XEROX®

# TECHNICAL REFERENCE MANUAL

## Xerox Professional Computer

1984 Xerox Corporation.

610P72384

Reprint permission granted by Zilog, Inc. for Zilog Reprint on pages 49-108.

Reprint permission granted by Shugart Associates for SA 1403D Controller Reprint on pages 253-278.

Reprint permission granted by Western Digital for Western Digital Reprint on pages 279-302.

**WARNING:** This equipment has been certified to comply with the limits for a Class B computing device, pursuant to Subpart J of part 15 of FCC Rules. Only peripherals (computer input/output devices, terminals, printers, etc.) certified to comply with the Class B limits may be attached to this computer. Operating with non-certified peripherals is likely to result in interference to radio and TV reception.

**WARNING:** This equipment generates and uses radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Subpart J of part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

Reorient the receiving antenna.
Relocate the computer with respect to the receiver.
Move the computer away from the receiver.
Plug the computer into a different outlet so that computer and receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful. This booklet is available from the U.S. GOVERNMENT PRINTING OFFICE, WASHINGTON, D.C. 20402, STOCK NO. 004-000-00345-4.

"HOW TO IDENTIFY AND RESOLVE RADIO-TV PROBLEMS"

Xerox Corporation reserves the right to make improvements to products without incurring any obligation to incorporate such improvements in products previously sold.

THIS PAGE INTENTIONALLY BLANK.

# Table of Contents

## Introduction

### Introduction & Miscellaneous Information

## Hardware

### Miscellaneous Hardware Information

## Hardware continued

### Theory of Operation

### Schematics:

## Hardware continued

## Software

### Device Initialization

### Operating System Interface

## Software continued

## Peripherals

## Appendices

# Introduction

The purpose of this manual is to provide technical reference material for the Xerox 820-II and 16/8 Professional Computers for programmers and engineers involved in hardware, software, and interface design. It is also intended for interested persons who have a desire to know how the Xerox 820-II and 16/8 operate and how to access their many features.

A list of the abbreviations and naming conventions used in this manual can be found in Appendix N.

## SYSTEM OVERVIEW

The modular design of the 820-II and 16/8 systems enhance the flexibility provided by the operating systems. The combination of operations provided by the system gives it a flexibility that allows it to be tailored to the needs of each user.

## Appendices continued

## Overview of Xerox Personal Computers

Xerox Personal Computers are comprised of four components: display/processor, disk drives, keyboard, and optional printers. Both the 820-II and 16/8 use the CP/M®-80 2.2 Operating System from Digital Research, Inc. Additionally, the 16/8 PC includes CP/M-86® 1.1and MS™-DOS Version 2.0 as standard operating systems.

### HARDWARE DESCRIPTION

#### System Board

The system board uses a Zilog Z80-A®-based microprocessor operating on a 4 megahertz clock with 64k RAM and 8k ROM. It is a single-board computer and uses a daughter board to interface with the disk drives. The 820-II is equipped with three user-accessible I/O ports. Two of the ports are located on the back of the display/processor; the third is located on the CPU board. On the back are the printer and the communications ports (both RS232C). The port inside the display is a dual parallel port (most printers and other devices that follow a standard Centronics 36-pin interface can be successfully attached).

The 16/8 has all of the above features as well as an Intel 8086®-based microprocessor operating with a 4.772 megahertz clock. The 8086 is equipped with 128k of RAM which is expandable to 256k total by adding a 128k daughter board to the 8086 board.

The 820-II and 16/8 are capable of having up to 8k of read only memory (four 2k ROMs): the 820-II has 6k of this 8k occupied; the 16/8 uses the full 8K. The last 2k on the 16/8 is used for decoding the position-encoded Low Profile Keyboard. The firmware contained in the ROM is capable of doing such things as executing a one-sector loader from disk; i.e., loading CP/M, emulating a terminal, operating in typewriter mode, etc. The monitor also has other commands that are useful for debugging hardware and software. The mother board also contains a speaker as well as an expansion slot (used by the 16/8 for the 8086 board). There are two types of daughter boards: one interfaces the display/processor to floppy disks and the other interfaces the display/processor to a rigid disk controller.

### Display

The display/processor houses the video display, the CPU mother board, the disk drive daughter board, and the 8086 processor board if so configured. The video display is a standard 24 line by 80 characters. It uses a 7 x 10 dot matrix for each character in all text modes and displays white characters on a black screen. For graphics characters, it uses a 4 x 4 pixel resolution. The display attributes can be changed to display either in blink, highlight/lowlight, inverse, or graphics characters.

| | |
|---|---|
| 820-II Display/processor for floppy disks | Product Code #U03 |
| 820-II Display/processor for rigid disk | Product Code #U05 |
| 16/8 Display/processor for floppy disks | Product Code #H69 |
| 16/8 Display/processor for rigid disk | Product Code #H70 |

### Keyboards

The 820-II and 16/8 use either a standard 96-character ASCII or Low Profile keyboards. Both keyboards include additional keys to the right of the keyboard, a 10-key numeric key pad and a set of keys for software control of the cursor. The low profile keyboard also includes 12 function keys that can be software-enabled and other keys such as Accept, Delete, Next, Previous, Home, and Undo.

| | |
|---|---|
| ASCII Keyboard | Product Code #X928 |
| Low Profile Keyboard | Product Code #G25 |

### Disk Drives

Five disk drive options are offered for the 820-II:

| | |
|---|---|
| Dual 5¼" single-sided floppy disk drives | Product Code #X929 |
| Dual 5¼" double-sided floppy disk drives | Product Code #T66 |
| Dual 8" single-sided floppy disk drives | Product Code #X973 |
| Dual 8" double-sided floppy disk drives | Product Code #F10 |
| One 10mb rigid disk drive with an 8" double-sided disk drive | Product Code #U07 |

Three disk drive options are offered for the 16/8:

| | |
|---|---|
| Dual 8" single sided floppy disk drives | Product Code #X973 |
| Dual 8" double sided floppy disk drives | Product Code #F10 |
| One 10mb rigid disk drive with an 8" double sided disk drive | Product Code #U07 |

### Printers

40 CPS Printer and 20 CPS Printer
As their names imply, the printers have a printing speed of 20 and 40 characters per second (CPS) respectfully. Both printers have a wide range of print styles available. The 20 CPS Printer supports 10, 12, and 15 pitch as well as Proportional Spacing (PS), while the 40 CPS Printer supports either metal or plastic printwheels in 10, 12, 15, and PS. More detailed information on these printers can be found in the Printer section under Peripherals.

The standard RS232C printer connector and dual parallel port are available to·interface with many types of serial and parallel printers.

| | |
|---|---|
| 40 CPS Printer | Product Code # D80 |
| 20 CPS Printer | Product Code # U01 |

## FUNCTIONAL DESCRIPTION

The 820-II and 16/8 systems are a collection of four components working in unison -- the display, keyboard, disk drives, and printer. The computer itself is housed in the display.

### System Monitor - ROM

The system monitor contained within the 8k ROM controls the essential functions of initializing and controlling all system input/output resources, and also provides a number of monitor commands that can be used to assist in programming.

### Ports

Three ports are standard on the 820-II and 16/8: two serial ports located at the back of the display unit and an additional dual parallel port inside the display unit. These allow printers, communication devices, and other peripheral equipment to be interfaced with the system.

### Operating Systems

The 820-II uses Digital Research's 2.2 CP/M-80 Operating System. The 16/8 can use Digital Research's 2.2 CP/M Operating System, as well as their CP/M-86 1.1 Operating System and Microsoft's MS-DOS 2.0 Operating System. These operating systems provide the user with a general environment for program construction, storage, and editing, along with assembly and program checkout facilities.

CP/M-80 operating system software as implemented on the 820-II and the 16/8 is logically divided into four parts:

| | |
|---|---|
| ROSR | ROM Operating System Routines (hardware dependent) |
| BIOS | Basic I/O System (hardware dependent)* |
| BDOS | Basic Disk Operating System* |
| CCP | Console Command Processor* |

*Disk resident portions of CP/M-80

ROSR provides code in ROM that can be executed without the presence of the CP/M system disk and provides the primitive operations necessary to access the disk drives and to interface with peripherals.

BIOS provides the interface between BDOS and ROSR.

BDOS provides disk management by controlling one or more disk drives containing independent file directories.

CCP provides symbolic interface between the user's console and the remainder of the CP/M system.

## HARDWARE INTERFACE

The 820-II and 16/8 are equipped with six input/output connectors. Four are on the back of the display unit and two are inside the display.

### Disk Drive

Used for connection of either the 8" or the 5¼" Dual Floppy Drives, or the 8" Rigid Disk Drive. This is determined by the type of disk daughter board installed in the display processor.

### Keyboard

Used for connection of either the ASCII or Low Profile keyboard.

### Printer

A serial printer can be attached to this RS-232-C connector.

### COMM

COMM is a second RS-232-C connector and can be used for a modem.

**Parallel Port**
A dual parallel port inside the display cabinet is also provided.

**Expansion Slot**
The expansion slot inside the display cabinet provides all of the Z80-A microprocessor control signals for connection to custom devices for future expansion. This slot is used for the 8086 co-processor if you have a 16/8.

## CP/M-80

The CP/M-80 2.2-C disk for the 820-II contains the standard Digital Research software development and checkout programs. Xerox issues additional utility programs that are unique to the 820-II. A description of each program is listed below:

**Digital Research Files**

| | |
|---|---|
| ASM.COM | The Assembler allows you to create a program which can be read and executed by the 820-II. |
| DDT.COM | The Dynamic Debugging Tool is used to debug a Z80-A assembly language program. |
| DUMP.COM | Allows binary command files that are not displayed on screen to be displayed showing the hexadecimal value for each byte. |
| ED.COM | A line-oriented screen editor. |
| L80.COM | Reads an .REL file created with the Macro-80 Assembler Program and outputs a command file. |
| LOAD.COM | Reads a .HEX file and creates a command file. |
| M80.COM | Converts a program written in Assembly Language to a relocatable (.REL) file and (optionally) a printer listing file (.PRN). |
| MOVCPM.COM | Lets you modify and move the CP/M system image to allocate a specific lesser memory size. |
| PIP.COM | Allows you to selectively copy a file or files from one disk to another or on the same disk. |
| STAT.COM | The status utility is a frequently-used transient command for all system housekeeping; i.e., checking the amount of space available on a disk. |
| SUBMIT.COM | Used to submit a file of commands for batch processing. |

SYSGEN.COM — Used to generate a CP/M-80 system image and copy the operating system to another disk.

XSUB.COM — Same as Submit.com, but has the facility to include line input to programs as well as the console command processor.

**Xerox Files**

BACKUP.COM — A multi-option utility that allows you to archive and retrieve files, delete files, list directories of any drive, and to verify data integrity of a floppy or rigid disk.

CONFIGUR.COM — Using Configur.com, you can select seven different options:

1. Record Restart Command - lets you enter a one-line command which will automatically load a program. For example, you could enter DIR as the restart command and every time you boot the system, it will automatically display the directory for you. Or you could enter the name of your application software package and it would automatically load that application package for you. This command is recorded on the disk and you can have a different one for each disk.
2. Select Printer Port Options - allows you to determine printer protocol. This option allows configuration for alternate printers without modifying the BIOS.
3. Select Communications Port Options - a convenient method for setting up the communications port on the 820-II or 16/8; that is, baud rate, protocol, stop bits, etc.
4. Select I/O Device Assignments - lets you select alternative input/output device assignments; i.e., set up the system so that everything displayed on the screen automatically prints on the printer.
5. Select Keyboard Data Format - lets you choose 7-bit or 8-bit mode for the keyboard.
6. Select Screen Attributes - includes blink, inverse video, highlight/lowlight, and graphics modes.

7. If you have a floppy disk system, Select Floppy Disk Head Step Rate will appear as selection 7. If you have a rigid disk system, Configure Rigid Disk will appear (program must be loaded from floppy or the first partition of the rigid).
   a. Select Floppy Disk Head Step Rate - lets you adjust the floppy head step rave for optimum performance.
   b. Configure Rigid Disk - lets you divide the eight megabyte rigid disk into sections (e.g., 4 Mb, 2 Mb, 1 Mb, 1 Mb).

COPY.COM Makes an exact copy of a disk, track for track.

FMT.COM Allows you to format (initialize) a rigid disk. Verification of the rigid disk is performed using the Backup.com utility.

HELP.COM A guide for CP/M-80 users that contains basic information about CP/M-80 commands; also cross-references to additional information in the CP/M-80 reference manual, Reorder #9R80448.

INIT.COM Prepares new (or used) disks for storing information. It will also alert the user to any flawed sectors on the disk.

KILLESC.COM Turns off the <CTRL> + <ESC> feature to enable use of <CTRL> + <ESC> for other purposes; for example, setting margins and tabs on a 40 CPS printer uses a <CTRL> + <ESC> sequence.

SET.COM A convenient method to temporarily change communication and printer port options in RAM.

SWAP.COM A utility that allows the user to swap drive names. For example, "A" and "E" for a rigid disk drive. By designating an alternate drive as the "A" drive, you can load software directly from that drive. Many CP/M-80 application packages have been written to be executed from the "A" disk drive only. Using Swap.com allows you to place your application software on any disk drive and load.

TiME.COM Displays the time and date on screen. Since there is no battery backup, however, you must re-enter the time and date each time you reload the system.

WHATSA.COM This utility lists the logical and physical names for each disk drive, as well as the density, number of sides, and types of disks logged into the system, (e.g., double density, single-sided 8" floppy).

## CP/M-86

The CP/M-80 2.2 and CP/M-86 1.1-F disks for the 16/8 contain the standard Digital Research software development and checkout programs. These disks contain the same files as described in the CP/M-80 section as well as the following files.

**Digital Research Files**

ASM86.CMD — The Assembler allows you to create a program which can be read and executed by the 8086.

DDT86.CMD — The Dynamic Debugging Tool is used to debug a 8086 assembly language program.

ED.CMD — A line-oriented screen editor.

GENCMD.CMD — Uses the hex output of ASM-86 and other language processors to produce a .CMD file.

GENCMD.COM — Uses the hex output of ASM-86 and other language processors to produce a .COM file.

GENDEF.CMD — Reads a 16-bit file containing the disk definition statements, and produces a 16-bit output file containing assembly language statements which define the tables necessary to support a particular drive configuration.

GENDEF.COM — Reads a 16-bit file containing the disk definition statements, and produces an 8-bit output file containing assembly language statements which define the tables necessary to support a particular drive configuration.

HELP.CMD — Provides summarized information for all of the CP/M-86 commands described in the Digital Research Users manual.

LMCMD.CMD — Operates in exactly the same manner as Gencmd.cmd, except Lmcmd also accepts an Intel L-module file as input.

LMCMD.COM — Operates in exactly the same manner as Gencmd.com except Lmcmd also accepts an Intel L-module file as input.

PIP.CMD — Allows you to selectively copy a file or files from one disk to another or on the same disk.

| | |
|---|---|
| STAT.CMD | The status utility is a frequently-used transient command for all system housekeeping, i.e., checking the amount of space available on a disk. |
| SUBMIT.CMD | Used to submit a file of commands for batch processing. |
| TOD.CMD | Time of day. |

**Xerox Files**

| | |
|---|---|
| CPM86.COM | Used by Load86.com to boot the 8086. |
| 86CON.COM | Switches from Z80-A console to the 8086 console. |
| GOBACK.CMD | Switches from 8086 console to the Z80-A console. |
| LOAD86.COM | Loads the 8086 for concurrent processing. |
| REBOOT.COM | From the concurrent mode, reboots the system as a Z80-A standalone. |
| SOFTKEYS.COM | Used to set up the 10-key pad with programmable functions (<CTRL> + one of the 10-key pad keys). |

## MS-DOS

The MS-DOS 2.0 disk for the 16/8 contains the standard Microsoft software development and checkout programs.

**Microsoft Files**

| | |
|---|---|
| ANSI.SYS | Allows programs that use the standard ANSI driver to be executed. |
| COMMAND.COM | This is the MS-DOS command processor. It is recommended that this file be placed on every application program disk. |
| CONFIG.SYS | Configures system at boot. |
| CHKDSK.COM | Checks disk. |
| CREF.EXE | Assists in debugging assembly language programs. |
| DEBUG.COM | Debugger supplied with MS-DOS. |
| DISKCOPY.COM | Copies a disk. |
| EDLIN.COM | Line-oriented screen editor. |
| EXE2BIN.EXE | Converts .EXE files to binary format. |
| FC.EXE | Compares two files for similarity. |
| FIND.EXE | Finds a string in a list of files or standard input. |
| FORMAT.COM | Formats an 8" floppy or a rigid disk. |
| LINK.EXE | Linker. |
| MORE.COM | Used to display text in 23-line segments. |

| | |
|---|---|
| MASM.EXE | Macro Assembler for MS-DOS. |
| PRINT.COM | Print spooler. |
| RDCPM.COM | Reads a CP/M-80 file and converts data to MS-DOS-readable file. |
| RECOVER.COM | Recovers bad or damaged disks. |
| SORT.EXE | Used to sort text. |

**Xerox Files**

| | |
|---|---|
| SAMPLE.TXT | Provided to assist going through MS-DOS Handbook. |

## Notes

## Specifications

This section details the following specifications: dimensions, electrical requirements, operating environment, and disk drive capacities of the Xerox 820-II and 16/8 PCs.

## Dimensions

| Equipment | Height | Depth | Width | Weight |
|---|---|---|---|---|
| 820-II-16/8 Display | 12.20" | 14.75" | 15.00" | 30 lbs. |
| ASCII keyboard | 3.75" | 9.50" | 20.00" | 10 lbs. |
| Low profile keyboard | 1.60" | 8.25" | 19.90" | 5 lbs. |
| 5¼" Floppy disk drives | 7.00" | 10.20" | 7.00" | 10 lbs. |
| 8" Floppy disk drives | 10.50" | 17.50" | 14.50" | 48 lbs. |
| 8" Rigid disk drive | 10.50" | 17.50" | 15.50" | 54 lbs. |
| 40 CPS printer | 10.00" | 17.50" | 15.50" | 56 lbs. |
| 20 CPS printer | 9.25" | 17.50" | 24.00" | 45 lbs. |

## Electrical Requirements

All Xerox products listed below require voltage of 115 VAC, a frequency of 60 Hz, and a two-pole, three-wire grounded duplex receptical.

| Equipment | Current |
|---|---|
| 820-II-16/8 Display | 1.1 Amps |
| 8" Floppy disk drives | 2.0 Amps |
| 8" Rigid disk drive | 2.2 Amps |
| 40 CPS printer | 2.0 Amps |
| 20 CPS printer | 1.0 Amp |

## Operating Environment

All Xerox equipment is tested to perform between 50 and 90 degrees Fahrenheit with a relative humidity factor between 20% and 80%.

| Disk Drive Storage | Unformatted | Formatted | Usable |
|---|---|---|---|
| 5¼" SS/SD | 125 k | 90 k | 81 k |
| 5¼" SS/DD | 250 k | 168 k | 155 k |
| 5¼" DS/SD | 250 k | 180 k | 172 k |
| 5¼" DS/DD | 500 k | 338 k | 322 k |
| 8" SS/SD | 400 k | 250 k | 241 k |
| 8" SS/DD | 800 k | 497 k | 482 k |
| 8" DS/SD | 800 k | 500 k | 490 k |
| 8" DS/DD | 1.6 Mb | 997 k | 980 k |
| 8" Rigid (DS/DD) | 10.67 Mb | 8.4 Mb | 8.192 Mb |

| Disk Drive Format | | | Bytes | Number |
|---|---|---|---|---|
| | | | per | of |
| Equipment | Tracks | Sectors | Sector | Heads |
| 5¼" SS/SD | 40 | 18 | 128 | 1 |
| 5¼" SS/DD* | 40 | 17 | 256 | 1 |
| 5¼" DS/SD | 80 | 18 | 128 | 2 |
| 5¼" DS/DD* | 80 | 17 | 256 | 2 |
| 8" SS/SS | 77 | 26 | 128 | 1 |
| 8" SS/DD** | 77 | 26 | 256 | 1 |
| 8" DS/SD | 154 | 26 | 128 | 2 |
| 8" DS/DD** | 154 | 26 | 256 | 2 |
| 8" Rigid DS/DD | 1,024 | 32 | 256 | 4 |

*Track 0 of 5¼" double density disks has 18 sectors of 128 bytes.
**Track 0 of 8" double density disks has 26 sectors of 128 bytes.

For more specific information on disk formats, see the Disk Drive Specifications section.

