1 IF (A)=0 PRESERVED: NONE
SRIN	&HFF60	SERIAL I/F BLOCK RECEPTION ENTRY: (X) ADDRESS OF PACKET EXIT: PACKET MAY BE UPDATED (A) ERROR CODE 0 - OK (B) IF A=0, 0=HEADER 1=NO HEADER C IO ERROR 1=ERROR Z 1 IF (A)=0 PRESERVED: NONE
SRINI	&HFF1C	INITIALIZE SERIAL I/F ENTRY: (A) 0=MASTER, 1=SLAVE EXIT: NONE PRESERVED: NONE

## RS232 ROM Calls

LABEL	ADDRESS	DESCRIPTION
RSMST	&HFF88	SET RS232 PARAMETERS
		ENTRY: (A) MODE: B7,6 0 EVEN PARITY 1 ODD PARITY 2/3 NO PARITY B5 0=CHECK CTS, 1 NOT B4 0=CHECK DSR, 1 NOT B3 1=RTS ON, 0 OFF B2 0=CHECK CD, 1 NOT B1,0 NO OF STOP BITS 1..3 (B) BIT RATE & WORD LENGTH: B7-4 BIT RATE 0-7 B3-0 WORD LENGTH 5-8
		EXIT: NONE
		PRESERVED: (A),(B),(X)
RSONF	&HFF85	TURN RS232 I/F POWER ON OR OFF
		ENTRY: (A) 0 - TURN POWER OFF 1 - TURN POWER ON
		EXIT: (A) ERROR CODE - 0 OK C IO ERROR 1=ERROR Z 1 IF (A)=0
		PRESERVED: (B),(X)
RSOPEN	&HFF82	OPEN RS232 FOR INPUT
		ENTRY: (D) RECEIVE BUFFER SIZE (X) RECEIVE BUFFER ADDRESS
		EXIT: (A) ERROR CODE 0=OK C IO ERROR FLAG 1=ERROR
		PRESERVED: NONE

LABEL	ADDRESS	DESCRIPTION
RSCLOS	!&HFF7F	!CLOSE RS232 INPUT
		!ENTRY: NONE
		!EXIT: (A) ERROR CODE 0=OK C IO ERROR FLAG 1=ERROR Z 1 IF (A)=0
		!PRESERVED: (B), (X)
RSGSTS	!&HFF7C	!GET RS232 INPUT STATUS
		!ENTRY: NONE
		!EXIT: (A) B7=1 IF RECEIVE BUFFER FULL (B) B5=1 IF RECEIVE ERROR B2=1 IF OVERRUN B1=1 IF PARITY ERROR B0=1 IF CARRIER DISCONNECT
		!PRESERVED: (X)
RSGET	!&HFF79	!READ ONE CHARACTER FROM RS232 BUFFER
		!ENTRY: NONE
		!EXIT: (A) RECEIVED DATA (B) ERROR CODE: 0=OK 1=BUFFER FULL/BUFFER EMPTY ELSE IO ERROR C IO ERROR 1=ERROR Z 1 IF (B)=0
		!PRESERVED: (X)
RSPUT	!&HFF76	!TRANSMIT CHARACTER TO RS232 I/F
		!ENTRY: (A) CHARACTER
		!EXIT: (B) ERROR CODE: 0 OK 1 DSR OFF 2 CTS OFF 3 DSR & CTS OFF C IO ERROR 1=ERROR Z 1 IF (B)=0
		!PRESERVED: (A), (X)



LABEL	ADDRESS	DESCRIPTION
CHKRS	&HFF16	RESTARTS INTERRUPTED RS232 INPUT
		ENTRY: NONE
		EXIT: NONE
		PRESERVED: (A), (B), (X), (CCR)

### Cassette & Microcassette ROM Calls

LABEL	ADDRESS	DESCRIPTION
RMTONF	&HFF46	TURN EXTERNAL CASSETTE REMOTE ON/OFF
		ENTRY: (A) 0 OFF 1 ON
		EXIT: (A) ERROR CODE 0 - OK C IO ERROR FLAG 1=ERROR
		PRESERVED: (B), (X)
MCSMAN	&HFF0D	ENTERS MANUAL MICROCASSETTE MODE (^PF1)
		ENTRY: NONE
		EXIT: (A) ERROR CODE 0 - OK C IO ERROR FLAG 1=ERROR Z 1 IF (A)=0
		PRESERVED: NONE
MCSREW	&HFEF5	REWIND MICROCASSETTE TO START OF TAPE
		ENTRY: NONE
		EXIT: (A) ERROR CODE 0 - OK (X) TAPE COUNTER VALUE C IO ERROR FLAG 1=ERROR Z 1 IF (A)=0
		PRESERVED: NONE

LABEL	ADDRESS	DESCRIPTION
MCSSEK	&HFEF2	WIND MICROCASSETTE TO SPECIFIED COUNT ENTRY: (X) TAPE COUNT EXIT: (A) ERROR CODE 0 - OK (X) TAPE COUNTER VALUE C IO ERROR FLAG 1=ERROR Z 1 IF (A)=0 PRESERVED: NONE
MCSCNT	&HFEF4	SETS OR READS M-CASSETTE COUNTER VALUE ENTRY: (A) 0 - READ, 1=SET (X) COUNTER VALUE (A=1) EXIT: (X) COUNTER VALUE (A=0) C IO ERROR 1=ERROR PRESERVED: (B)
CASOPNR	&HFF43	OPENS SPECIFIED CASSETTE FILE FOR INPUT
MCSOPNR	&HFF0A	OPENS SPECIFIED M-CASS FILE FOR INPUT ENTRY: (X) PACKET ADDRESS: +0 STOP MODE: 0 STOP 1 NOT STOP -1 AUTOMATIC +1,2 ADDR OF 260 BYTE BUF +3..+10 8 BYTE FILENAME +11..+18 8 BYTE FILETYPE EXIT: (A) ERROR CODE 0=OK C IO ERROR FLAG 1=ERROR Z 1 IF (A)=0 PRESERVED: NONE

LABEL	ADDRESS	DESCRIPTION
CASSRCH	&HFF40	OPENS FIRST CASSETTE FILE FOR INPUT
MCSSRCH	&HFF07	OPENS FIRST M-CASS FILE FOR INPUT
		ENTRY: (X)      PACKET ADDRESS: +0            STOP MODE: 0 STOP 1 NOT STOP -1 AUTOMATIC +1,2        ADDR OF 260 BYTE BUF +3..+10    8 BYTE FILENAME +11..+18   8 BYTE FILETYPE +19..+35   SPARE
		EXIT: PACKET: +19..+27    8 BYTE FOUND FILENAME +28..+35   8 BYTE FOUND FILETYPE (A)    ERROR CODE 0=OK C    IO ERROR FLAG 1=ERROR Z    1 IF (A)=0
		PRESERVED: NONE
CASRD	&HFF3D	READ ONE CHAR FOM E-CASS FILE
MCSRCH	&HFF04	READ ONE CHAR FROM M-CASS FILE
		ENTRY: NONE
		EXIT: (A) CHARACTER (B) ERROR CODE: 0 - OK 1 - EOF ELSE IO ERROR C    IO ERROR FLAG 1=ERROR Z    1 IF (B)=0
		PRESERVED: (X)

LABEL	ADDRESS	DESCRIPTION
CASOPNW	&HFF3A	OPENS CASSETTE FILE FOR OUTPUT
MCSOPNW	&HFF01	OPENS M-CASS FILE FOR OUTPUT
		ENTRY: (X) PACKET ADDRESS: +0 STOP MODE: 0 STOP 1 NOT STOP +1,2 ADDR OF 260 BYTE BUF +3..+10 8 BYTE FILENAME +11..+18 8 BYTE FILETYPE
		EXIT: (A) ERROR CODE 0=OK C IO ERROR FLAG 1=ERROR Z 1 IF (A)=0
		PRESERVED: NONE
CASWR	&HFF37	WRITES ONE CHAR TO E-CASS FILE
MCSWR	&HFEFE	WRITES ONE CHAR TO M-CASS FILE
		ENTRY: (A) CHARACTER
		EXIT: (B) ERROR CODE 0=OK C IO ERROR FLAG 1=ERROR Z 1 IF (B)=0
		PRESERVED: (A), (X)
CASCLS	&HFF34	CLOSE CASSETTE FILE
MCSCLS	&HFEFB	CLOSE M-CASS FILE
		ENTRY: NONE
		EXIT: (A) ERROR CODE 0=OK C IO ERROR FLAG 1=ERROR Z 1 IF (A)=0
		PRESERVED: NONE