## DISPLAY SPECIFICATION

| | | |
|---|---|---|
| SIZE: | 12 inch, landscape mode | |
| TYPE: | Aluminized | P4 |
| | Fluorescence | White (W) |
| | Phosphorescence | White (W) |
| | Persistence | Short |
| RESOLUTION: | ● 240 active line raster adjusted to 8.5 x 5.3 inch usable area<br>● Brightness level 30 ( ± 2) foot-lamberts<br>● Resolution at centers (within 1" diameter circle) -100 lines/inch minimum | |
| CHARACTER CELL: | 7x10 | |
| BUSINESS GRAPHICS: | 4x4 Pixel Resolution | |
| CHARACTER SET: | 4 sets of 128: | (1 U.S. font, 1 Graphics font) (1 U.S. font, Inverse Video font) |
| CHARACTER LINES: | 24 | |
| CHARACTERS/LINE: | 80 | |
| VOLTAGE: | + 12 ( ± 5.0%) VDC at 2.0 A DC maximum | |
| RIPPLE: | 50 MV P-P synchronous or nonsynchronous with refresh or power frequency. | |
| VIDEO BIT RATE: | 10.694 MBPS | (93.51 nanoseconds) |
| BITS/HORZ LINE: | 560 | |
| HORZ SYNC PULSE: | 126 | (11.78 microseconds) |
| TOTAL BITS/LINE: | 686 | |
| HORZ RATE: | 15.59 KHz | (64.14 microseconds) |
| LINES/FIELD: | 240 | |
| VERT BLANKING LINES: | 20 | |
| VERT SYNC PULSE: | 20(1.28 milliseconds) | |
| VERT RETRACE (lines): | 8 TYP | |
| TOTAL LINES/FIELD: | 260 | |
| FIELD RATE: | 59.95 Hz | (16.68 milliseconds) |
| REFRESH RATE: | 61 Hz | |
| VIDEO RATE: | 15 MHz | |

## FUNCTIONAL DESCRIPTION, XEROX DISPLAY

The display has the following functional characteristics:

- 24 line display
- 80 characters per line
- 7x10 dot matrix per character
- White characters on black
- Software-selectible character attributes
  - Inverse Video
  - Blink
  - Low Intensity
  - Graphics with 4 x 4 pixel resolution
- Brightness adjust

## DISPLAY CONTROLLER

The Display Controller is based on displaying characters within a 7x10 cell (7 dots horizontally by 10 scan lines vertically). To guarantee spaces between characters, one dot on each side of the cell is blanked by hardware. Also, to guarantee spaces between character lines, the top two scan lines are blanked by hardware. This gives an actual active character size of 5 dots horizontally by 8 scan lines vertically.

For Business Graphics, the hardware is configured to eliminate the automatic blanking and allow continuous lines both horizontally and vertically. However, the Display Controller is still based on displaying a character within a 7 x 10 cell. The controller design and available refresh memory allows one byte per character. The maximum number of unique characters that can be defined by any 8 bits is 256. Since the standard text font set contains 128 characters, the limit on unique characters for graphics that can be displayed together with text is 128.

The character set for Business Graphics divides the cell into blocks of 4 dots horizontally by 4 scan lines vertically. Since the total number of scan lines per character is 10, the character set actually consists of two sub-sets of 4-4-2 and 2-4-4.

Each subset divides the cell into 6 parts requiring 64 possible combinations or unique characters. Therefore, the total number of unique characters for the complete graphics set is 128. With this character set, any combination of adjacent 4 x 4 blocks can be chosen. Also, at the character cell boundary, the 4 x 4 blocks can be set vertically by 2 scan lines. Since the total number of horizontal dots per cell is 7, there will be an overlap of one horizontal dot in the center of the cell for diagonal blocks within the cell.

It should be also noted that for the standard text font containing 128 unique characters defined by 7 bits, the eighth bit is used to set the attribute function. For Business Graphics, since both text characters and graphic characters can be displayed simultaneously, it requires all 8 bits to define the character. Consequently, display attributes are not available in graphics mode.

## SYSTEM BUS EXPANSION SLOT

### ELECTRICAL

The DC system power available at the expansion slot is as follows:

| | | $5\frac{1}{4}$" system | 8" or Rigid system |
|---|---|---|---|
| PIN 50 | + 5V DC | 1.2A | 2.1 A |
| PIN 45 | + 12V DC #1 | 0.3A | 1.75 A |

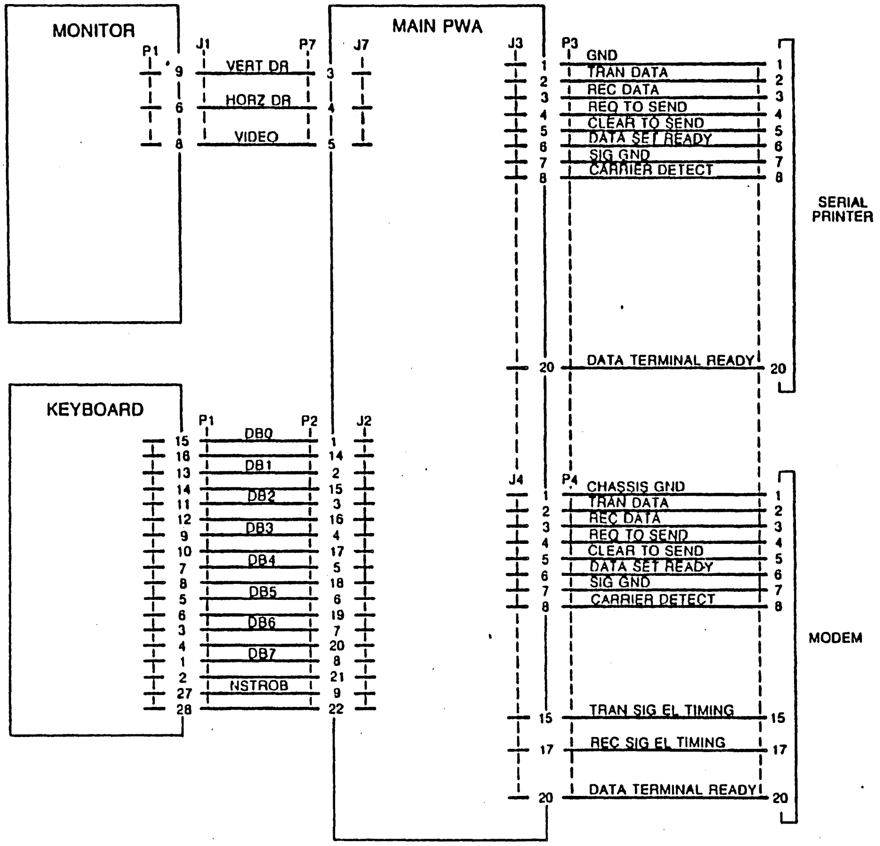
### ENVIRONMENTAL

The following temperature, humidity and altitude environmental requirements are specified:

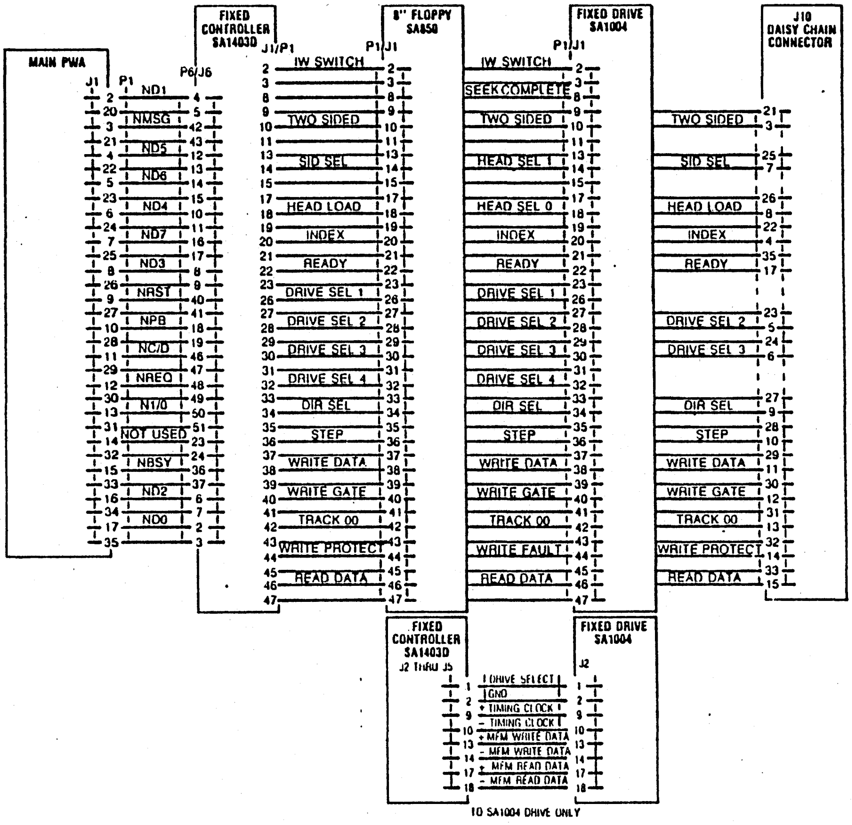
| | Temp. | Rel.Hum. | Altitude |
|---|---|---|---|
| | (°Celsius) | (%) | (miles) |
| Operating | 10 to 32 | 20 to 80 | 1830 |
| Non-operating | -77 to 66 | 15 to 90 | 7620 |

Any optional or additional electronic assembly using the expansion slot must be capable of performing to design specification when the host is subjected to the environmental range, above. Furthermore, the presence of such an assembly in the expansion slot must not degrade performance with regard to the above environmental requirements.

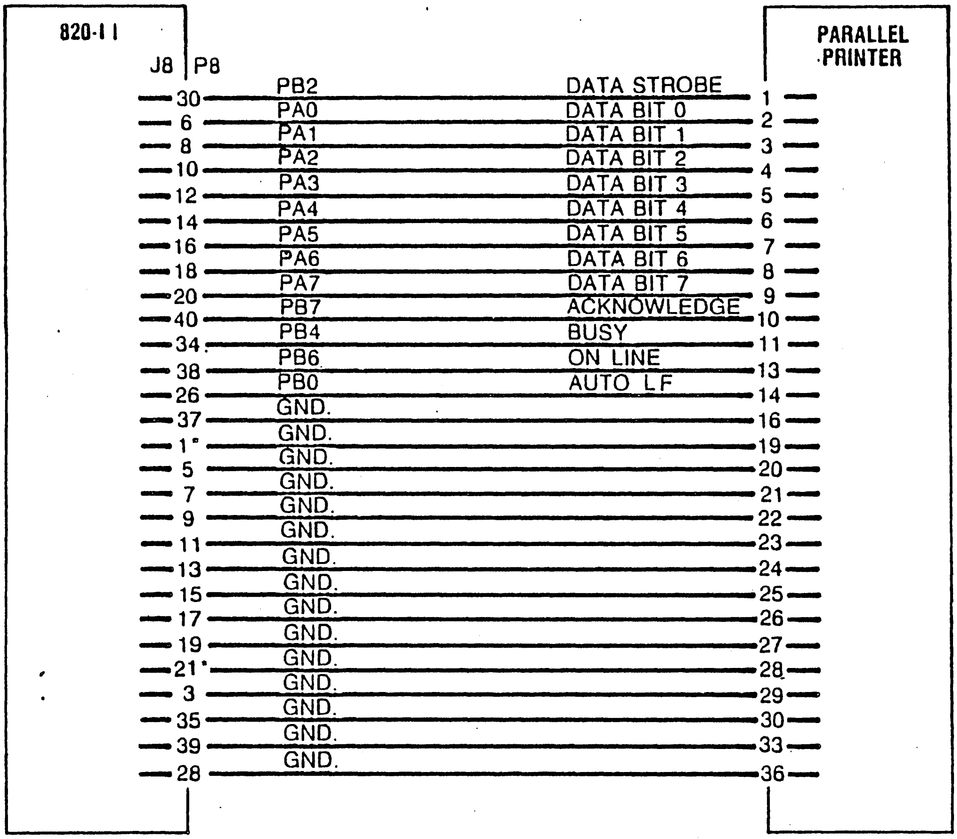
# HARDWARE INTERFACE



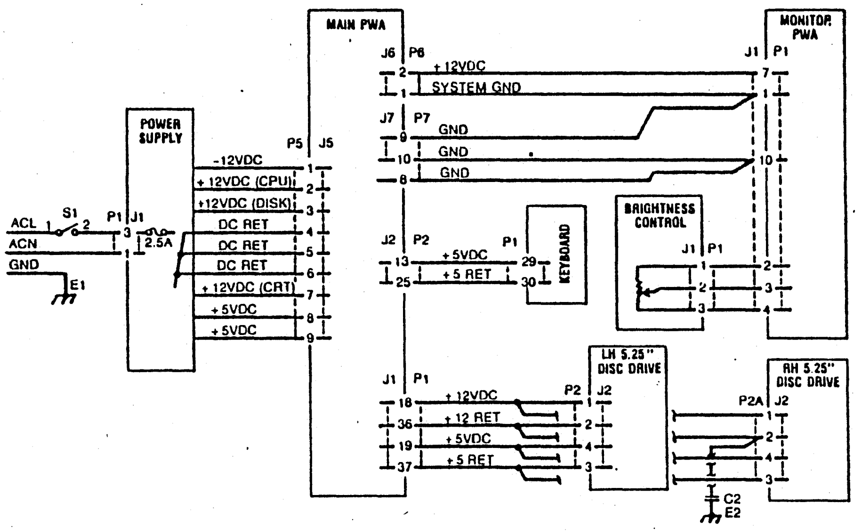
# J1 illustration



J8 illustration



## Power Supplies, and Video Connectors



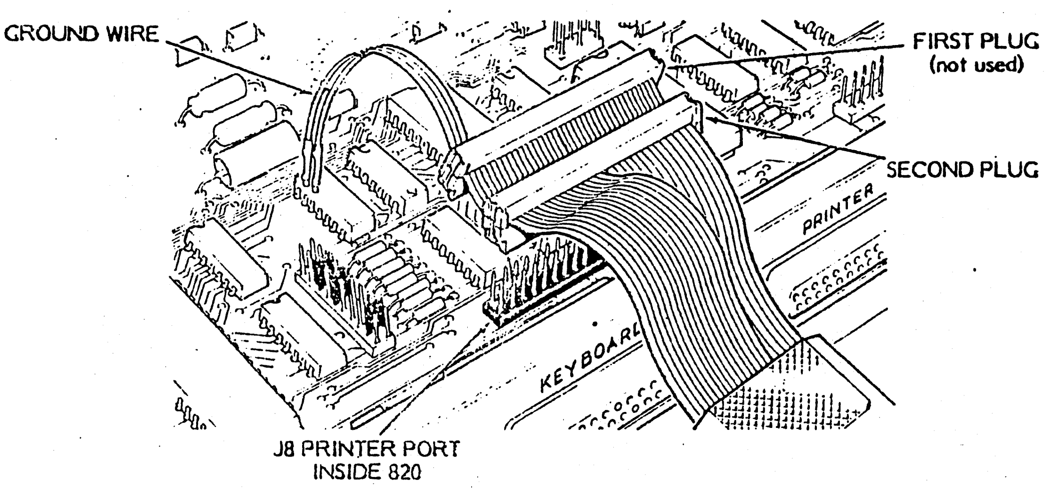
### Parallel Port Connector (J8)

```
39                                          1
      o o o o o o o o o o o o o o o o o o o o
      o o o o o o o o o o o o o o o o o o o o
40                                          2
```

J8

| Pin | Value |
|---:|---|
| 2 | Port A Strobe |
| 4 | Port A Ready |
| 6 | Port A Bit 0 |
| 8 | Port A Bit 1 |
| 10 | Port A Bit 2 |
| 12 | Port A Bit 3 |
| 14 | Port A Bit 4 |
| 16 | Port A Bit 5 |
| 18 | Port A Bit 6 |
| 20 | Port A Bit 7 |
| 22 | Port B Ready |
| 24 | Port B Strobe |
| 26 | Port B Bit 0 |
| 28 | Port B Bit 1 |
| 30 | Port B Bit 2 |
| 32 | Port B Bit 3 |
| 34 | Port B Bit 4 |
| 36 | Port B Bit 5 |
| 38 | Port B Bit 6 |
| 40 | Port B Bit 7 |
| Odd # Pins | Ground |

Parallel connector picture



## COMM Port Strapping Options

```
39                                          1
     o o o o o o o o o o o o o o o o o o o o
     o o o o o o o o o o o o o o o o o o o o
40                                          2
```

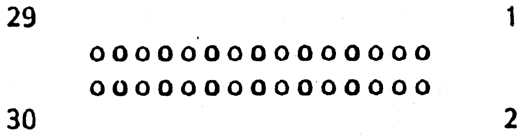
J9

| Pin | Value |
|---|---|
| 5--6 | (M) TXD to Pin 3 |
| **7--8** | (T) TXD to Pin 2 |
| 9--10 | (M) RXD from Pin 2 |
| **11--12** | (T) RXD from Pin 3 |
| 13--14 | (M) RTS to Pin 5 |
| **15--16** | (T) RTS to Pin 4 |
| 17--18 | (M) CTS from Pin 4 |
| **19--20** | (T) CTS from Pin 5 |
| 21--22 | (M) DTR to Pin 8 |
| **23--24** | (T) DTR to Pin 20 |
| 25--26 | (M) DCD from Pin 20 |
| **27--28** | (T) DCD from Pin 8 |
| 29--30 | Clock supplied to Modem as RX Clock |
| **31--32** | Clock supplied to SIO with RX Clock |
| 33--34 | Modem supplies SIO with RX Clock |
| **35--36** | Clock supplied to SIO with TX Clock |
| 37--38 | Modem supplies SIO with TX Clock |
| 39--40 | Clock supplied to Modem with TX Clock |

The filled-in pins indicate the options as they are jumpered on an 820-II or 16/8.

**Note:** (M) indicates modem (data communications equipment) function. (T) indicates terminal data equipment) function. For instance, exercising the (M) strap option will allow communication with a modem; exercising the (T) strap option will allow communication with a terminal.
The above shows factory settings for (T).

## J9 (Etch 2 CPU)



| Pin | Value |
|---|---|
| 3--4 | |
| 5--6 | (M) TXD to Pin 3 |
| **7--8** | (T) TXD to Pin 2 |
| 9--10 | (M) RXD from Pin 2 |
| **11--12** | (T) RXD from Pin 3 |
| 13--14 | (M) RTS to Pin 5 |
| **15--16** | (T) RTS to Pin 4 |
| 17--18 | (M) CTS from Pin 4 |
| **19--20** | (T) CTS from Pin 5 |
| 21--22 | (M) DTR to Pin 8 |
| **23--24** | (T) DTR to Pin 20 |
| 25--26 | (M) DCD from Pin 20 |
| **27--28** | (T) DCD from Pin 8 |
| 29--30 | Clock supplied to Modem as RX Clock |

The filled-in pins indicate the options as they are jumpered on an 820-II or 16/8.

Note: To change from ASYNC to SYNC on the Etch 2 CPU requires a modification to the operating system rather than moving jumpers.

**Note:** (M) indicates modem (data communications equipment) function. (T) indicates terminal data equipment) function. For instance, exercising the (M) strap option will allow communication with a modem; exercising the (T) strap option will allow communication with a terminal. The above shows factory settings for (T).