## Microprinter ROM Calls

LABEL	ADDRESS	DESCRIPTION
PRTCHR	&HFF97	PRINT ONE CHAR ON MICROPRINTER
		ENTRY: (A) CHARACTER
		EXIT: C IO ERROR FLAG 1=ERROR
		PRESERVED: (A), (B), (X)
PRTLIN	&HFF94	PRINT ONE LINE ON MICROPRINTER
		ENTRY: (X) ADDRESS OF 24 CHAR BUFFER
		EXIT: C IO ERROR FLAG 1=ERROR
		PRESERVED: (A), (B), (X)
PRTDOT	&HFF91	PRINT ONE DOT LINE ON MICROPRINTER
		ENTRY: (X) ADDRESS OF 24 BYTE BUFFER
		+0 B0->DOT 0 .. B5->DOT 5
		+1 B0->DOT 6 .. B5->DOT 11
		: :
		+23 B0->DOT 138 .. B5->DOT 143
EXIT: C IO ERROR FLAG 1=ERROR		
PRESERVED: (A), (B), (X)		
PRTLFD	&HFF8E	FEED PAPER ON MICROPRINTER
		ENTRY: (A) NUMBER OF DOT LINES FEED
		EXIT: C IO ERROR FLAG 1=ERROR
		PRESERVED: (A), (B), (X)
PRTSCR	&HFF8B	PRINT PHYSICAL LCD SCREEN (^PF2)
		ENTRY: NONE
		EXIT: C IO ERROR FLAG 1=ERROR
		PRESERVED: (A), (B), (X)

# ROM Cartridge ROM Calls

LABEL	ADDRESS	DESCRIPTION
PRMOPN	:&HFEEC	OPEN ROM FILE FOR INPUT
		ENTRY: (A) 0 - FILENAME NOT RETURNED 1 - RETURN OPENED FILENAME: (X) PACKET ADDRESS: +0..+7 FILENAME +8..+15 FILETYPE +16..+31 UNUSED (A=1)
		EXIT: PACKET: (A=1) +16..+23 OPENED FILENAME +24..+31 OPENED FILETYPE (A) ERROR CODE 0=OK C IO ERROR FLAG 1=ERROR Z 1 IF (A)=0
		PRESERVED: NONE
PRMRD	:&HFEE9	READ ONE BYTE FROM PROM FILE
		ENTRY: NONE
		EXIT: (A) BYTE READ (B) ERROR CODE: 0 - OK 1 - EOF ELSE IO ERROR C IO ERROR FLAG 1=ERROR Z 1 IF (B)=0
		PRESERVED: NONE
PRMCLS	:&HFEE6	CLOSE PROM FILE
		ENTRY: NONE
		EXIT: C IO ERROR FLAG 1=ERROR
		PRESERVED: (B), (X)

LABEL	ADDRESS	DESCRIPTION
PRMDIR	&HFEE3	READ PROM DIRECTORY RECORD
		ENTRY: (A) DIRECTORY RECORD NO 0..63 (X) ADDR OF 32 BYTE WORK AREA
		EXIT: WORK AREA: DIRECTORY RECORD (A=0)
		EXIT: (A) ERROR CODE 0=OK C IO ERROR FLAG 1=ERROR Z 1 IF (A)=0
		PRESERVED: NONE

### Memory Dump/Load ROM Calls

LABEL	ADDRESS	DESCRIPTION
DMPOPN	&HFEE0	OPEN FILE FOR MEMORY DUMP TO DEVICE
		ENTRY: (B) DEVICE NAME: "M" - M-CASS "C" - E-CASS "0" - RS232 (110 BAUD) : : "6" - RS232 (4800 BAUD) (X) PACKET ADDRESS: (27 BYTE) +0 TAPE STOP MODE: 0 - STOP 1 - DO NOT STOP +1,2 ADDRESS OF 260 BYTE BUF +3..+10 8 BYTE FILENAME +11..+18 8 BYTE FILETYPE +19,20 DUMP START ADDRESS +21,22 DUMP END ADDRESS +23,24 DUMP OFFSET +25,26 PROGRAM EXEC ADDRESS
		EXIT: (A) ERROR CODE 0=OK C IO ERROR FLAG 1=ERROR
		PRESERVED: NONE

LABEL	ADDRESS	DESCRIPTION
DMPBIN	&HFEDD	DUMP MEMORY TO FILE
		ENTRY: NONE
		EXIT: C IO ERROR FLAG 1=ERROR
		PRESERVED: NONE
LODOPN	&HFEDA	OPEN FILE FOR MEMORY LOAD FROM DEVICE
		ENTRY: (A) 0 - DO NOT RETURN FILENAME 1 - RETURN OPENED FILENAME
		(B) DEVICE NAME: "M" - M-CASS "C" - E-CASS "P" - ROM CARTRIDGE "B" - RS232 (110 BAUD) : : "6" - RS232 (4800 BAUD)
		(X) PACKET ADDRESS: +0 TAPE STOP MODE: 0 - STOP 1 - DO NOT STOP -1 - AUTOMATIC
		+1,2 ADDRESS OF 260 BYTE BUF
		+3..+10 8 BYTE FILENAME
		+11..+18 8 BYTE FILETYPE
		+19,20 LOWER ADDRESS LIMIT
		+21,22 UPPER ADDRESS LIMIT
		+23,24 LOAD OFFSET
+25..+34 SPARE (A=1)		
EXIT: PACKET: +19..+26 FOUND FILENAME +27..+34 FOUND FILETYPE (A) ERROR CODE 0=OK C IO ERROR FLAG 1=ERROR		
PRESERVED: NONE		
LODBIN	&HFED7	LOAD MEMORY FROM FILE
		ENTRY: (A) 0 - LOAD FILE INTO MEMORY 1 - DO NOT LOAD - VERIFY
		EXIT: (X) PROGRAM EXEC ADDR (A) ERROR CODE 0=OK C IO ERROR FLAG 1=ERROR
		PRESERVED: NONE



## Miscellaneous ROM Calls

LABEL	ADDRESS	DESCRIPTION
SNSCOM	&HFF19	SEND BYTE TO SLAVE MPU
		ENTRY: (A) BYTE
		EXIT: (A) SLAVE RETURN CODE C IO ERROR FLAG 1=ERROR
		PRESERVED: (B), (X)
BEEP	&HFF64	SOUND BUZZER
		ENTRY: (A) TONE 0..56 (B) DURATION (UNITS: .1S) 0..255
		EXIT: C IO ERROR FLAG 1=ERROR
		PRESERVED: (A), (B), (X)
SLEEP	&HFFA9	ENTER SLEEP MODE UNTIL INTERRUPT
		ENTRY: NONE
		EXIT: NONE
		PRESERVED: (A), (B), (X)
CHKPLG	&HFF2E	ASCERTAIN PLUG IN CARTRIDGE TYPE
		ENTRY: NONE
		EXIT: (A) DEVICE CODE: 0 - ROM CARTRIDGE 1 - UNDEFINED 2 - NONE 3 - UNDEFINED 4-7 - MICROCASSETTE C IO ERROR FLAG 1=ERROR
		PRESERVED: (B), (X)
PWROFF	&HFFAC	TURN POWER OFF - NO EXIT
		ENTRY: NONE

LABEL	ADDRESS	DESCRIPTION
PWRDWN	&HFF1F	DISPLAYS "CHARGE BATTERY!" RETURNS ONLY IF BATTERY RECOVERS, OTHERWISE TURNS POWER OFF
		ENTRY: NONE
		EXIT: NONE
		PRESERVED: NONE
REQINI	&HFF13	COLD START - EXIT VIA RESET VECTOR
		ENTRY: NONE
WRTP26	&HFED4	WRITE DATA TO P26 AND P26DAT
		ENTRY: (A) PORT MASK - 1=ALTER BIT (B) PORT DATA
		EXIT: NONE
		PRESERVED: (A), (B), (X)
BRKIO	&HFFA3	IO BREAK PROCESSING, SET BRK AND SBRK
		ENTRY: NONE
		EXIT: NONE
		PRESERVED: NONE
RSTIO	&HFFA6	RESTART BROKEN IO
		ENTRY: NONE
		EXIT: NONE
		PRESERVED: (X)
ONTIO	&HFFAF	RESET BRK & SBRK, RESTART RS232 INPUT
		ENTRY: NONE
		EXIT: NONE
		PRESERVED: NONE