## System Bus Connector

J13

| | | | |
|---|---|---|---|
| D1 | 1 | 2 | /RD |
| D0 | 3 | 4 | /MEMRQ |
| D7 | 5 | 6 | /IORQ |
| D2 | 7 | 8 | /WR |
| D6 | 9 | 10 | /REFRESH |
| D5 | 11 | 12 | /M1 |
| D3 | 13 | 14 | A0 |
| D4 | 15 | 16 | A1 |
| SYSRESET | 17 | 18 | A2 |
| A4 | 19 | 20 | A3 |
| A6 | 21 | 22 | A5 |
| A15 | 23 | 24 | A7 |
| A13 | 25 | 26 | A14 |
| A12 | 27 | 28 | A10 |
| A9 | 29 | 30 | A11 |
| A8 | 31 | 32 | /BUSRQ |
| WAITRQ | 33 | 34 | /BUSAK |
| PCI | 35 | 36 | |
| /INTRQ | 37 | 38 | |
| /HALT | 39 | 40 | /CLOCK |
| SPKR | 41 | 42 | /MEM8 |
| | 43 | 44 | /MEM4 |
| + 12V | 45 | 46 | |
| + 12V | 47 | 48 | GND |
| GND | 49 | 50 | + 5V |

| Symbol | Pin # | Pin Name | Meaning |
|---|---|---|---|
| D0 | 3 | Data bus | Data Bus (Tri-state, input/output, active high) constitutes an 8-bit bi-directional data exchange with memory and I/O devices. |
| D1 | 1 | Data bus | |
| D2 | 7 | Data bus | |
| D3 | 13 | Data bus | |
| D4 | 15 | Data bus | |
| D5 | 11 | Data bus | |
| D6 | 9 | Data bus | |
| D7 | 5 | Data bus | |
| A0 | 14 | Address bus | Address Bus (Tri-state, output, active high) makes up a 16-bit address for up to 65k bytes of memory for I/O devices data exchange. I/O addressing uses the lower 8 bits for direct selection of up to 256 output ports. A0 is the least significant address bit. During refresh time, the lower 7 bits contain a valid refresh address for dynamic memories. |
| A1 | 16 | Address bus | |
| A2 | 18 | Address bus | |
| A3 | 20 | Address bus | |
| A4 | 19 | Address bus | |
| A5 | 22 | Address bus | |
| A6 | 21 | Address bus | |
| A7 | 24 | Address bus | |
| A8 | 31 | Address bus | |
| A9 | 29 | Address bus | |
| A10 | 28 | Address bus | |
| A11 | 30 | Address bus | |
| A12 | 27 | Address bus | |
| A13 | 25 | Address bus | |
| A14 | 26 | Address bus | |
| A15 | 23 | Address bus | |
| /WR | 8 | Write | Write (Tri-state, output, active low) indicates that the CPU data bus holds valid data to be stored in the addressed memory or I/O device. |
| /RD | 2 | Read | Read (Tri-state, output, active high) indicates that the CPU wants to read data from memory or an I/O device. The addressed I/O device or memory should use this signal to gate data onto the CPU data bus. |
| /IORQ | 6 | I/O Request | Input/Output Request (Tri-state, output, active low) signal indicates that the lower half of |

| | | | |
|---|---|---|---|
| | | | the address bus holds a valid I/O address for an I/O read or write operation. This signal is also generated with a "/M1" signal when an interrupt is being acknowledged to indicate that an interrupt response vector can be placed on the data bus. Interrupt Acknowledge operations occur during "/M1" time, while I/O operations never occur during "/M1" time. |
| /HALT | 39 | Halt | Halt (Output, active low) signal indicates that the CPU has executed a Halt Software instruction and is awaiting either a non-maskable or maskable interrupt before operation can resume. |
| /MEMRQ | 4 | Memory Request | Memory Request (Tri-state, output, active low) signal indicates that the address bus holds a valid address for a memory read or memory write operation. |
| /REFRESH | 10 | Refresh | Refresh (Tri-state, output, active low) indicates that the lower 7 bits of the address contain a refresh address for dynamic memories and the "/MEMRQ" signal should be used to perform a refresh cycle for all dynamic RAMs in the system. During the refresh cycle "A7" is a logic zero and the upper 8 bits of the address bus contain the "I" register. |
| /M1 | 12 | Machine Cycle One | Machine Cycle One (Tri-state, output, active low) indicates that the current machine cycle is in the op-code fetch cycle of an instruction. Note |

|  |  |  |  |
|---|---|---|---|
|  |  |  | that during the execution of two-byte op-codes, "/M1" will be generated as each op-code is fetched. These two-byte op-codes always begin with a CB, DD, ED, or FD. "/M1" also occurs with "/IORQ" to indicate an interrupt acknowledge cycle. |
| /BUSAK | 34 | Bus Acknowledge | Bus Acknowledge (Output, active low) is used to indicate to the requesting device that the CPU address bus, data bus, and control bus signals have been set to their high impedance states and the external device can now control the bus. |
| /BUSRQ | 32 | Bus Request | Bus Request (Input, active low) signal is used to request the CPU address bus, data bus, and control signal bus to go to a high impedance state so that other devices can control those buses. When "/BUSRQ" is activated, the CPU will set these buses to a high impedance state as soon as the current CPU machine cycle is finished and the "/BUSAK" signal is activated. |
| /INTRQ | 37 | Interrupt Request | Interrupt Request (Input, active low) signal is generated by I/O devices. A request will be honored at the end of the current instruction if the internal software controlled interrupt enable flip flop (IFF) is enabled and if the "/BUSRQ" signal is not active. |
| /WAITRQ | 33 | Wait Request | Wait Request (Input, active low) indicates to the CPU that the addressed memory or I/O device is not ready for a data transfer. The CPU continues to enter wait states |

| | | | |
|---|---|---|---|
| | | | for as long as this signal is active. This signal allows memory or I/O devices of any speed to be synchronized to the CPU. Use of this signal postpones refresh as long as it is held active. |
| /SYSREST | 17 | System Reset | System Reset (Output, active low) indicates that a reset has been generated either from push button reset or the power on reset circuit. The system reset will occur only once per reset and will be approximately 10 microseconds in duration. |
| /CLOCK | 40 | Processor Clock | Processor Clock (Output, active low) is a single-phase system clock of 4 MHz. |
| PCI | 35 | Priority Chain In | Priority Chain In (Input, active high) is used to form a priority-interrupt daisy chain when more than one interrupt-driven device is being used. A high level on this pin indicates that no other devices of higher priority are being serviced by a CPU interrupt service routine. |
| /MEM4 | 44 | Memory Expansion | Memory Expansion (Output, active low) signal is low during "/MEMRQ" for a block of addresses from "4000 thru 7FFF" if the Bank Switch is set for the ROM side of memory. |
| /MEM8 | 42 | Memory Expansion | Memory Expansion (Output, active low) signal is low during "/MEMRQ" for a block of addresses from "8000 thru BFFF" if the Bank Switch is set for the ROM side of memory. |
| /SPKR | 41 | Speaker | Speaker pin provides access to the speaker on the CPU Board. This pin is connected to the open collector output of the speaker |

| | | | |
|---|---|---|---|
| | | | driver (75451). This output is normally connected thru the speaker and parallel 100 ohm resistor to a + 12 VDC, but can be disconnected by jumper option. |
| + 5VDC | 50 | DC Power | + 5VDC system power. |
| GND | 49,48 | Ground | Ground-System is signal ground and DC return. |
| + 12VDC | 47,45 | DC Power | + 12VDC system power. |
| | 36 | Not Used | |
| | 38 | Not Used | |
| | 43 | Not Used | |
| | 46 | Not Used | |

## Disk Access Connector

### J12

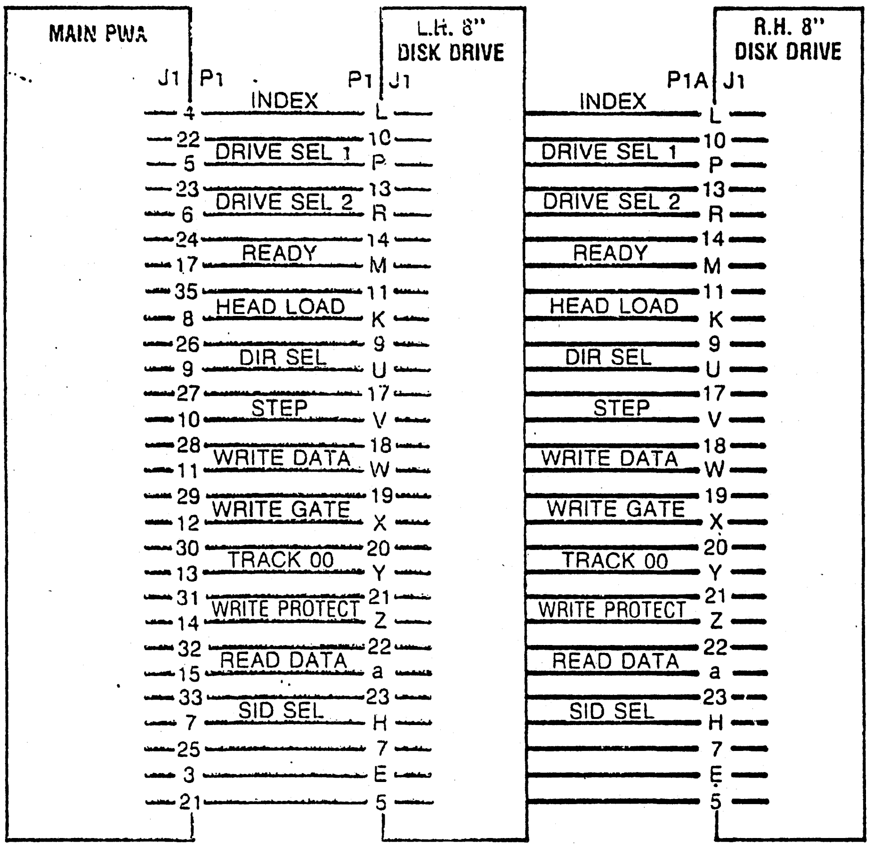
| | | | |
|---|---|---|---|
| D1 | 1 | 2 | /RD |
| D0 | 3 | 4 | /MREQ |
| D7 | 5 | 6 | /IORQ |
| D2 | 7 | 8 | /WR |
| D6 | 9 | 10 | /BUSAK |
| D5 | 11 | 12 | /M1 |
| D3 | 13 | 14 | A0 |
| D4 | 15 | 16 | A1 |
| RST | 17 | 18 | A2 |
| A4 | 19 | 20 | A3 |
| A6 | 21 | 22 | A5 |
| A15 | 23 | 24 | A7 |
| A13 | 25 | 26 | A14 |
| A12 | 27 | 28 | A10 |
| A9 | 29 | 30 | A11 |
| A8 | 31 | 32 | /BUSRQ |
| 16 MHz Clock | 33 | 34 | /BUSAK1 |
| /HALT | 35 | 36 | /1797CS |
| INT | 37 | 38 | PRIO |
| PP5 | 39 | 40 | 4 MHz Clock |
| PP2 | 41 | 42 | PP4 |
| PP1 | 43 | 44 | PP0 |
| + 12V | 45 | 46 | NM1 |
| GND | 47 | 48 | GND |
| DSKWAT | 49 | 50 | + 5V |
| | 51 | 52 | + 5V |
| J1-19 | 53 | 54 | J1-10 |
| J1-18 | 55 | 56 | J1-9 |
| J1-17 | 57 | 58 | J1-8 |
| J1-16 | 59 | 60 | J1-2 |
| J1-15 | 61 | 62 | J1-3 |
| J1-14 | 63 | 64 | J1-4 |
| J1-13 | 65 | 66 | J1-5 |
| J1-12 | 67 | 68 | J1-6 |
| J1-11 | 69 | 70 | J1-7 |
| | 71 | 72 | |

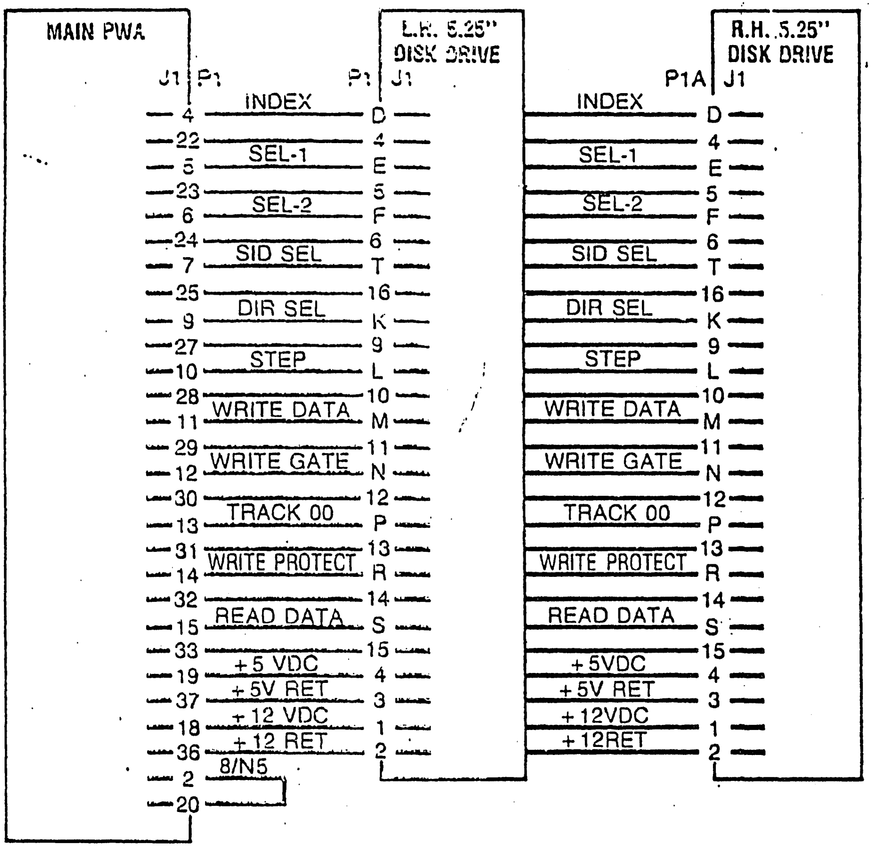
|  | Pin | Pin |  |
|---|---|---|---|
| Symbol | # | Name | Meaning |
| D0 | 3 | Data bus | Data Bus (Tri-state, input/output, |
| D1 | 1 | Data bus | active high) constitutes an 8-bit |
| D2 | 7 | Data bus | bi-directional data exchange with |
| D3 | 13 | Data bus | memory and I/O devices. |
| D4 | 15 | Data bus |  |
| D5 | 11 | Data bus |  |
| D6 | 9 | Data bus |  |
| D7 | 5 | Data bus |  |
| A0 | 14 | Address Bus | Address bus A0-A15 |
| A1 | 16 | Address Bus | provides addresses for 65k |
| A2 | 18 | Address Bus | bytes of memory. Bit A0 and |
| A3 | 20 | Address Bus | A1 while under /RD and /WR |
| A4 | 19 | Address Bus | control select the register |
| A5 | 22 | Address Bus | to receive transfer of data |
| A6 | 21 | Address Bus | on D0-D7: |
| A7 | 24 | Address Bus | A1 A0 /RD /WR |
| A8 | 31 | Address Bus | 0 0 Status REG Command REG |
| A9 | 29 | Address Bus | 0 1 Track REG Track REG |
| 2A10 | 8 | Address Bus | 1 0 Sector REG Sector REG |
| A11 | 30 | Address Bus | 1 1 Data REG Data REG |
| 2A12 | 7 | Address Bus | A5 while under /RD and /WR |
| A13 | 25 | Address Bus | Control Select Density: |
| A14 | 26 | Address Bus | 0 = double density |
| A15 | 23 | Address Bus | 1 = single density |
| PP0 | 44 | SYS-PIO Port A | Port A bit 0 |
| PP1 | 43 | SYS-PIO Port A | Port A bit 1 |
| PP2 | 41 | SYS-PIO Port A | Port A bit 2 |
| PP4 | 42 | SYS-PIO Port A | Port A bit 4 |
| PP5 | 39 | SYS-PIO Port A | Port A bit 5 |
| PRIO | 38 | SYS-PIO |  |
| /DSKWAT | 49 | Disk Wait | Generates Wait signal to CPU. |
| /RD | 2 | Read | Controls input on the data registers D0-D7. |
| /MREQ | 4 | Memory Request | /MREQ indicates that the address bus holds a valid address for a memory read or memory write operation. |

| | | | |
|---|---|---|---|
| /IORQ | 6 | I/O Request | /IORQ indicates that the lower half of the address bus holds a valid I/O address for an I/O read or write operation. /IORQ is also generated concurrently with /M1 during an interrupt acknowledge cycle to indicate that an interrupt response vector can be placed on the data bus. |
| /WR | 8 | Write | Controls output on the data registers D0-D7. |
| /BUSACK | 10 | Bus Acknowledge | /BUSACk indicates to the requesting device that the CPU address bus, data bus, and control signals /MREQ, /IORQ, /RD, /WR have entered the high impedance states. The external circuitry can now control these lines. |
| /M1 | 12 | Machine Cycle 1 | /M1, together with /MREQ indicates that the current machine cycle is the op-code fetch cycle of an instruction execution. /M1, together with /IORQ, indicates an interrupt acknowledge cycle. |
| /BUSREQ | 32 | Bus Request | /BUSREQ has the highest priority and is always recognized at the end of the current machine cycle. /BUSREQ forces the CPU address bus, data bus, and control signals /MREQ, /IORQ, /RD, and /WR to go to a high impedance state so that other devices can control these lines. |
| /BUSAK1 | 34 | Bus Acknowledge | /BUSAK1 is daisy-chained Bus Acknowledge output which indicates to the requesting device that the CPU address bus, data bus, and control signals /MREQ, /IORQ, /RD, /WR have entered the high impedance states. The |

| | | | |
|---|---|---|---|
| | | | external circuitry can now control these lines. |
| /1797CS | 36 | Chip Select | /1797CS logic low selects the Floppy Disk Controller chip and enables computer communication with the device. |
| INT | 37 | Interrupt Request | INT is generated by I/O devices. The CPU honors a request at the end of the current instruction if the internal software controlled interrupt enable flip-flop (IFF) is enabled. |
| NMI | 46 | Non-Maskable Interrupt | NMI is always recognized at the end of the current instruction, independent of the status of the interrupt enable flip-flop and automatically forces the CPU to restart at location 0066h. |
| /HALT | 35 | Halt | /HALT indicates that the CPU has executed a Halt instruction and is awaiting either a non-maskable or a maskable interrupt (with the mask enabled) before operation can resume. While halted, the CPU executes NOPs to maintain memory refresh. |
| 16MHz | 33 | Clock | 16 MHz clock. |
| CLK | 40 | Clock | 4 MHz clock. |
| J1-2 | 60 | Device I/O Interface | All interface lines use negative logic. |
| J1-3 | 62 | Device I/O Interface | |
| J1-4 | 64 | Device I/O Interface | |
| J1-5 | 66 | Device I/O Interface | |
| J1-6 | 68 | Device I/O Interface | |
| J1-7 | 70 | Device I/O Interface | |
| J1-8 | 58 | Device I/O Interface | |
| J1-9 | 56 | Device I/O Interface | |
| J1-10 | 54 | Device I/O Interface | |
| J1-11 | 69 | Device I/O Interface | |
| J1-12 | 67 | Device I/O Interface | |
| J1-13 | 65 | Device I/O Interface | |
| J1-14 | 63 | Device I/O Interface | |

| | | | |
|---|---|---|---|
| J1-15 | 61 | Device I/O Interface | |
| J1-16 | 59 | Device I/O Interface | |
| J1-17 | 57 | Device I/O Interface | |
| J1-18 | 55 | Device I/O Interface | |
| J1-19 | 53 | Device I/O Interface | |
| + 12VDC | 45 | DC Voltage | + 12 Volts DC |
| GND | 47 | Ground | Ground and DC Return |
| GND | 48 | Ground | Ground and DC Return |
| + 5VDC | 50 | DC Voltage | + 5 Volts DC |
| + 5VDC | 52 | DC Voltage | + 5 Volts DC |
| RST | 17 | Reset | Reset indicates that a System Reset has been generated either from push button reset or power on reset. |
| | 51 | Not Used | |
| | 71 | Not Used | |
| | 72 | Not Used | |


MAIN PWA
L.H. 8" DISK DRIVE
R.H. 8" DISK DRIVE
J1
P1
P1
J1
P1A
J1
4 INDEX L
22 10
5 DRIVE SEL 1 P
23 13
6 DRIVE SEL 2 R
24 14
17 READY M
35 11
8 HEAD LOAD K
26 9
9 DIR SEL U
27 17
10 STEP V
28 18
11 WRITE DATA W
29 19
12 WRITE GATE X
30 20
13 TRACK 00 Y
31 21
14 WRITE PROTECT Z
32 22
15 READ DATA a
33 23
7 SID SEL H
25 7
3 E
21 5
INDEX L
10
DRIVE SEL 1 P
13
DRIVE SEL 2 R
14
READY M
11
HEAD LOAD K
9
DIR SEL U
17
STEP V
18
WRITE DATA W
19
WRITE GATE X
20
TRACK 00 Y
21
WRITE PROTECT Z
22
READ DATA a
23
SID SEL H
7
E
5


MAIN PWA
J1
P1
L.H. 5.25" DISK DRIVE
P1
J1
R.H. 5.25" DISK DRIVE
P1A
J1
4
22
5
23
6
24
7
25
9
27
10
28
11
29
12
30
13
31
14
32
15
33
19
37
18
36
2
20
INDEX
SEL-1
SEL-2
SID SEL
DIR SEL
STEP
WRITE DATA
WRITE GATE
TRACK 00
WRITE PROTECT
READ DATA
+5 VDC
+5V RET
+12 VDC
+12 RET
8/N5
D
4
E
5
F
6
T
16
K
9
L
10
M
11
N
12
P
13
R
14
S
15
4
3
1
2

## Notes

## Theory of Operation

The display processor houses the system board, disk drive daughter board, the CRT, the power supply, and one bus expansion slot.

The system board has the following:

- Central Processing Unit (CPU)
- 6 to 8k of Read Only Memory (ROM)
- 64k of Random Access (Read/Write) Memory (RAM)
- Counter Timer Circuit (CTC)
- Serial Input/Output Controller (SIO)
- Parallel Input/Output Controller (PIO)
- Two RS-232-C Serial I/O Ports
- Dual 8-bit Parallel Ports
- CRT Controller and CRT Refresh Memory
- Speaker
- Disk Drive Daughter Board Connector
- Bus Expansion Connector
  - 8086 Co-processor (16/8 system)
- Parallel Keyboard Interface

### CPU

The CPU is a Zilog Z80-A operating with a clock rate of 4 Mhz. It is initialized to use Interrupt Mode 2 by the ROSR monitor at power on. The Z80-A also provides refresh to the 64k of dynamic memory on the system board. Therefore, the I and R registers should not be altered by an application program.

### ROM and RAM Memory

The System Board has two banks of memory. Bank 1 has 64k of RAM. Bank 0 has up to 8K of ROM.

When power is turned on or RESET is pressed, the Monitor, ROM/CRT RAM (Bank 0), is enabled by the hardware and the contents of the monitor ROM are moved by the CPU to the program memory starting at location F000H. When the move is complete, the CPU transfers control to location F000H and RAM (Bank 1) is enabled. Bank 0 is also enabled when a character is sent to the screen.

### 6-8k ROM

The CPU board has provisions for 4-2k x 8 Read Only Memory devices. The first 3 (U33, U34 & U35) store the firmware for the ROSR monitor. The fourth (U36) provides translation tables and related firmware for the position-encoded low profile keyboard.

### 64k RAM

The 64k byte (65536 x 8) RAM provides space for a portion of the ROSR monitor (upper 4k F000h - FFFFh), and 60k (0000h - EFFFh) is free for programs to execute in such as an operating system and an application program. This RAM is dynamic and refresh is provided by the Z80-A CPU.