LABEL	ADDRESS	DESCRIPTION
INITIO	&HFFCD	CALLS HSTRIO, INITIALIZES KEYBOARD, LCD, CALLS RSTIO, ASCERTAINS CARTRIDGE TYPE, ENABLES INTERRUPTS ENTRY: NONE EXIT: NONE PRESERVED: NONE
HSTRIO	&HFED1	INITIALIZE IO SYSTEM EXCEPT KYBD & LCD ENTRY: NONE EXIT: NONE PRESERVED: NONE
HEXBIN	&HFF2B	2 DIG ASCII HEX NO -> 1 BYTE BINARY NO ENTRY: (D) 2 DIGIT ASCII HEX NUMBER EXIT: (A) BINARY NO (B) ERROR CODE 0 - OK Z 1 IF (B)=0 PRESERVED: NONE
BINDEC	&HFF28	2 BYTE UNSIGNED BIN -> 5 BYTE ASCII DEC ENTRY: (D) 2 BYTE UNSIGNED BINARY NO (X) ADDRESS OF 5 BYTE WORK AREA EXIT: WORK AREA CONTAINS 5 DIGIT ASCII DECIMAL NUMBER PRESERVED: NONE
RDCLK	&HE1FA &HFF31	READ TIME & DATE FROM RTC ENTRY: (X) ADDRESS OF 6 BYTE WORK AREA EXIT: WORK AREA: (BCD) +0 MONTH 01..&H12 +1 DAY 01..&H31 +2 YEAR 00..&H99 +3 HOUR 00..&H23 +4 MINUTES 00..&H59 +5 SECONDS 00..&H59 PRESERVED: NONE

LABEL	ADDRESS	DESCRIPTION
WRCLK	&HE1E3 &HFF08	WRITES THE DATE & TIME TO THE RTC
		ENTRY: (X) ADDRESS OF 6 BYTE PACKET: +0 MONTH 01..&H12 +1 DAY 01..&H31 +2 YEAR 00..&H99 +3 HOUR 00..&H23 +4 MINUTES 00..&H59 +5 SECONDS 00..&H59
		EXIT: NONE
		PRESERVED: NONE
MONITOR	&HFF10 &HDFF7	CALL MONITOR AS SUBROUTINE USER MAY OPT TO NEVER RETURN
		ENTRY: NONE
		EXIT: NONE
		PRESERVED: NONE
MTRP	&HFFB8 &HDFFA	MONITOR TRAP ENTRY POINT USER MAY OPT TO NEVER RETURN
		ENTRY: NONE
		EXIT: NONE
		PRESERVED: NONE
MENU	&HFF25 &HDFFD	MENU ENTRY POINT - NO RETURN
		ENTRY: NONE
BRKIN	&HFFB2	MENU ENTRY POINT ON BREAK - NO RETURN
		ENTRY: NONE
SCRCHR	&HFF4F &HDFF1	WRITE ONE CHAR TO VIRTUAL SCREEN
		ENTRY: (A) CHARACTER
		EXIT: (X) NEW X-COORD:NEW Y-COORD
		PRESERVED: NONE

## Virtual Screen Functions

Subroutine **VIRSCR** handles the Virtual screen on the LCD or Display controller. All calls to **VIRSCR** must pass the address of a data packet. The possible contents and functions of the packet are given below. Note that if you use the display controller you must reserve 4 bytes of unused RAM **before** the packet. The packet may be updated on return from **VIRSCR**. The packet is normally in RAM. Note also that all control codes except &H12 have the function defined in section 1.5 of HX-20 BASIC REFERENCE MANUAL. Code &H12 inserts a single space character at the cursor position. The Size of the Screen Buffer is  $(WIDTH \times (LENGTH + 1) + 1)$  bytes.