### Counter Timer Circuit (CTC)

The CTC has four independently-programmable counter/timer channels, each with a readable downcounter and a selectable 16 or 256 prescaler. Downcounters are reloaded automatically at zero. Each channel is programmed with two bytes. Once started, the CTC counts down, reloads its time constant automatically, and resumes counting. Internally, the CTC generates a unique vector for each channel.

### Serial Input/Output Controller (SIO)

The Serial I/O Controller has two independent, full-duplex channels with separate control and status lines for modems or other devices. Data rates are from 50 to 19,200 bits/second. Channel A (modem) supports both Asynchronous and Synchronous protocols. Channel B (printer) is dedicated to Asynchronous. The receiver is quadruple-buffered and the transmitter is double-buffered. The controller also supports daisy-chain interrupt vectoring for interrupts without external logic.

### Serial I/O Ports

The 820-II CPU board contains a Z80-A SIO that provides two user-accessible serial ports to the 25-pin printer and modem connectors on the rear of the display processor. The Communications port is capable of operating in synchronous or asynschronous modes, while the Printer port is only capable of operating asynchronously. On an Etch 2 CPU, there is a 30-pin connector. Selection of synchronous or asynchronous mode is under program control as opposed to the Etch 1 CPU (with a 40-pin connector) where a physical change is required to make the sync or async selection.

### Parallel Input/Output Controller (PIO)

There is a System and a General Purpose Parallel I/O Controller which provides direct interface between the CPU and the peripheral devices. Each controller has two 8-bit I/O ports. The System PIO is dedicated for keyboard input, memory bank and CRT font selection, and floppy disk drive and side selection. The General Purpose PIO provides the user with a dual 8-bit parallel I/O port for interfacing with peripherals.

### Parallel Port

The Z80-A General Purpose PIO is accessible on the main CPU board on connector J8. This PIO is programmed by the ROSR monitor at power-on to provide a parallel Centronics-compatible interface for a parallel printer. A transceiver is physically located between the Z80-A PIO and the J8 connector. Jumpers must be installed on option connector J11 to select whether the transceiver will transmit or receive data. See also page 24.

### CRT Controller

The CPU board contains the 2k of refresh RAM where the characters that are to be displayed on the screen are stored. It also has the necessary electronics to provide the control signals (sync and video) to the CRT monitor. The CPU board has two character font ROMs; each font ROM contains two character sets.

| | |
|---|---|
| **U57** | Normal white on black font |
| | Reverse video font |
| **U58** | Normal white on black font |
| | Graphic character font |

The CRT driver in the ROSR monitor translates character-level escape sequences into commands as to which of the font ROMs to select and which of the two fonts inside the selected font ROM to select. Basically, characters that are stored in the CRT's refresh memory address the selected font ROM; the font ROM provides dot information to the video input of the CRT so the character can be displayed.

The characters on the CRT can have one of the following attributes:

Blink
Inverse video
Graphics
Low intensity

The most significant bit of the character stored in the CRT's refresh memory determines if the character is to be displayed with its attribute enabled.

The ROSR monitor provides a character-oriented command format for controlling the screen and font ROM selection. It is recommended that programs use this method to control the CRT and its attributes.

## CRT RAM

### Memory Allocation

The CRT RAM occupies 3000H - 3FFFH in bank 0 (System Bank). Each 80-character line on the CRT is allocated 128 bytes in the CRT RAM. Listed below are the starting and ending addresses for each of the 24 rows in the CRT RAM. The example (at the bottom) shows some character locations in CRT memory. (Assumes scroll register = 23)

| Row | Starting Address | Ending Address |
|---|---|---|
| 0 | 3000H | 304FH |
| 1 | 3080H | 30CFH |
| 2 | 3100H | 314FH |
| 3 | 3180H | 31CFH |
| 4 | 3200H | 324FH |
| 5 | 3280H | 32CFH |
| 6 | 3300H | 334FH |
| 7 | 3380H | 33CFH |
| 8 | 3400H | 344FH |
| 9 | 3480H | 34CFH |
| 10 | 3500H | 354FH |
| 11 | 3580H | 35CFH |
| 12 | 3600H | 364FH |
| 13 | 3680H | 36CFH |
| 14 | 3700H | 374FH |
| 15 | 3780H | 37CFH |
| 16 | 3800H | 384FH |
| 17 | 3880H | 38CFH |
| 18 | 3900H | 394FH |
| 19 | 3980H | 39CFH |
| 20 | 3A00H | 3A4FH |
| 21 | 3A80H | 3ACFH |
| 22 | 3B00H | 3B4FH |
| 23 | 3B80H | 3BCFH |

| Row | Column | CRT Memory Address |
|---|---|---|
| 0 | 0 | 3000H |
| 0 | 79 | 304FH |
| 1 | 1 | 3081H |
| 1 | 5 | 3085H |
| 23 | 0 | 3B80H |
| 23 | 1 | 3B81H |
| 23 | 79 | 3BCFH |

### Scroll Register

To eliminate the delay associated with software scrolling, hardware scrolling is employed. Writing into the scroll register (Port 14h) adds an offset to the line address developed by the line counter. For instance, with an offset of zero (scroll register = 0), the data at location 3000H (in the CRT refresh memory) will be displayed on the bottom row of the display. If the offset is 23, the data at location 3000H will be displayed on the top row of the screen. The scroll register is loaded from A8 to A15 rather than D0 to D7. Therefore, the scroll value must be in the B register if an indirect OUT instruction is used.

| Scroll Register | Row 0, Column 0 | Row 23, Column 0 |
|---|---|---|
| 23 | 3000H | 3B80H |
| 22 | 3080H | 3B00H |
| 21 | 3100H | 3A80H |
| 20 | 3180H | 3A00H |
| 19 | 3200H | 3980H |
| 18 | 3280H | 3900H |
| 17 | 3300H | 3880H |
| 16 | 3380H | 3800H |
| 15 | 3400H | 3780H |
| 14 | 3480H | 3700H |
| 13 | 3500H | 3680H |
| 12 | 3580H | 3600H |
| 11 | 3600H | 3580H |
| 10 | 3680H | 3500H |
| 9 | 3700H | 3480H |
| 8 | 3780H | 3400H |
| 7 | 3800H | 3380H |
| 6 | 3880H | 3300H |
| 5 | 3900H | 3280H |
| 4 | 3980H | 3200H |
| 3 | 3A00H | 3180H |
| 2 | 3A80H | 3100H |
| 1 | 3B00H | 3080H |
| 0 | 3B80H | 3000H |

## Speaker

The 820-II and 16/8 have an audio speaker connected to two I/O ports (28h and 29h). Outputting to one I/O port causes the speaker cone to be pushed out; outputting to the other I/O port pulls in the speaker cone. The actual value output to these ports has no significance. To generate a beep, the application program can simply send an ASCII Bell character to the CRT. To generate a tone other than the standard bell character, the program must move the speaker cone in and out at the desired frequency.

## Disk Drive Daughter Board

The disk drive connector on the rear is a "dual personality" connector, depending on which disk drive daughter board is installed on the mother board. Presently, there are two types of disk interface:

> Shugart SASI interface controller suitable for interfacing to a SA1403D Rigid Disk Controller.
>
> Floppy-only interface suitable for interfacing to Shugart SA800/SA400L/SA850/SA450 dual daisy-chained disk configurations.

The ROSR monitor detects which daughter board is installed at power-on and selects the appropriate physical disk driver firmware to process physical disk drive requests.

### Caution:

If a rigid disk drive unit (U07, U08) is connected to a floppy display/processor (U03/H69, U04), the rigid controller PWB will be destroyed when power is switched on. The rigid disk drive unit must be connected only to a rigid display/processor (U05/H70, U06). Connecting a floppy disk drive unit (929/T66/973/F10, E41/E44/E42/E89) to a rigid display/processor (U05/H70, U06) may cause the processor PWB to fail. Before connecting any disk drive unit to a display/processor, check that the configuration of the display/processor is compatible with the disk drive unit. The configuration can be determined in one of two ways. (1) Check the product code of the display/processor. The product code is the first three digits of the serial number, located on the underside of the display processor. (2) Verify that the proper drive interface PWB is installed by checking the part number.

### System Bus

The System Bus contains an 8-bit Data Bus (Tri-state, Input/Output) bi-directional Data exchange with memory and I/O devices. It has a 16-bit Address Bus to address up to 64k of memory for I/O devices data exchange.

### Keyboard Interface

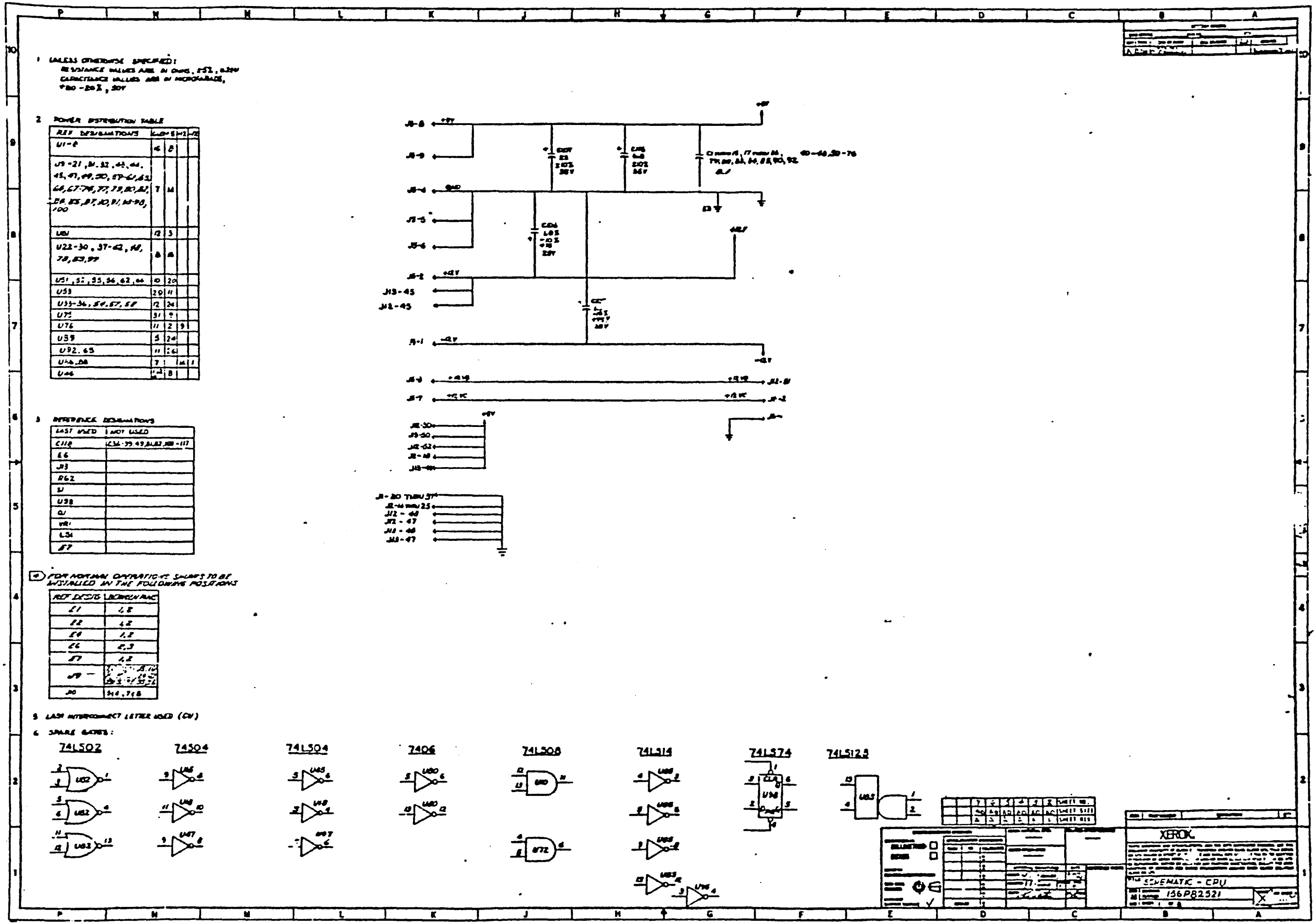
The keyboard FIFO (Etch 2 CPU only) has space for 16 (decimal) entries. Associated with the keyboard FIFO are input and output position pointers and a count of the number of entries currently in the FIFO.

The available memory pointers provide the addresses bounding the available unused RAM in the memory reserved for system use. Although these pointers are a supported feature, there is no guaranteed available memory size.

There are two tables used to disk map a logical disk to its physical driver. The first table, Seltab, associates a logical disk number with a physical disk number. The second table, Drvtab, identifies which physical disk driver is appropriate to use with the selected physical disk.

The physical driver command block is a collection of all information necessary for the disk system to perform the requested disk activity.

The timer and clock variables are a collection of locations used for maintaining the one second timer and the time-of-day clock and calendar. The console command line buffer immediately follows these variables.



1 UNLESS OTHERWISE SPECIFIED:
RESISTANCE VALUES ARE IN OHMS, ±5%, 0.25W
CAPACITANCE VALUES ARE IN MICROFARADS,
+80 -20%, 50V

2 POWER DISTRIBUTION TABLE

| REF DESIGNATIONS | GND | 5 | +12 | -12 |
|---|---|---|---|---|
| U1-8 | 16 | 8 | | |
| U9-21, 31-32, 43, 44, 45, 47, 49, 50, 59-61, 63, 66, 67-74, 77, 79, 80, 82, 84, 85, 87, 90, 91, 94-98, 100 | 7 | 14 | | |
| U81 | 12 | 3 | | |
| U22-30, 37-42, 48, 78, 83, 99 | 8 | 16 | | |
| U51, 52, 55, 56, 62, 64 | 10 | 20 | | |
| U53 | 29 | 11 | | |
| U33-36, 54, 57, 58 | 12 | 24 | | |
| U75 | 31 | 9 | | |
| U76 | 11 | 2 | 9 | |
| U39 | 5 | 24 | | |
| U92, 65 | 11 | 26 | | |
| U46, 88 | 7 | | 14 | 1 |
| U46 | 1-2 | 8 | | |

3 REFERENCE DESIGNATIONS

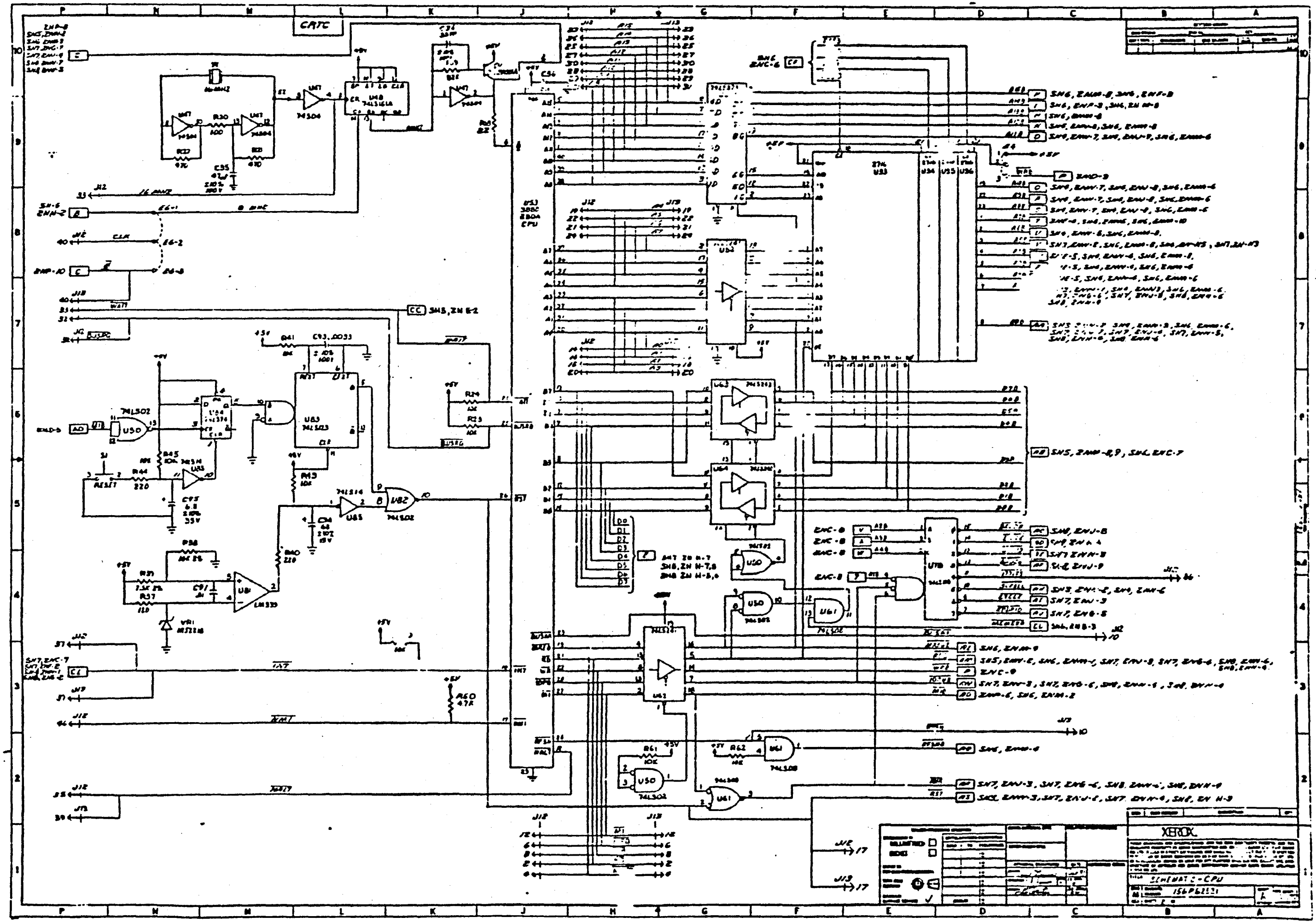
| LAST USED | NOT USED |
|---|---|
| C118 | C36-39, 49, 81, 82, 108-117 |
| E6 | |
| J13 | |
| R62 | |
| SJ | |
| U98 | |
| Q1 | |
| VR1 | |
| LS1 | |
| E7 | |

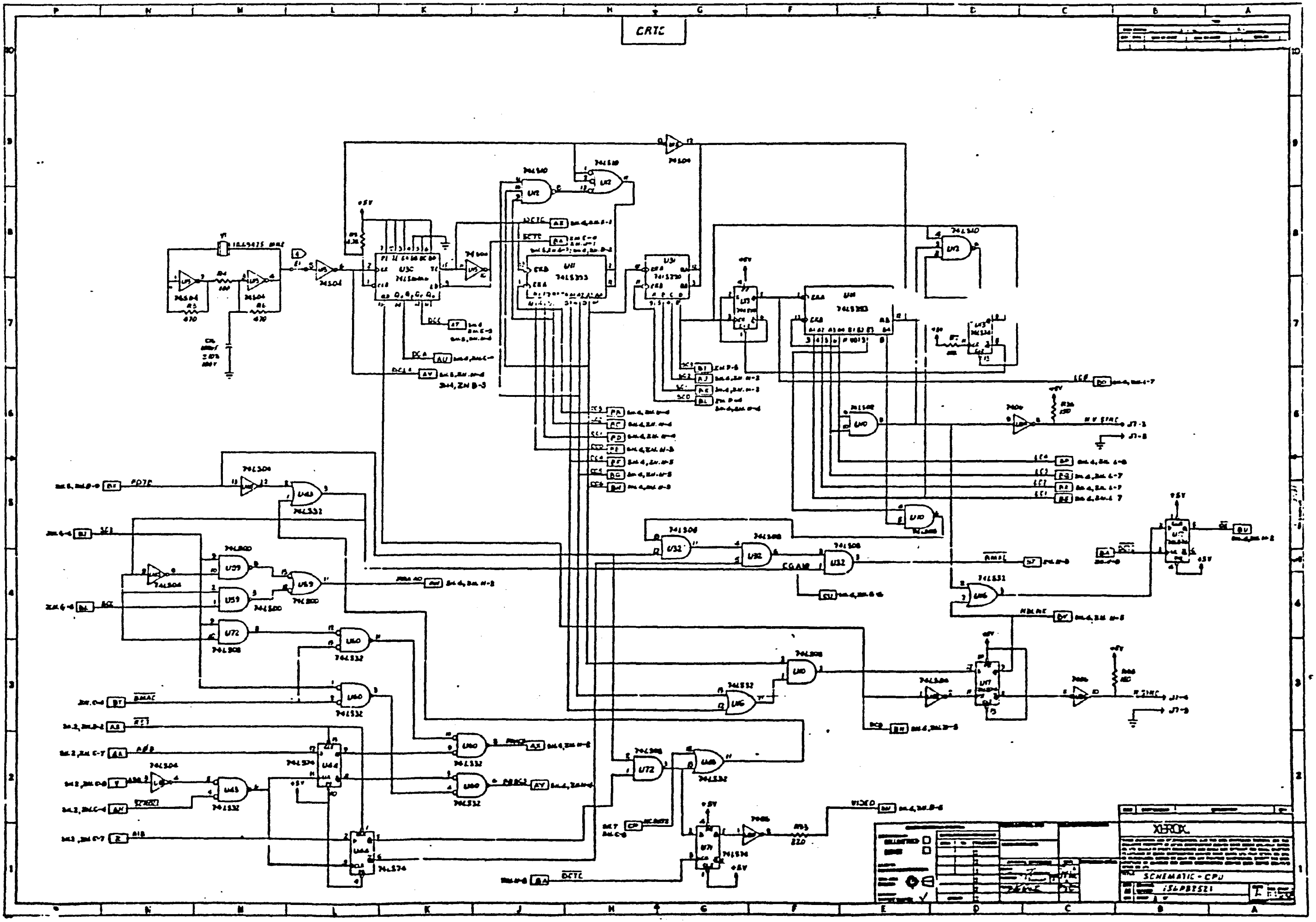
4 FOR NORMAL OPERATION SHUNTS TO BE INSTALLED IN THE FOLLOWING POSITIONS

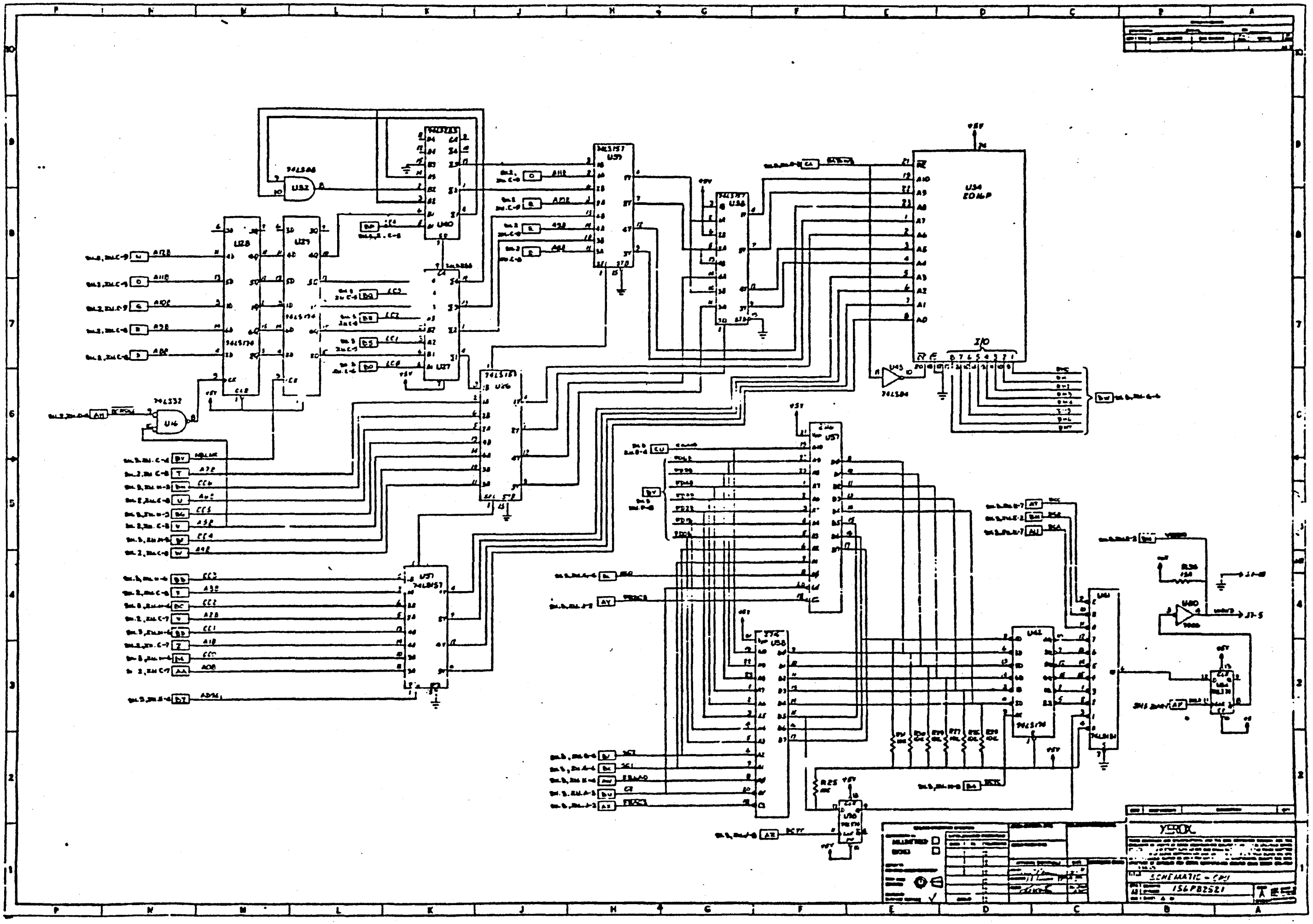
| REF DESIG | BETWEEN PINS |
|---|---|
| E1 | 1,2 |
| E2 | 1,2 |
| E4 | 1,2 |
| E6 | 2,3 |
| E7 | 1,2 |
| J9 | [illegible] |
| J10 | 3-4, 7-8 |

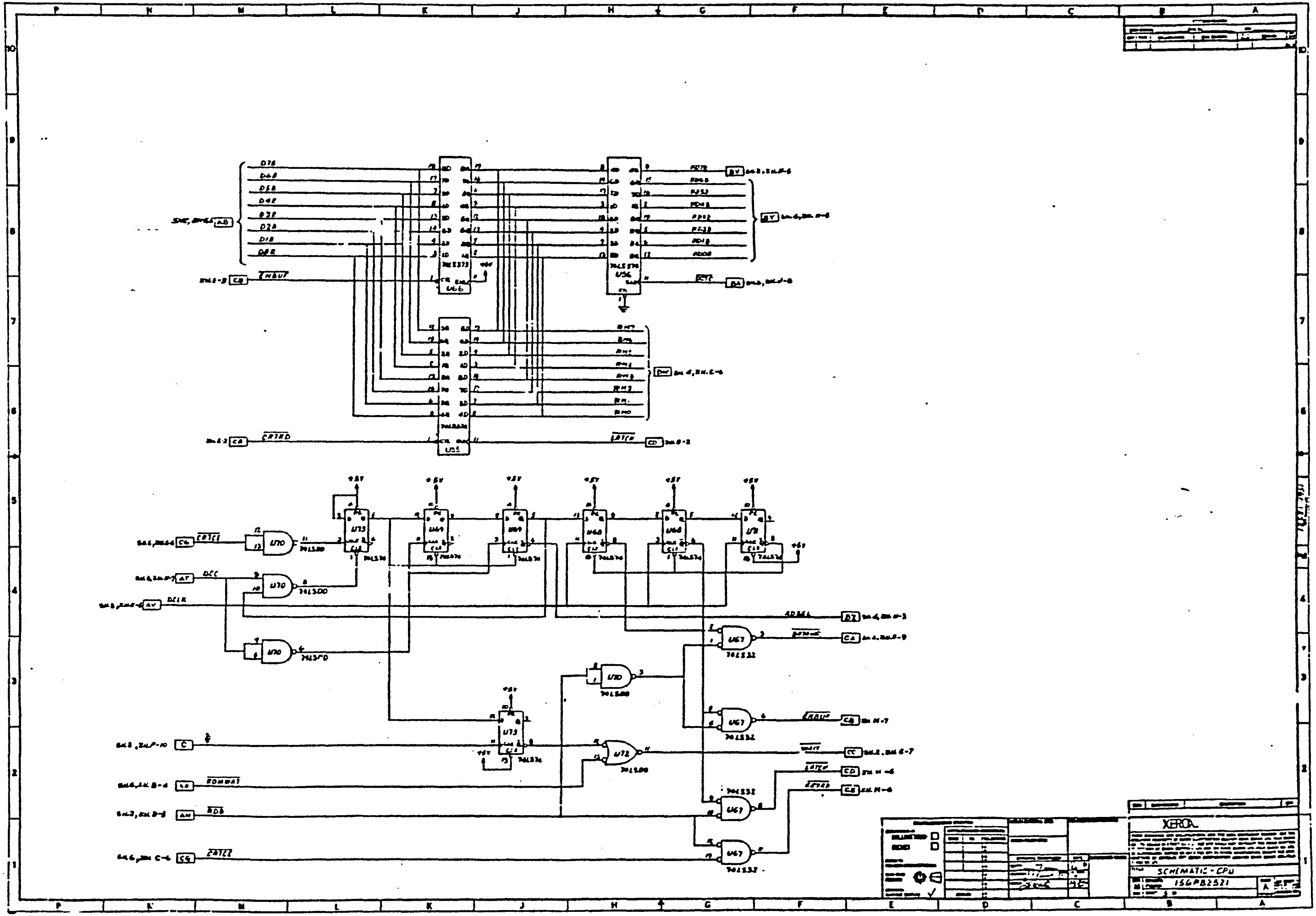
5 LAST INTERCONNECT LETTER USED (CV)

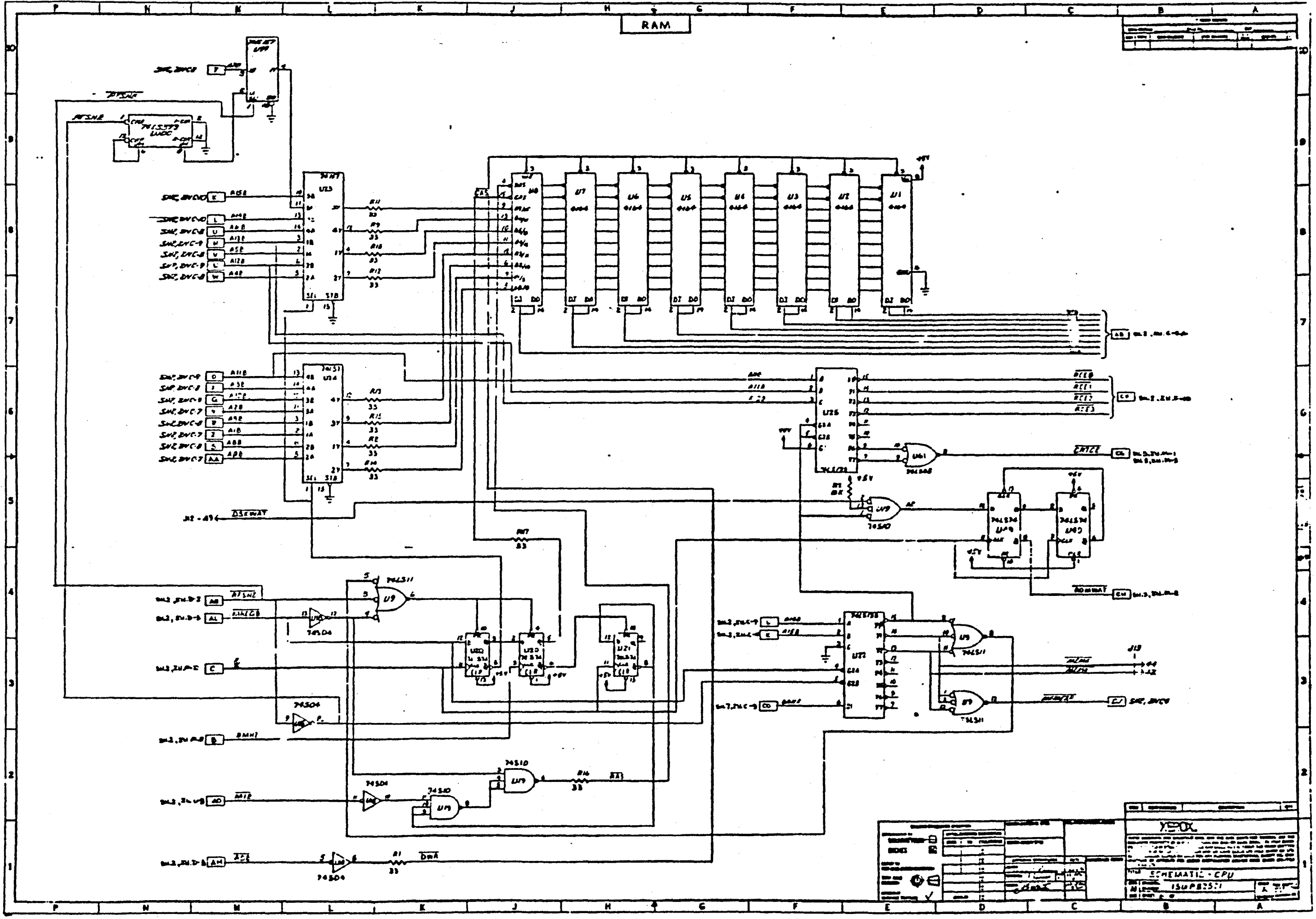
6 SPARE GATES:

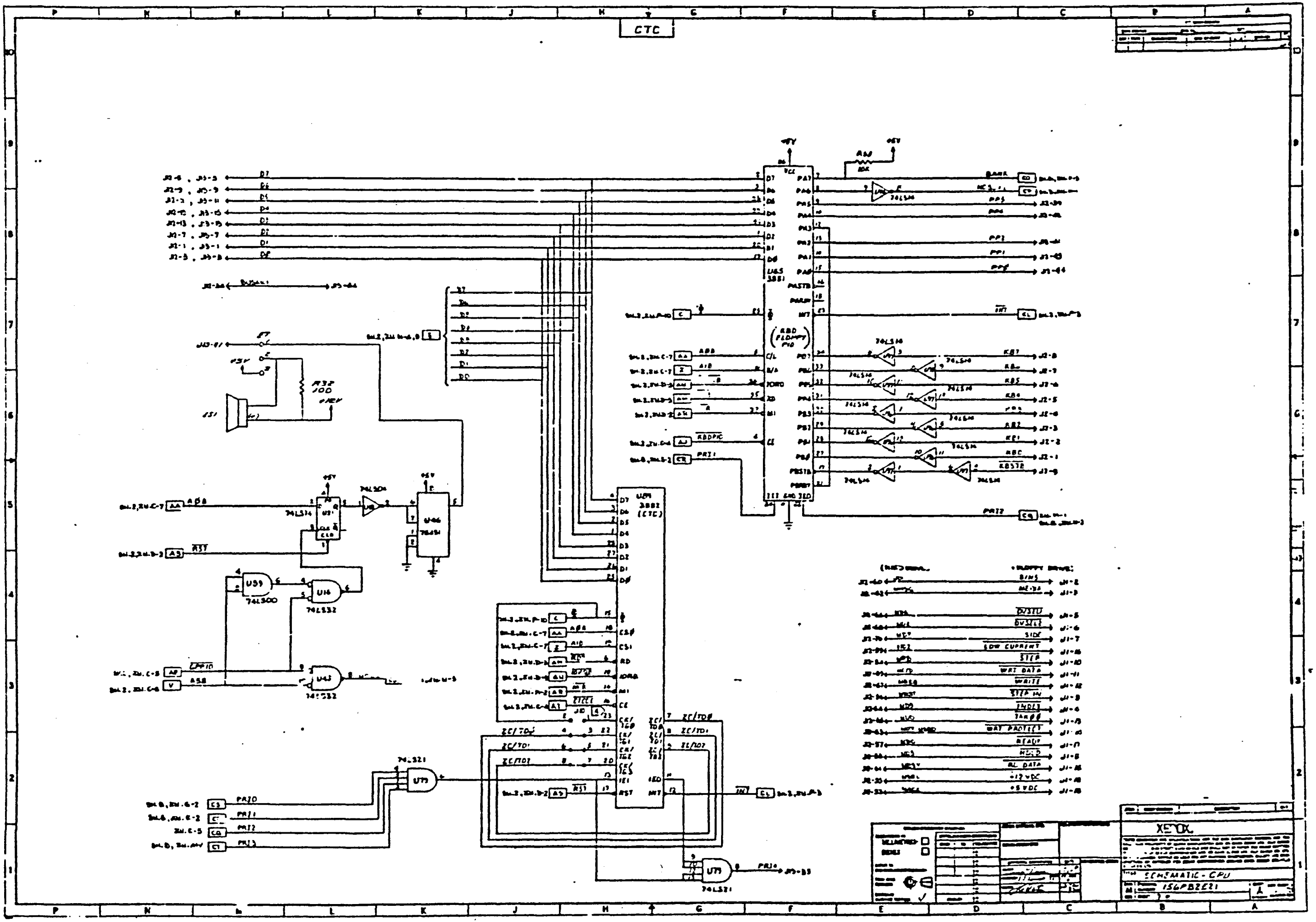

CRTC
74LS161A
U48
74S04
16MHZ
R30
100
R22
470
R21
470
C35
47µf
U47
16 MHZ
8 MHZ
CLK
WAIT
BUSRQ
U53
Z80C
Z80A
CPU
U52
U33
U34
U35
U36
U63
74LS243
U64
74LS243
U62
U78
U50
74LS02
U61
74LS08
U44
74LS74
U83
74LS123
U82
U85
74LS14
U81
LM339
VR1
RESET
R44
220
R45
10K
C95
R41
10K
C93 .0033
R43
10K
R40
220
C94
R38
R39
R37
R24
10K
R23
10K
R60
4.7K
R61
10K
R62
10K
+5V
INT
NMI
HALT
M1
RD
WR
MREQ
IORQ
RFSH
D0
D1
D2
D3
D4
D5
D6
D7
J12
J13
SN5, ZN E-2
SN6, ZNM-9
SN7, ZNM-3, SN7, ZNG-6, SN8, ZNN-4, SN8, ZNN-4
XEROX
SCHEMATIC-CPU
156P62231
P
N
M
L
K
J
H
G
F
E
D
C
B
A
10
9
8
7
6
5
4
3
2
1

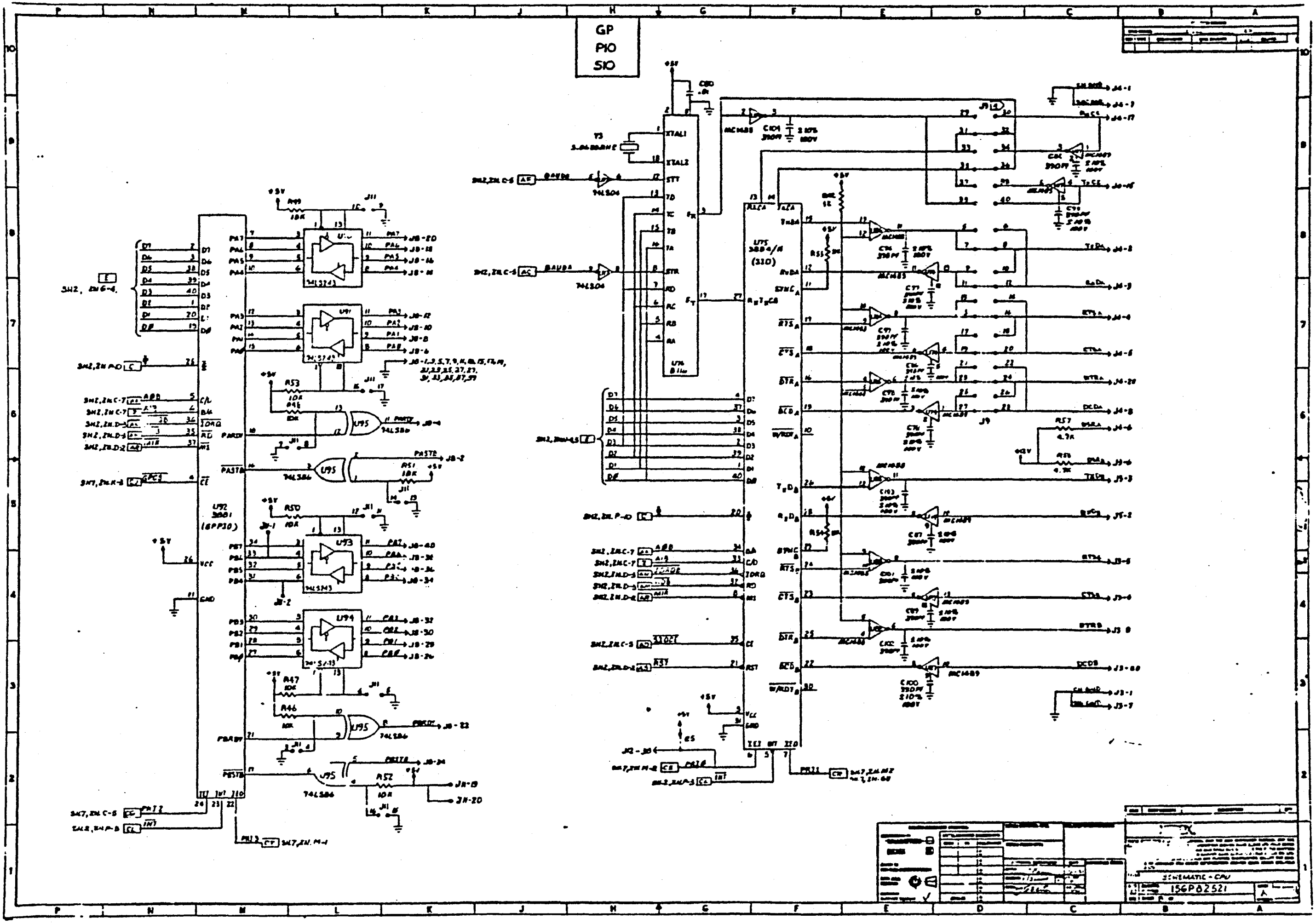

CRTC
Y1
R3
470
R6
470
74LS04
U5
+5V
U3C
74LS161
U11
74LS393
U31
74LS390
U12
74LS10
74LS20
U41
74LS393
U13
74LS74
U10
74LS02
HV SYNC
J7-3
J7-8
U43
74LS32
FDTC
U59
74LS00
U72
74LS08
U60
74LS32
U44
74LS74
U32
74LS08
CGAM
U66
74LS32
HBLANK
U7
V SYNC
J7-6
J7-9
U71
74LS74
VIDEO
DCTC
XEROX
SCHEMATIC - CPU
156P83521