Byte	Entry	Exit
Select Device		
0	&H84	
1	DEVICE NO: &H22 = LCD &H30 = EXT DISPLAY	0 = OK, -1 = DEV NO ERR; -2 = NOT READY
Initialize Display Controller		
0	&H85	
1		0 = OK, -1 = IO ERROR
Get Device No		
0	&H86	
1		DEVICE NO
Set Screen Size		
0	&H87	
1	WIDTH - 1	0 = OK, -1 = SIZE ERROR; -2 = ADDR ERROR
2	LENGTH - 1	
3,4	BUFFER ADDRESS (LCD)	
Get Screen Size		
0	&H88	
1		WIDTH - 1
2		LENGTH - 1
Get Physical Screen Size		
0	&H89	
1		WIDTH - 1
2		LENGTH - 1

Byte	Entry	Exit
Get Upper Left Corner Window Position		
0	&H8A	
1		X-COORD
2		Y-COORD
Get Cursor Position on Virtual Screen		
0	&H8C	
1		X-COORD
2		Y-COORD
Get Cursor Margin		
0	&H8D	
1		CURSOR MARGIN
Get Scroll Steps		
0	&H8E	
1		HORIZONTAL SCROLL VALUE
2		VERTICAL SCROLL VALUE
Get Physical Screen Dot Status		
0	&H8F	
1	X-COORD (MSB)	DOT STATUS: LCD: 0 = OFF, -1 = ON; DISPLAY: COLOUR CODE
2	X-COORD (LSB)	
3,4	Y-COORD	
Get Logical line range		
0	&H91	
1		X-COORD ) - FIRST LINE
2		Y-COORD )
3		PHYSICAL SCREEN WIDTH-1
4		Y-COORD - LAST LINE
Display Character on Virtual Screen		
0	&H92	
1	CHARACTER	NEW X-COORD
2		NEW Y-COORD

Byte	Entry	Exit
Set Display Controller mode		
0	&H93	
1	MODE: 0 - GRAPHIC MODE 1 - TEXT MODE	0 = OK, -1 = IO ERROR
2	GRAPHIC MODE: 0 - TEXT MODE 1 - 4 COLOUR MODE 2 - 2 COLOUR MODE	
3	BACKGROUND COLOUR	
Get Characters from Virtual Screen		
0	&H97	
1	START X-COORD	CHARACTER1 ...
2	START Y-COORD	
3	NO OF CHARACTERS	
Display Character on Virtual Screen		
0	&H98	
1	CHARACTER	NEW CURSOR X-COORD
2		NEW CURSOR Y-COORD
3		FIRST Y-COORD OF LINE CONTAINING CURSOR
4		LAST Y-COORD OF LINE CONTAINING CURSOR
Set Window Position		
0	&HC0	
1	X-COORD OF WINDOW	
2	Y-COORD OF WINDOW	
Set Cursor Position		
0	&HC2	
1	X-COORD OF CURSOR	
2	Y-COORD OF CURSOR	
Set Cursor Margin		
0	&HC3	
1	CURSOR MARGIN VALUE	
Set Scroll Step Values		
0	&HC4	
1	HORIZONTAL SCROLL STEP	
2	VERTICAL SCROLL STEP	

Byte	Entry	Exit
	Disable Left/Right Scrolling (LISTING)	
0	&HC5	
	Enable Left/Right Scrolling	
0	&HC6	
	Set/Reset Dot on Graphic Screen	
0	&HC7	
1,2	X-COORD	
3,4	Y-COORD	
5	DOT STATUS: LCD: 0 OFF, -1 ON DISP: COLOUR CODE	
	Draw Line on Graphic Screen	
0	&HC8	
1,2	START X-COORD	
3,4	START Y-COORD	
5,6	END X-COORD	
7,8	END Y-COORD	
9	LINE STATUS: SEE DOT STATUS ABOVE	
	Start New Logical Line	
0	&HC9	
1	LINE Y-COORD	
	Clear Graphic Screen	
0	&HCA	
1	COLOUR (DISP)	
	Set LCD Scroll Speed	
0	&HCB	
1	SCROLL SPEED (0-9)	