U34
2016P
+5V
74LS157
U37
74LS157
U36
74LS283
U40
74LS86
U32
U28
U29
74LS174
U27
74LS157
U26
74LS32
U16
U43
74LS04
U57
U31
74LS157
U58
U42
74LS174
U41
U60
I/O
A0
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
XEROX
SCHEMATIC - CPU
156P82521


D7B
D6B
D5B
D4B
D3B
D2B
D1B
D0B
ENBUF
U66
74LS373
+5V
U56
74LS374
U55
74LS374
CRTRD
LATCH
+5V
CRTCE
U70
74LS00
DCC
DCLK
U73
U69
U68
U71
74LS74
ADREL
U67
74LS32
U72
WAIT
ROMWAT
RDB
XEROX
SCHEMATIC - CPU
15GPB2521


RAM
P
N
M
L
K
J
H
G
F
E
D
C
B
A
U23
U24
U25
U22
U8
U7
U6
U5
U4
U3
U2
U1
4164
DI
DO
CAS
+5V
U9
U19
U20
U21
U61
74LS11
74S04
74S10
74LS74
R11
R9
R10
R12
R13
R15
R8
R14
R17
R16
R1
33
DSKWAT
DWA
XEROX
SCHEMATIC - CPU
1SUP8251


CTC
U65
3881
(KBD FLOPPY PIO)
U84
3882
(CTC)
74LS14
74LS04
74LS00
74LS32
74LS21
74LS74
74LS51
U59
U14
U43
U79
U46
R32
100
LS1
+5V
RST
D7
D6
D5
D4
D3
D2
D1
D0
PA7
PA6
PA5
PA4
PA3
PA2
PA1
PA0
PB7
PB6
PB5
PB4
PB3
PB2
PB1
PB0
ZC/TO0
ZC/TO1
ZC/TO2
INT
PRI0
PRI1
PRI2
PRI3
FLOPPY DRIVE
SIDE
LOW CURRENT
STEP
WRT DATA
WRITE
STEP IN
INDEX
TRK00
WRT PROTECT
READY
RD DATA
+12 VDC
+5 VDC
XEROX
SCHEMATIC - CPU
156P82E21


GP
PIO
SIO
U92
3881
(GPPIO)
D7
D6
D5
D4
D3
D2
D1
D0
PA7
PA6
PA5
PA4
PA3
PA2
PA1
PA0
PB7
PB6
PB5
PB4
PB3
PB2
PB1
PB0
PARDY
PASTB
PBRDY
PBSTB
C/L
B/A
IORQ
RD
M1
CE
VCC
GND
IEI
INT
IEO
74LS243
U93
U94
U95
74LS86
R49
10K
R53
R50
R51
R52
R46
R47
J8
J11
SH2, ZN6-6
+5V
Y3
5.0688MHZ
XTAL1
XTAL2
STT
STR
U76
8116
74LS04
BAUDA
BAUDB
U75
3884/H
(SIO)
TxDA
RxDA
SYNCA
RTSA
CTSA
DTRA
DCDA
W/RDYA
TxDB
RxDB
SYNCB
RTSB
CTSB
DTRB
DCDB
W/RDYB
RxTxCB
RxCA
TxCA
MC1488
MC1489
C80
C101
C104
C100
330PF
R55
R56
R57
4.7K
J9
J4
J5
CH GND
SIG GND
+12V
SCHEMATIC - CPU
156P82521
A

1. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE VALUES ARE IN OHMS, 5%, 0.25W
   CAPACITANCE VALUES ARE IN MICROFARADS,
   +80 -20%, 50V

2. POWER DISTRIBUTION

| REF DESIGNATIONS | GND | +5V | +12 | -12 |
|---|---|---|---|---|
| U1-9 | 16 | 8 | | |
| U9-21, 31, 37, 44<br>45, 47, 49, 50, 57, 61, 62,<br>66, 67-70, 77, 79, 80,<br>84-88, 90, 92, 97, 98,<br>100, 103, 104 | 7 | 14 | | |
| U18 | 12 | 3 | | |
| U22-30, 37-43, 48,<br>75 82, 83, 99 | 8 | 16 | | |
| U51, 52, 55, 56, 63, 64 | 12 | 22 | | |
| U53 | 25 | 1 | | |
| U33-36, 54, 57, 58 | 12 | 24 | | |
| U72 | 21 | 9 | | |
| U76 | 11 | 2 | 9 | |
| U89 | 12 | 24 | | |
| U65, 91 | 11 | 26 | | |
| U84, 86 | 7 | 1 | 14 | 1 |
| U46 | [illegible] | E | | |
| U101, 102 | 8 | 16 | | 1 |

3. REFERENCE DESIGNATIONS

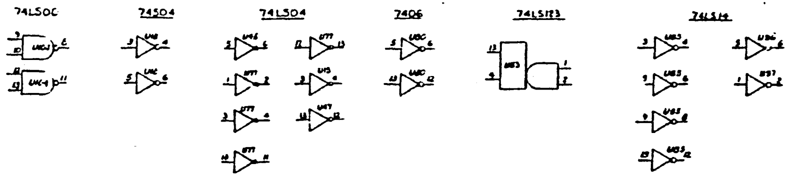
| LAST USED | NOT USED |
|---|---|
| C118 | C16, 54, 60, 112, 113, 115-117 |
| E7 | E6 |
| J13 | |
| R64 | R30, 63 |
| S1 | |
| U104 | |
| EV | |
| W1 | |
| LS1 | |
| W2 | |

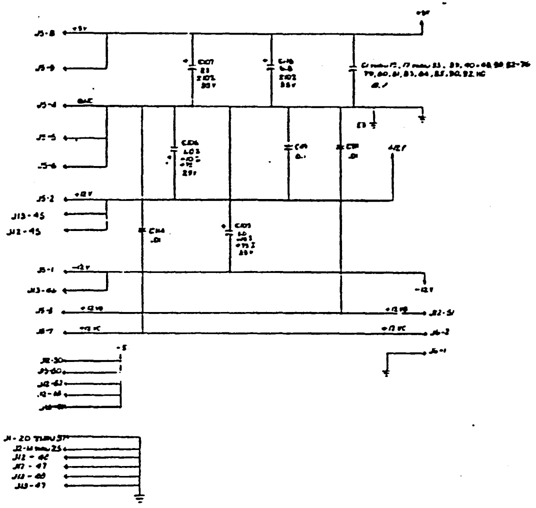
4. FOR NORMAL OPERATION SHUNTS TO BE INSTALLED IN THE FOLLOWING POSITIONS

| REF DESIG | BETWEEN PINS |
|---|---|
| E1 | 1, 2 |
| E2 | 1, 2 |
| E4 | 1, 2 |
| E7 | 1, 2 |
| J9 | 7, 8 11, 12 15, 16<br>19, 20 23, 24<br>27, 28. |
| J10 | 3, 4/7, 8 |
| | |

5. LAST INTERCONNECT LETTER USED (CV)

6. SPARE GATES:

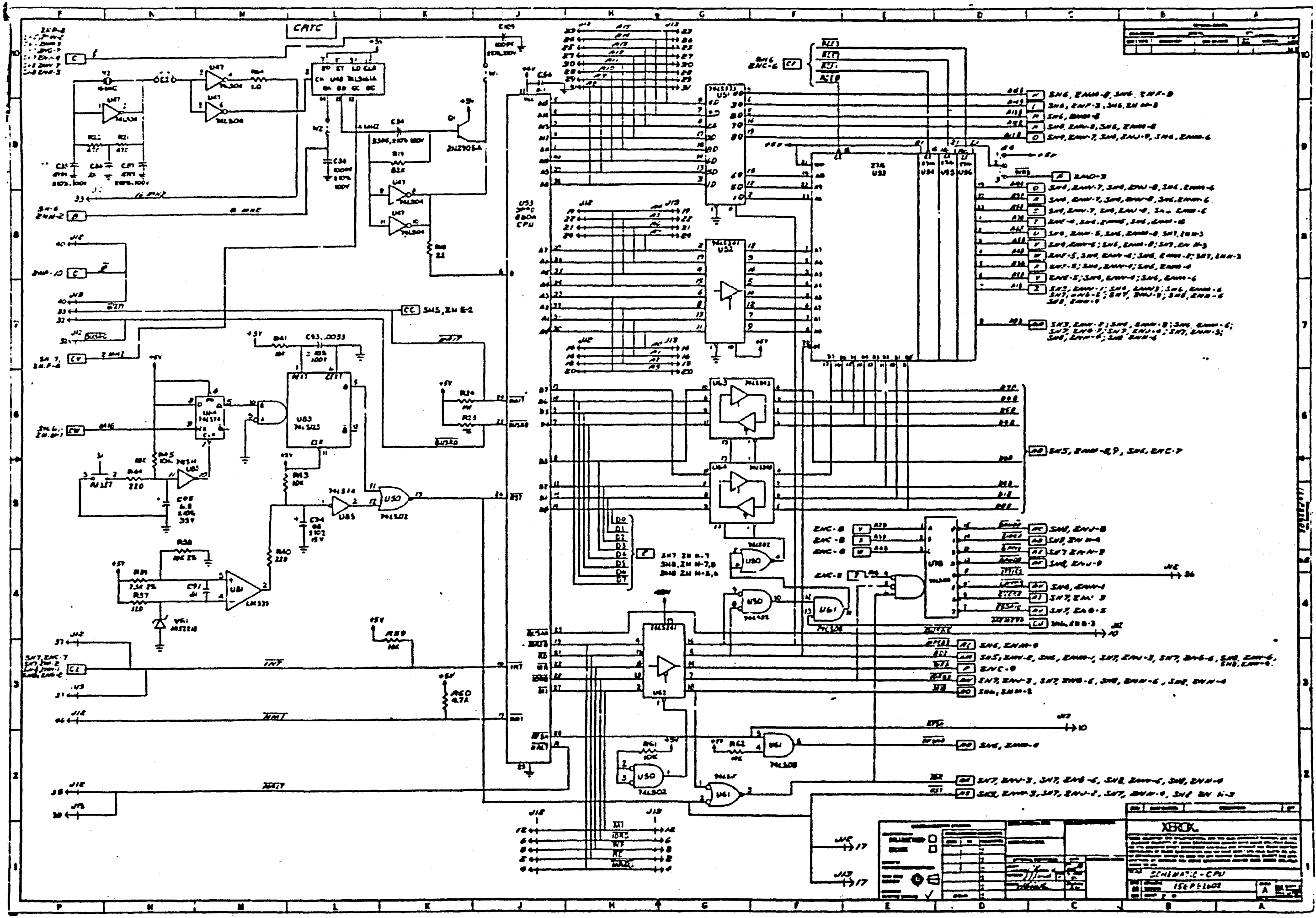


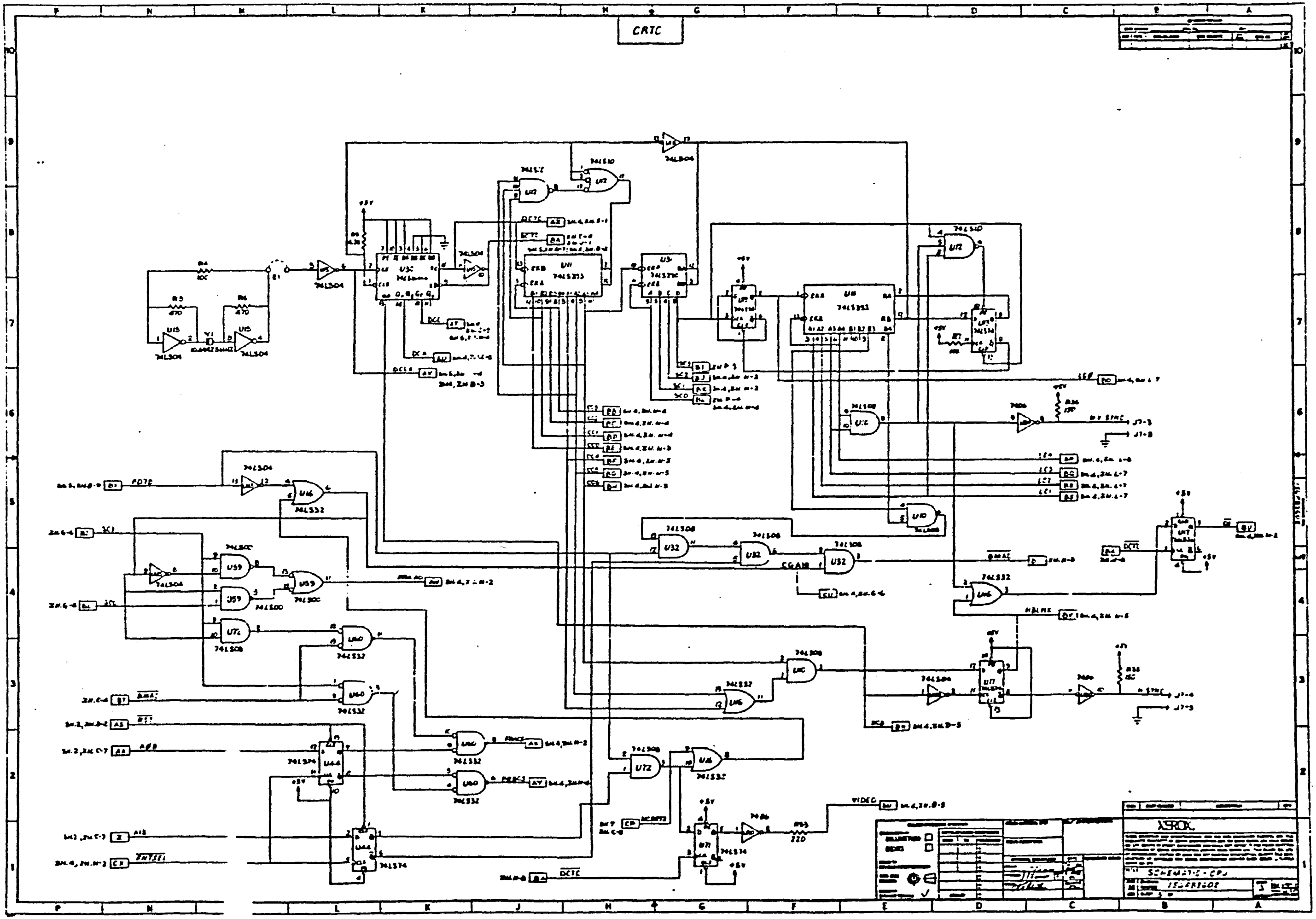


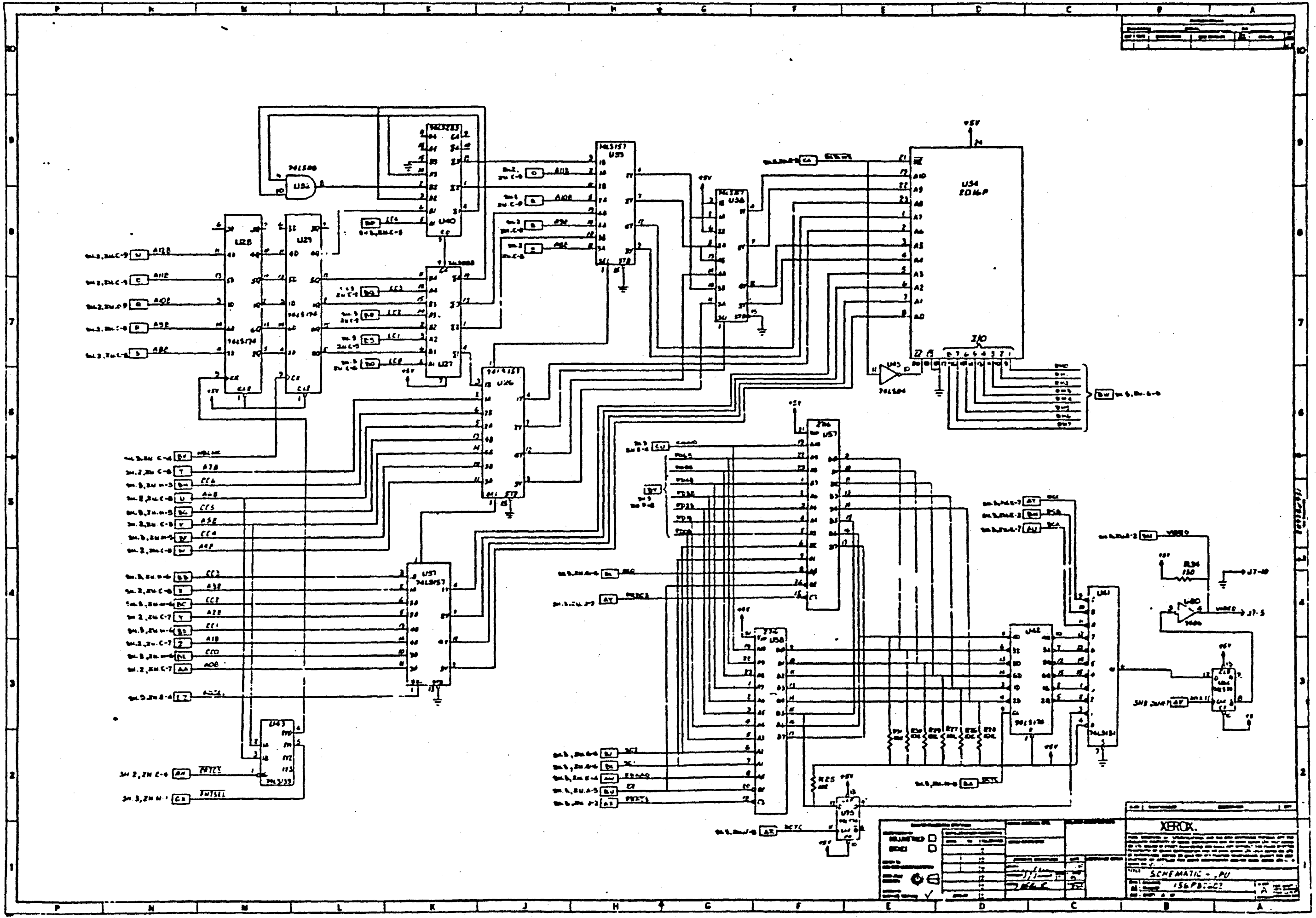
XEROX

SCHEMATIC - CPU

15EP32602


CRTC
U53
Z80A
CPU
U51
74LS373
U52
74LS541
U32
2716
U34
U35
U36
U63
74LS245
U64
74LS245
U48
74LS161A
U47
74LS04
U83
74LS123
U84
74LS74
U85
74LS14
U81
LM339
U50
74LS02
U61
74LS08
U62
74LS241
U78
Q1
2N2905A
RESET
INT
NMI
WAIT
BUSRQ
BUSAK
RST
MREQ
IORQ
RD
WR
M1
RFSH
HALT
D0
D1
D2
D3
D4
D5
D6
D7
+5V
J12
J13
XEROX
SCHEMATIC - CPU
156P52602
A


CRTC
U15
74LS04
Y1
R4
R5
R6
470
U5C
U11
74LS393
U3
74LS390
U12
74LS10
U2
U10
U16
74LS32
U59
74LS00
U32
74LS08
U60
74LS32
U72
U44
74LS74
U71
U17
U14
74LS04
FD7E
CGA18
H SYNC
V SYNC
VIDEO
R33
220
R36
R35
+5V
HBLNK
DCTC
XEROX
SCHEMATIC - CPU
P
N
M
L
K
J
H
G
F
E
D
C
B
A
10
9
8
7
6
5
4
3
2
1


74LS283
U40
74LS08
U32
74LS174
U28
U29
U27
74LS157
U35
U36
U26
U37
U34
2016P
I/O
U45
74LS04
U57
2716
U58
U43
74LS139
U42
U41
74LS151
U60
R25
R34
+5V
VIDEO
J7-10
J7-5
XEROX.
SCHEMATIC - .PU
156P81..C2
A

### Specifications

| | |
|---|---|
| Print Speed: | Up to 40 characters per second with metalized printwheels. |
| Character Set: | 88, 92, or 96 printable characters per printwheel. Switch-selectable program support for APL and all English language printwheels. |
| Printwheels: | 88, 92, 96 character Xerox - Metal<br>96 character Diablo - Plastic |
| Character Spacing: | 10-pitch = 10 characters/inch (3.94 ch/cm)<br>12-pitch = 12 characters/inch (4.72 ch/cm)<br>15-pitch = 15 characters/inch (5.91 ch/cm)<br>Proportional Space (PS) - see HMI, page 241. |
| Column Spacing: | 1/120 inch (.21mm) minimum. |
| Print Line: | 13.2 inches (335.3mm)<br>132 columns 10-pitch<br>158 columns 12-pitch<br>198 columns 15-pitch |
| Print Buffer: | 2688 bytes. |
| Paper Width: | 16.53 inches (419.9mm) maximum<br>- friction feed without Top Paper Out switch.<br>16.00 inches (406.4mm) maximum<br>- friction feed with Top Paper Out switch.<br>15.25 inches (387.4mm) maximum<br>- full width with optional forms tractor (14.75 inches/-374.7mm between holes). 3.25 inches (82.55mm) minimum with forms tractor (2.75 inches/69.85mm between holes). |
| Carriage Speed: | 400 msec maximum for 13.1 inches (332.77mm) of motion. |
| Tabulation: | Left or right. |
| Line Spacing: | 1/48 inch (.53mm) minimum. |
| Paper Feed: | Bidirectional, except with unidirectional forms tractor and unidirectional pin feed platen. |

Paper Feed Speed: 4 inches (101.6mm) per second plus 40 msec (typical) settling delay time.

Paper Thickness: .000 - .010 inch (.254mm) at low setting (1-3 part forms)
.010 - .027 inch (.254 - .686mm) at high setting (4-6 part forms).

Sensors: End of ribbon, paper out, and cover open.

Other Features: Self test; host program control through escape sequences; data receive/transmit speed selection.

Power Requirements: Strappable for operation from nominal 100, 120, 220, or 240 volt ( + 10%/-15%) AC inputs, 49-61 Hz. 350W maximum power consumption. Factory preset for 120 VAC. Check your printer's serial plate for proper input power.

**Cabling Requirements**

A standard RS-232-C interface cable is required for connection between the screen and the printer. This cable must be equipped with DB-25P connectors with the following pins connected:

| PIN | CCITT | TELCO | |
|---|---|---|---|
| NO. | DESIG. | DESIG. | DESCRIPTION |
| 1 | 101 | AA | Protective Ground |
| 2 | 103 | BA | Transmitted Data |
| 3 | 104 | BB | Received Data |
| 4 | 105 | CA | Request To Send |
| 6 | 107 | CC | Data Set Ready * |
| 7 | 102 | AB | Signal Ground |
| 20 | 108 | CD | Data terminal Ready |

* Pin 6 must be HI to receive or transmit data.

## 1.0 INTRODUCTION

The SA1403D Controller consists of a micrprocessor based controller with on-board data separator logic and is able to control a maximum of four drives. The drives can be any combination of Shugart SA1000 fixed disk drives, SA800 floppy disk drives, or SA850 floppy disk drives. The floppy disk track formats are compatible with IBM 1D/2D track formats. The SA1403D can be mounted on the SA1000 drive.

Commands are issued to the controller over a bidirectional bus connected to the host computer. The data separator/"serdes" logic serializes bytes and converts to FM/MFM data, and deserializes FM/MFM data into 8-bit bytes.

Due to the microprogrammed approach utilized in the controller, limited diagnostic capabilities are implemented. This methodology increases fault isolation efficiency and reduces system down time. Error detection and correction will tolerate media imperfections up to 4-bit burst errors.

NOTE: This device utilizes neaative logic (i.e., 0V = logical 1)

## 1.1 SA1403D CONTROLLER FEATURES

OVERLAPPED SEEK
In multiple drive configurations the host can issue seeks to different drives without waiting for the first drive to complete its seek.

AUTOMATIC SEEK AND VERIFY
A seek command is implied in every data transfer command (READ, WRITE CHECK, etc.). If the heads are not positioned over the correct cylinder, a seek is initiated and a cylinder verification is performed after the seek completes.

FAULT DETECTION
Three classes of fault detection are provided for fault diagnosis:
1) Disk related faults.
2) Controller related faults.
3) Host command or I/O timing faults.
Fault detection is available from the interface as a status message and is also visibly displayed on a row of status LED's on the controller PCB.

AUTOMATIC HEAD AND CYLINDER SWITCHING
If during a multi-block data transfer the end of a track is reached, the controller automatically switches to the next track. If the end of a cylinder is reached, the controller issues a seek and resumes the transfer.

DATA ERROR SENSING AND CORRECTION
If a data error is detected during a disk data transfer, the controller indicates whether or not it is correctable. If correctable, it can be automatically corrected. (This applies to the SA1000 only. CRC error detection is used on floppy disc drives.)

LOGICAL TO PHYSICAL DRIVE CORRELATION
Logical Unit Number (LUN's) are independent of physical port numbers. All accesses specify LUN's.

ON BOARD SECTOR BUFFER
A sector buffer is provided on the controller to eliminate the possibility of data overruns during a data transfer.

EFFICIENT HOST INTERFACE PROTOCOL
A bidirectional bus between the controller and host provides a simple, yet efficient communication path. In addition, a high level command set permits effective command initiation.

SECTOR INTERLEAVE
Sector interleaving is programmable with up to a 16 way interleave.

ODD PARITY
The 8 data bits on the interface bus can have odd parity. Depending on user preference, parity can be disabled.

FIXED SECTOR SIZE
The sector size is fixed at 256 bytes of data for the SA1000.

NUMBER OF DRIVES — The controller will connect to a maximum of four (4) drives. The drives can be any combination of SA1000's and/or SA850's and/or SA800's

### 1.1.1 OPTIONAL FEATURES

MICRO DIAGNOSTICS — A set of diagnostic PROM's are available to allow stand alone diagnostic testing of both drive and controller. Reference Appendix A.

### 1.1.2 SYSTEM CONFIGURATION

The controller and data separator comprise a single PCB that can be mounted onto the SA1000 drive. A maximum of four (4) drives may be connected as shown in Figure 2.

### 1.2 TRACK FORMATS AND CAPACITY

A) 32 sectors of 256 bytes per sector (SA1000only).
C) 26 sectors of 256 bytes per sector (Floppy only).
D) 26 sectors of 128 bytes per sector (Floppy only.)

IBM 1D/2D TRACK FORMAT — Track format for Floppy Disk drives can be selected under program control in real time. The track formats are:

1) Single density, single sided
2) Single density, double sided
3) Double density, single sided
4) Double density, double sided

| | 26 SECTOR | 32 SECTOR |
|---|---|---|
| SA800 | 2001 | N/A |
| SA850 | 4003 | N/A |
| SA1002 | N/A | 16383 |
| SA1004 | N/A | 32767 |

**TABLE I.**

Format/Capacity Relationship
Maximum Logical Sector Address Shown

## 2.0 SPECIFICATION SUMMARY

### 2.1 ENVIRONMENTAL LIMITS

| | **Operating** | **Storage** |
|---|---|---|
| Temperature F/C | 32°/0° to 131°/55° | -40°/-40° to 167°/75° |
| Max. Wet Bulb | 85°F | non condensing |
| Relative Humidity | 10% to 95% | 10% to 95% |
| Altitude | Sea level to 10,000 ft | Sea level to 15,000 ft |

## 2.2 POWER REQUIREMENTS

Three power supply voltages are required for the SA1400 series controllers. The maximum current requirements are as follows:

+5VDC ± 5% at 4.6 Amps
-5VDC ± 5% at 0.5 Amps
+24VDC ± 10% at 0.1 Amps

Power is applied to the SA1400 series controller via J10 which is a 6 pin AMP Mate-N-Lok connector (P/N 1-380999-0) mounted on the component side of the board. The recommended mating connector, P10, is an AMP P/N 1-480270-0 utilizing AMP pins P/N 60619-1. The J10 pins are labeled on the connector. Figure 1 shows the pin assignments.

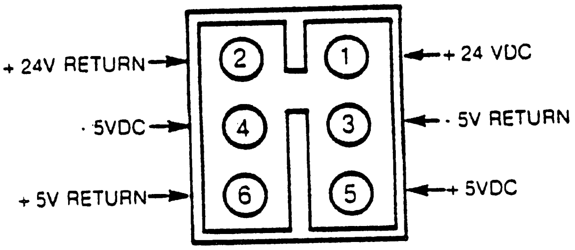


**FIGURE 1.** J10 DC POWER CONNECTOR

## 2.3 PHYSICAL PARAMETERS

| | |
|---|---|
| Length: | 13.7 inches (34.8cm) ± .030" (.076 cm) |
| Width: | 8.25 inches (21cm) ± .010" (.025 cm) |
| Height: | 0.5 inches (1.3cm) ± .030" (.076 cm) |
| Weight: | 1.12 lbs (0.5Kg) ± .010 lbs (0.25 g) |

## 3.0 SA1403D DISK DRIVE INTERFACE

Shugart SA1000 and SA800/850 disk drives are interfaced to the controller via J1, J2, J3, J4 and J5. Refer to Figure 2 for connection block diagram.

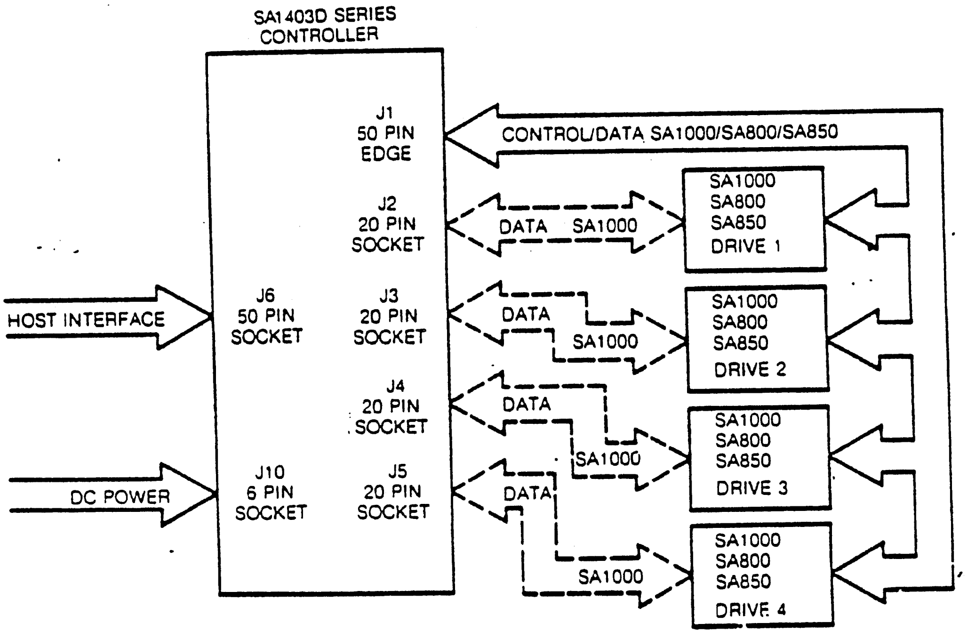


**FIGURE 2.** SA1403D INTERCONNECT DIAGRAM

NOTE: The last physical device on the control cable (drive to be terminated) must be an SA1000.

J1 is a 50 pin edge type connector which connects all drives in a daisy chain configuration. This connector carries control and data information for the floppy disk drives and control information only for the SA1000 disk drive. Maximum cable length should not exceed 20 feet (6 meters).

The recommended mating connector for J1 is a 3M Scotchflex ribbon connector P/N 3415-0001.

J2 through J5 are 20 pin socket type connectors used to radially connect the SA1000 data lines to the controller. Maximum cable length should not exceed 20 feet (6 meters).

The recommended mating connector for J2 through J5 is a 3M Scotchflex P/N 3421-3000. Figure 3 shows the pinouts for J1 and J2 through J5.

| J1 |  | SA1000 | SA800 | SA850 |
|---|---|---|---|---|
| 1 | 2 | - IW SWITCH |  | - IW SWITCH |
|  | 4 |  |  |  |
|  | 6 |  |  |  |
|  | 8 | - SEEK COMPLETE |  |  |
|  | 10 |  |  | - TWO SIDED |
|  | 12 |  |  |  |
|  | 14 | - HEAD SEL $2^0$ |  | - SIDE SEL |
|  | 16 |  |  |  |
|  | 18 | - HEAD SEL $2^1$ | - HEAD LOAD | - HEAD LOAD |
|  | 20 | - INDEX | - INDEX | - INDEX |
|  | 22 | - READY | - READY | - READY |
|  | 24 |  |  |  |
|  | 26 | - DRIVE SEL 1 | - DRIVE SEL 1 | - DRIVE SEL 1 |
|  | 28 | - DRIVE SEL 2 | - DRIVE SEL 2 | - DRIVE SEL 2 |
|  | 30 | - DRIVE SEL 3 | - DRIVE SEL 3 | - DRIVE SEL 3 |
|  | 32 | - DRIVE SEL 4 | - DRIVE SEL 4 | - DRIVE SEL 4 |
|  | 34 | - DIRECTION SEL | - DIRECTION SEL | - DIRECTION SEL |
|  | 36 | - STEP | - STEP | - STEP |
|  | 38 |  | - WRITE DATA | - WRITE DATA |
|  | 40 | - WRITE GATE | - WRITE GATE | - WRITE GATE |
|  | 42 | - TRACK 000 | - TRACK 00 | - TRACK 00 |
|  | 44 | - WRITE FAULT | - WRITE PROTECT | - WRITE PROTECT |
|  | 46 |  | - READ DATA | - READ DATA |
|  | 48 |  |  |  |
| 49 | 50 |  |  |  |

J2 THROUGH J5

|  |  |  |  |
|---|---|---|---|
| - DRIVE SELECTED | 1 | 2 | GROUND |
|  | 3 | 4 | ↕ |
|  | 5 | 6 |  |
|  | 7 | 8 | GROUND |
| + TIMING CLOCK | 9 | 10 | - TIMING CLOCK |
| GROUND | 11 | 12 | GROUND |
| + MFM WRITE DATA | 13 | 14 | - MFM WRITE DATA |
| GROUND | 15 | 16 | GROUND |
| + MFM READ DATA | 17 | 18 | - MFM READ DATA |
| GROUND | 19 | 20 | GROUND |

**FIGURE 3.** SA1403D DRIVE CONNECTOR PINOUTS

### 3.1 CABLE TERMINATION

The last physical drive at the end of J1 (50 pin) cable must be properly terminated. Termination networks are provided on the drives (refer to SA1000, SA800 or SA850 OEM manuals for location of termination networks). Termination networks must be removed from all drives except the last drive on the cable to avoid multiple termination.

NOTE: If a combination of fixed and floppy drive are used,.the last drive at the end of the control cable must be an SA1000.

## 4.0 HOST CPU INTERFACE

The SA1400 series controller interface is a general purpose 8 bit parallel DMA.

The Host CPU is interfaced to the controller via connector J6, J6 is a 50 pin socket type connector. The recommended mating connector for J6 is a 3M Scotchflex ribbon connector P/N 3425-3000. The J6 interface cable should not exceed 20 feet (6 meters).

### 4.1 HOST CPU ELECTRICAL INTERFACE

All Host CPU interface signals are negative true. The signals are "Asserted" at 0 VDC to 0.4 VDC. The signals are "Deasserted" or inactive at 2.5 VDC to 5.25 VDC.

### 4.1.1 HOST CPU INTERFACE TERMINATION

All Host CPU interface timing lines are terminated with a 220/330 ohm network. The Host CPU adapter should be terminated in a similar fashion (see Figure 4).

The devices driving the controller inputs should be open collector devices capable of sinking at least 48 milliamps to a voltage level of less than 0.5 VDC (7438 or equivalent).

The devices receiving the controller outputs should be of the SCHMITT trigger type to improve the noise margin (74LS240, 74LS14, or equivalent). The Host adaptor should not load the bus with more than 1 standard TTL input load per line.

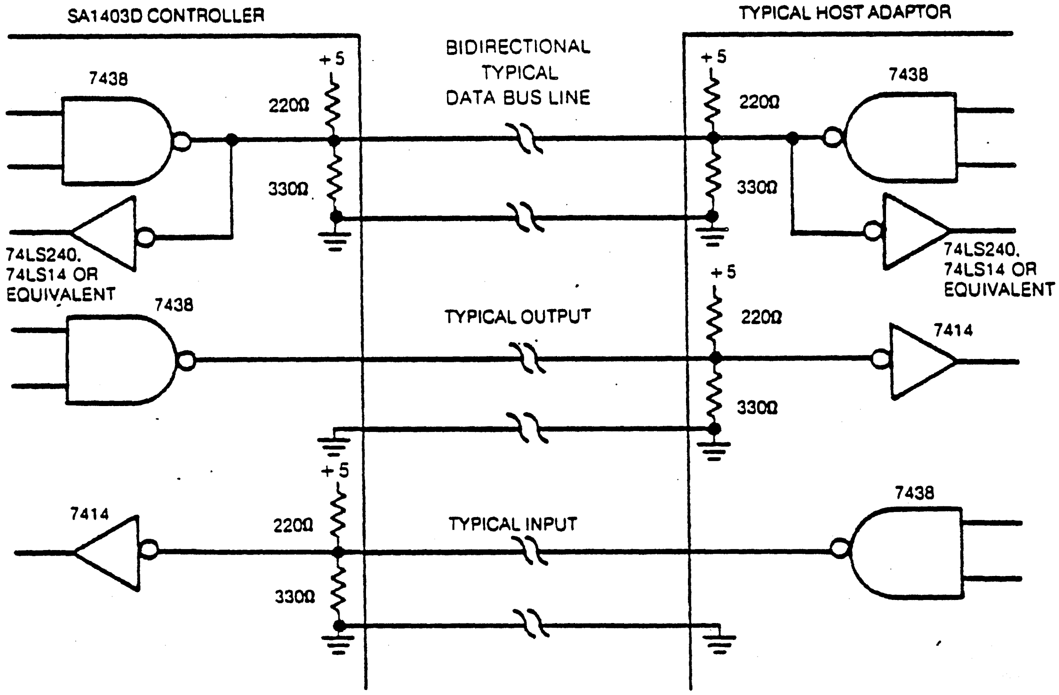
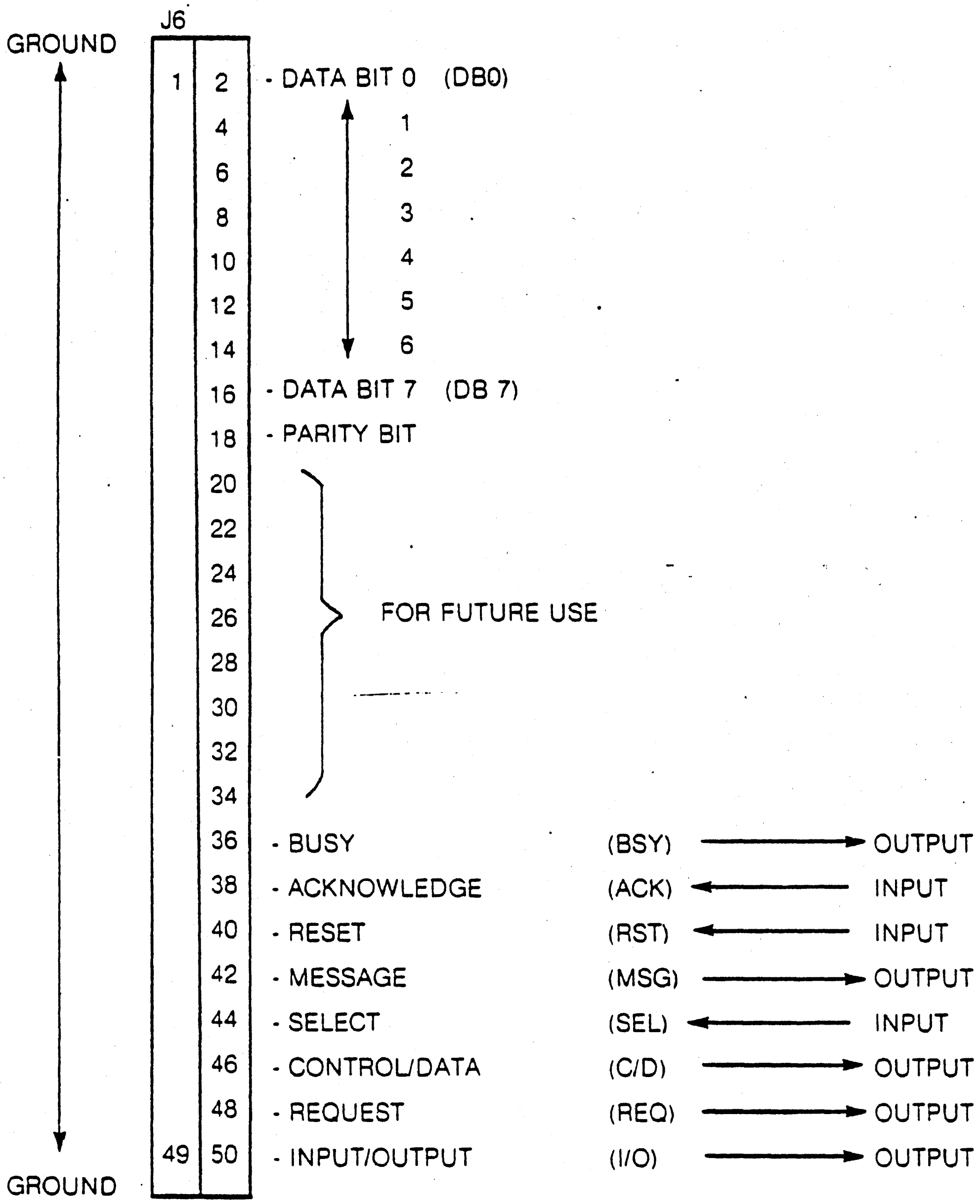


**FIGURE 4.** HOST ADAPTOR BUS TERMINATION

### 4.1.2 HOST CPU SIGNAL INTERFACE

The Host CPU signals are interfaced via J6. See figure 5 for J6 pinouts.



NOTE: ALL SIGNALS ARE TTL NEGATIVE TRUE

**FIGURE 5.** J6 HOST INTERFACE CONNECTOR PINOUT

## 4.2 SA1403D HOST BUS

### 4.2.1 THEORY OF OPERATIONS

Disk commands are issued to the SA1403D via the host bus following a defined protocol. The host initiates a command sequence by selecting the controller on the bus. If the controller is not busy, it requests command bytes from the host for task execution. (Command structure is described in 4.5). Depending on the type of command, the controller will request either 6 or 10 bytes. Upon reception of the last command byte, the controller begins execution of the command.