## Disk Drive Functions

Subroutine **SRDOUT** is used to transmit and receive data packets with the TF-20. All calls to **SRDOUT** must pass the address of a data packet. The possible contents and functions of the packet are given below. Note that the first three bytes of the packet are as follows:

```
Byte 0  0
       1  &H31 for drive "A:" or "B:"
          &H32 for drive "C:" or "D:"
       2  &H20
```

The packet is normally in RAM and is updated on return. Note that the first three bytes will be changed on return to:

```
Byte 0  1
       1  &H20
       2  &H31 for drive "A:" or "B:"
          &H32 for drive "C:" or "D:"
```

Byte	Entry	Exit
Initialize TF-20		
3	&H0D	
4	0	
5	0	
Open File		
3	&H0F	
4	&H0E	0
5	FCB ADDR IN HX20 (MSB):	RETURN CODE
6	FCB ADDR IN HX20 (LSB):	
7	DRIVE CODE ( 1-A, 2-B):	
8-15	FILENAME	
16-18	FILETYPE	
19	EXTENT (USUALLY 0)	
Close File		
3	&H10	
4	1	0
5	FCB ADDR IN HX20 (MSB):	RETURN CODE
6	FCB ADDR IN HX20 (LSB):	

Byte	Entry	Exit
First Directory Search		
3	&H11	
4	&HC	:&H20
5	DRIVE CODE	:RETURN CODE
6-13	FILENAME	:FCB (32 BYTES)
14-16	FILETYPE	
17	EXTENT	
18-37		
Subsequent Directory Search		
3	&H12	
4	0	:&H20
5	0	:RETURN CODE
6-37		:FCB (32 BYTES)
Delete File		
3	&H13	
4	&HC	:0
5	DRIVE CODE	:RETURN CODE
6-13	FILENAME	
14-16	FILETYPE	
17	EXTENT	
Create File		
3	&H16	
4	&HE	:0
5	FCB ADDR IN HX20 (MSB)	:RETURN CODE
6	FCB ADDR IN HX20 (LSB)	
7	DRIVE CODE	
8-15	FILENAME	
16-18	FILETYPE	
19	EXTENT	
File Rename		
3	&H17	
4	&H1F	:0
5	DRIVE CODE	:RETURN CODE
6-13	FILENAME	
14-16	FILETYPE	
17	EXTENT	
18-20	UNUSED	
21	DRIVE CODE	
22-29	FILENAME	
30-32	FILETYPE	
33	EXTENT	
34-36	UNUSED	

Byte	Entry	Exit
Read Random Data Record		
3	&H21	
4	4	&HB2
5	FCB ADDR IN HX20 (MSB)	EXTENT
6	FCB ADDR IN HX20 (LSB)	CURRENT RECORD NO
7	RECORD NO (LSB)	DATA RECORD (128 BYTES)
8	RECORD NO (MSB)	
9	0	
10-134		
135		RETURN CODE
Write Random Data Record		
3	&H22	
4	&HB4	2
5	FCB ADDR IN HX20 (MSB)	EXTENT
6	FCB ADDR IN HX20 (LSB)	CURRENT RECORD NO
7	DATA (128 BYTES)	RETURN CODE
8-134		
135	RECORD NO (LSB)	
136	RECORD NO (MSB)	
137	0	
Get File Size Calculation		
3	&H23	
4	1	5
5	FCB ADDR IN HX20 (MSB)	EXTENT
6	FCB ADDR IN HX20 (LSB)	CURRENT RECORD NUMBER
7		RECORD NO (LSB)
8		RECORD NO (MSB)
9		0 - OK, >0 OVERFLOW
10		RETURN CODE
Disk Copy		
3	&H7A	
4	0	2
5	DRIVE CODE	LAST TRACK COPIED (MSB)
6		LAST TRACK COPIED (LSB)
		0..39 ERROR, -1 OK
7		RETURN CODE

Byte	Entry	Exit
Direct Write to disk		
3	&H7B	
4	&H82	0
5	DRIVE CODE	RETURN CODE
6	TRACK NO 0..39	
7	SECTOR NO 1..64	
8-135	DATA (128 BYTES)	
Direct Read from disk		
3	&H7F	
4	2	&H80
5	DRIVE CODE	DATA (128 BYTES)
6	TRACK NO 0..39	
7	SECTOR NO 1..64	
8-132		
133		RETURN CODE
Format Disk		
3	&H7C	
4	0	2
5	DRIVE CODE	LAST TRACK COPIED (MSB)
6		LAST TRACK COPIED (LSB)
7		0..39 ERROR, -1 OK
		RETURN CODE
System Disk Generation		
3	&H7D	
4	0	2
5,6	0	0 ERROR, -1 OK
7		RETURN CODE
Get Disk free Area		
3	&H7E	
4	0	1
5	DRIVE CODE	FREE AREA SIZE 2K UNITS
6		RETURN CODE
File Boot		
3	&H80	
4	0	&HFF
5	&Hnn -> BOOTnn.SYS	RETURN CODE
6-260		READ DATA (255 BYTES)

Byte	Entry	Exit
Load Open		
3	&H01	
4	&H0D	2
5-12	FILENAME	
13-15	FILETYPE	
16	RELOCATE FLAG: 0 - NO RELOCATION 1 - RELOC FROM START 2 - RELOC FROM END	
17,18	STARTING/ENDING ADDR	
5		RETURN CODE
6,7		FILE SIZE
Load Close		
3	&H02	
4	0	0
5	0	RETURN CODE
Read one block		
3	&H03	
4	1	&H02
5	RECORD NO (MSB)	RECORD NO (MSB)
6	RECORD NO (LSB)	RECORD NO (LSB)
7-134		DATA (128 BYTES)
135		RETURN CODE: -1=EOF

### FCB Format

Byte: 0 Drive Code 0 = Default Drive 1..4 = "A:".."D:"

1-8 Filename

9-11 Filetype

12 Extent 0..31

13 System use

14 System use

15 Record count within extent

16-31 Extent Map

32 Record no read/write

33 No of records in file (LSB)

34 No of records in file (MSB)

35 0=Ok, >0 Error

## LCD commands

&H08 Display off  
 &H09 Display on  
 &H64 Set write mode. Data is written to LCD memory  
 &H60 Set read mode. Data is read from LCD memory  
 &H6C Set AND mode. Data is ANDed with LCD memory  
 &H68 Set OR mode. Data is ORed with LCD memory

## Keyboard Scan Table Map

BIT:	7	6	5	4	3	2	1	0
BYTE:								
+0	7	6	5	4	3	2	1	0
+1	/	.	-	,	;	:	9	8
+2	G	F	E	D	C	B	A	@
+3	O	N	M	L	K	J	I	H
+4	W	V	U	T	S	R	Q	P
+5	<-	->	\	]	[	Z	Y	X
+6	CAPS	GRPH	NUM			TAB	SPACE	RETURN
+7			MENU	DEL	PAUSE	BREAK	SCRN	CLR
+8			FEED	PF5	PF4	PF3	PF2	PF1
+9	PRINT	CTRL	SHIFT		DIP 4	DIP 3	DIP 2	DIP 1

## ROM Subroutine Return Codes

0	No Error
1	RS232 Driver off
	RS232 Receive Buffer full
	RS232 Receive Buffer Empty
	Cassette/M-Cass EOF
&H80	Microcassette not connected
&H81	Read Error
&H82	File not found
&H83	File I/O error
&H84	File not open for input
&H85	File error
&H86	File format error
&H87	File not open
&H88	File already Open
&H8B	File found is not specified file
&H8C	Load of binary file outside limits
&H91	Output Error
&H94	File not open for output
&H99	Binary dump/load device name error
&HA0	PROM Cartridge not connected
&HA1	File not found
&HA2	File already open
&HA3	File not open
	Invalid PROM directory number
&HA4	Invalid PROM Header
&HA5	Invalid PROM data
&HB0	Serial I/F time out
&HB1	Serial I/F Device error
&HB2	Serial I/F communication error
&HB3	Serial I/F driver off
&HC0	RS232 Parity error
&HC1	RS232 CD off
&HFA	Disk read error
&HFB	Disk write error
&HFC	Disk select error
&HFD	) - Disk Write protect error
&HFE	)
&HFF	Disk file not found

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