For the data transfer commands, a check is performed on the disk address and status flagged if it exceeds the drive limits. The data is stored in a sector buffer before transfer to the host or disk drive. This buffer eliminates any possibility of data overruns between the host and the disk.

Upon completion of the command, the controller will send completion status to the host. Further delineation of the completion status may be requested by issuing the appropriate sense commands.

Odd parity is generated by the SA1403D for all information that it puts on the I/O bus. If enabled, the SA1403D checks all information that it receives for odd parity.

## 4.3 SIGNAL DEFINITION

Unidirectional Signals Driven By Controller

I/O **Input/Output.** When asserted, the data on the bus is driven by the controller; when deasserted, the data on the bus is driven by the host adapter. The host adapter will use this line to enable its drivers onto the data bus.

C/D **Control/Data.** When asserted the data transmitted across the bus will be the command or status bytes; when deasserted the data will be the disk data bytes.

BUSY This bit is asserted as a response to the SEL line from the host adapter and to indicate that the host bus is currently in use.

MSG **Message.** When asserted indicates that the command is completed and status has been transferred. The assertion of this bit is always followed with the assertion of I/O, and the assertion of REQ, to cause a message byte transfer.

REQ **Request.** This bit operates in conjunction with I/O, C/D, & MSG. When asserted and I/O is asserted, REQ will mean that the data on the host bus is driven by the controller. When asserted and I/O is deasserted, REQ will mean that the data is driven by the host adaptor (H/A).

| I/O | C/D | MSG | Meaning |
|---|---|---|---|
| d | a | d | Get command from H/A |
| d | d | d | Get data from H/A |
| a | d | d | Send data to H/A |
| a | a | d | Send status byte to H/A |
| a | a | a | Command done to H/A |

**TABLE 2.**

a = asserted, d = deasserted, H/A = host adaptor

## 4.4 UNIDIRECTIONAL SIGNALS DRIVEN BY HOST ADAPTOR

ACK **Acknowledge.** This bit is asserted as a response to REQ from the controller. The timing requirements on this signal with respect to the data is described in REQuest section. ACK must be returned for each REQ assertion

RST **Reset.** Assertion by the Host causes the controller to cease all operations and return to an idle condition. This signal is normally used during a power up sequence. A reset during a write operation would cause incorrect data to be written on the selected disk. The controller may take a maximum of 2 seconds to respond to the select sequence following deassertion of the RESET line.

SEL **Select.** When asserted indicates the beginning of the command transaction. The H/A asserts SEL to gain the attention of the controller. Data bit zero on the host bus must also be asserted during SEL time to select the controller address. The controller will return BUSY within approximately 1$\mu$s.

### 4.4.1 DATA BUS BITS 0-7 (DB)

These bidirectional data lines are used to transfer 8 bit parallel data to/from the Host adaptor. Bit 7 is most signifant bit. NOTE: All I/F lines utilize negative logic.

### 4.4.2 PARITY BIT

This bit is asserted to maintain odd parity on all data and status information transfered to the Host. If enabled, the controller will test for odd parity on all command and data information transfered to the controller (see section 9.1).

## 4.5 HOST INTERFACE PROTOCOL

There are 4 sequences required to initiate and complete a command to the SA1403D series controller:

1) Controller Selection Sequence

2) Command Transfer Squence

3) Data Transfer Sequence

4) Status and Message Transfer Sequence

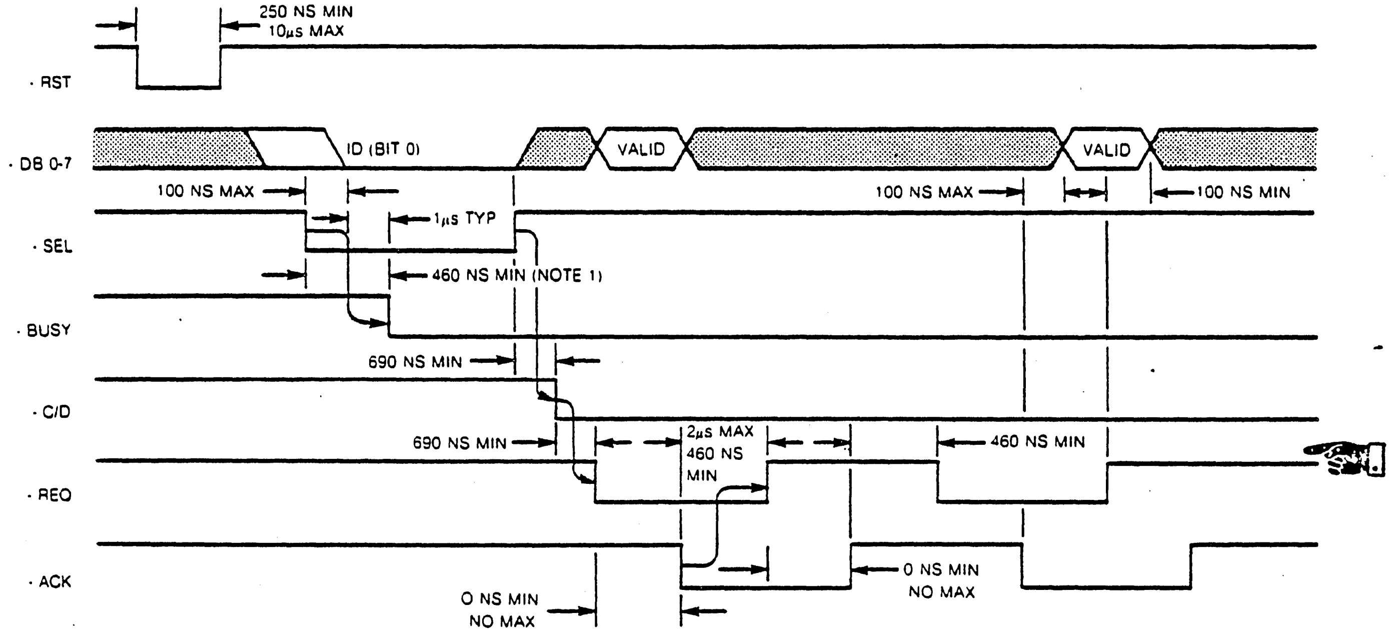
### 4.5.1 CONTROLLER SELECTION SEQUENCE

In order to gain the attention of the controller it is necessary to perform a selection sequence. Refer also to Figure 6.

The Host must first test BSY to determine if the controller is available. If BSY is deasserted, the Host will assert data bit 0 (controller ID) and then assert SEL. The controller will then respond by asserting BSY. At this point the Host must deassert SEL and data bit 0. I/O will remain deasserted throughout the selection sequence.

### 4.5.2 COMMAND TRANSFER SEQUENCE

Following the selection sequence the controller will assert REQ (see Figure 6). The Host will then place the first byte of the command descriptor block (see section 5.0) on the data bus. The Host will then assert ACK (if ACK is not asserted within 256 microseconds after the assertion of REQ, the controller will abort the command transfer sequence and attempt to transfer a status byte). The controller will respond by reading the byte on the data bus and then deasserting REQ. The Host then must deassert ACK to begin the next REQ/ACK handshake. This handshake must be completed to assure that all command and data bytes are transferred.



NOTE 1 - 2 SEC IMMEDIATELY AFTER RESET

**FIGURE 6.** SELECT SEQUENCE TIMING

### 4.5.3 DATA TRANSFER SEQUENCE

Following the command transfer sequence, the controller will respond on one of four ways:

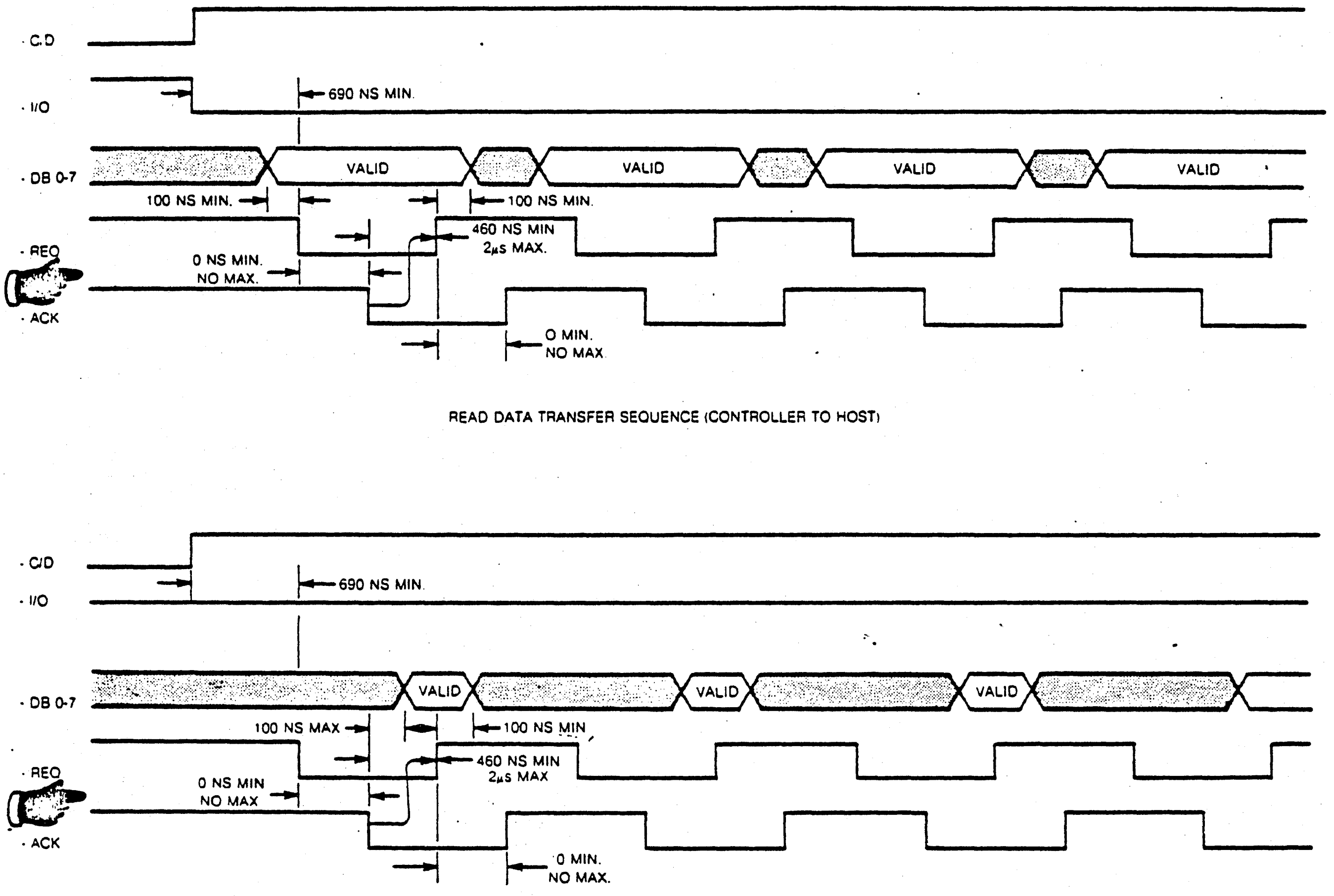
1) Begin seeking the drive.

2) Begin accepting write data from the Host.

3) Begin transferring read data to the Host.

4) Return status to the Host.

If the command sent to the controller involves a data transfer (see Figure 7), the controller will deassert the C/D line to indicate a data transfer. If the data transfer is from the Host to the controller (write data) the I/O line will be deasserted. If the data transfer is from the controller to the Host (read data) the I/O line will be asserted. The controller will then set the REQ line to request a byte transfer. The Host will respond by transferring a byte across the data bus and then asserting ACK (if ACK is not asserted within 256 microseconds after the assertion of REQ, the controller will abort the data transfer sequence and attempt to transfer a status byte - see section 4.5.4). The Host will then deassert ACK and wait for the next assertion of REQ. This handshake continues until all data has been transferred



READ DATA TRANSFER SEQUENCE (CONTROLLER TO HOST)

WRITE DATA TRANSFER SEQUENCE (HOST TO CONTROLLER)

**FIGURE 7.** DATA TRANSFER SEQUENCE TIMING

### 4.5.4 STATUS AND MESSAGE TRANSFER SEQUENCE

Following a command transfer or data transfer, the controller will initiate a status byte and completion message transfer.

When a status byte transfer is required, the controller will assert C/D and I/O (see Figure 8). The controller will then assert REQ. The Host must then read the status byte on the data bus and then assert ACK (if ACK is not asserted within 256 microseconds after the assertion of REQ, REQ will be deasserted. REQ will then be asserted again).The controller will then deassert REQ. The host will then deassert ACK.

Following the status byte transfer, a completion message byte of all zero's will be transfered to indicate operation complete. The controller will assert the MSG line (along with I/O and C/D) and then assert REQ. The Host may read the completion message byte on the data bus and assert ACK (if ACK is not asserted within 256 microseconds, the controller will deassert the MSG line and attempt to transfer a status byte). The controller will respond by deasserting REQ. The Host will then deassert ACK. At this point BSY and all other controller I/O lines will be deasserted and the controller will return to an IDLE LOOP awaiting the next selection sequence.

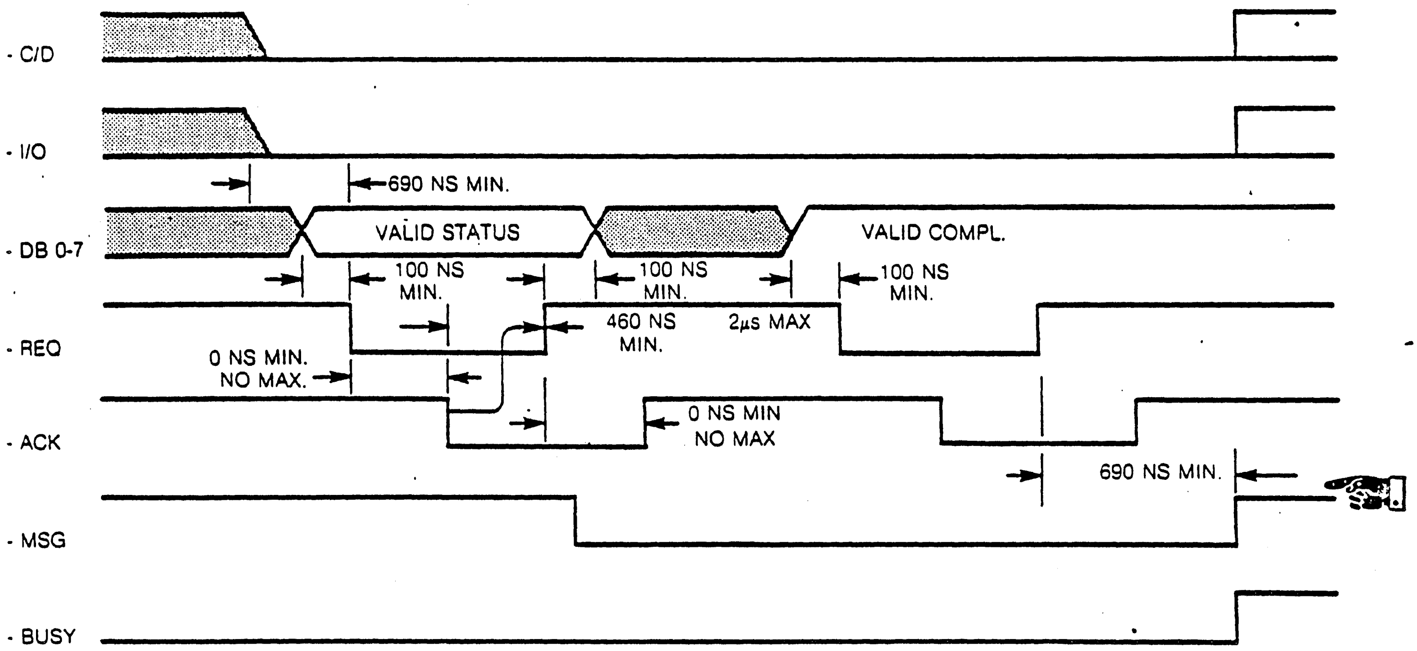


**FIGURE 8.** STATUS AND COMPLETION SEQUENCE TIMING

## 5.0 CONTROLLER COMMAND DESCRIPTOR BLOCK

Following the controller selection sequence the controller will request a command descriptor block (CDB) which, depending on the class of command, may be either 6 or 10 bytes in length. The first byte of the CDB contains the command class and the command operation code. The remaining bytes specify the drive logical unit number (LUN), logical sector address, number of sectors to be transfered or a destination device (Copy Command), and a control field byte.

Commands are categorized into four classes as indicated:

| | |
|---|---|
| Class 0 | - Utility, Data Transfer and Status Commands |
| Class 1 | - Disk Copy Commands |
| Class 2-5,7 | - Reserved |
| Class 6 | - Floppy Disk Track Format Selection |

The command descriptor blocks in Command Class 0 and 6 are 6 bytes long, and those in Class 1 are 10 bytes long.

The controller will check all incoming command descriptor blocks for validity and will also check (if enabled) all CDB's and data for odd parity (see section 9.1). A parity error will cause an immediate halt of the command or data transfer. This will not cause incorrect data to be written because the write does not occur until the sector buffer has been filled. An error in the command structure will cause a status byte transfer to occur upon completion of the CDB transfer.

## 5.1 COMMAND DESCRIPTION (CLASS 0)

***WARNING!***
Commands READ and WRITE require that the floppy diskette used be formatted. If unformatted, the controller will appear to "hang" - i.e., continue waiting for a data address mark. (Reset to clear this condition if it should occur).

| **Opcode (Hex)** | **Description** |
|---|---|
| 00 | Test drive ready - Selects the drive and verifies drive ready. The ready condition is indicated by the status byte. A not-ready drive will cause bit 1 of the status byte to be set. |
| 01 | Recalibrate. Positions the R/W of selected drive arm to Track 00, clears error status in the drive. |
| 02 | Request Syndrome - returns two bytes of error offset and syndrom to the Host System for Host error correction capability (see Table 3). The first byte is offset in the data field of the error location. The most significant 3 bits of the second byte point to the beginning of the error location. The least significant 4 bits of the second byte are the syndrome which is a data correction mark to be exclusive or'ed with the faulty data. This command is only valid of the automatic data correction has been disabled. |

| | MSB | | | | | | | LSB |
|---|---|---|---|---|---|---|---|---|
| | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| BYTE 1 | BYTE OFFSET | | | | | | | |
| BYTE 2 | BIT OFFSET | | | 0 | SYNDROME | | | |

**TABLE 3**

| | |
|---|---|
| 03 | Request Sense. This command must be issued immediately after an error. It returns 4 bytes of drive and controller sense for the specified LUN. (See copy block for exception) |
| 04 | Format Drive. Formats all blocks with ID field set according to interleave code. The data field contains E5 Hex. |
| 05 | Spare. |
| 06 | Format Track. *Formats the specified track with bad block flag cleared in all blocks of that track. Writes E5 Hex in the data fields. |
| 07 | Format Bad Track *(bad block flag). Formats the specified track with bad block flag set in the ID fields (bit 7 of the Head Address byte set). Writes E5 Hex in the data fields. |
| 08 | Read. Reads the specified number of blocks starting from initial block address given in the CDB. (See Warning above!) |
| 09 | Reserved. |
| 0A | Write. Writes the specified number of blocks starting from initial block address given in the CDB. (See Warning above!) |
| 0B | Seek. Initiates seek to specified block and immediately returns completion status before the seek is complete for those drives capable of overlap seek. |

The track is addressed via the logical sector address, which may be any address within the desired track.

### 5.1.2 COMMAND DESCRIPTION (CLASS 1)

| Opcode (Hex) | Description |
|---|---|
| 00 | Copy Blocks. Copies the specified number of blocks from Source LUN starting at the specified Logical address to Destination LUN starting at the specified Logical address. The number of sectors transferred may be from 1 to 256. The completion status byte will indicate the source LUN. If an error occurs, a Request Sense command is issued to the source LUN. The sense will indicate the type of error for the appropriate LUN. Note the data in the blocks will be truncated or appended with undefined data if the Source and Destination block sizes are not the same (e.g. Source block size - 128 bytes/sector, and Destination block size - 256 bytes/sector). |

### 5.1.3 COMMAND DESCRIPTION (CLASS 6)

| Opcode (Hex) | Description |
|---|---|
| 00 | Define Floppy Disk Track Format. The Track format code in byte 6 of the CDB defines the track format for the LUN. The Track Format Codes are as follows: |

| Track Format Code (Hex) | Description |
|---|---|
| 00 | Single Density, Single Sided. All tracks - FM recording, 128 bytes/sector, 26 sectors/track. |
| 01 | Single Density, Double Sided. All tracks - FM recording, 128 bytes/sector, 26 sectors/track. |
| 02 | Double Density, Single Sided. Side 0, Cylinder 0 - FM Recording, 128 bytes/sector, 26 sectors/track. All other tracks - MFM recording, 256 bytes/sector, 26 sectors/track. |
| 03 | Double Density, Double Sided. Side 0, Cylinder 0 - FM recording, 128 bytes/sector, 26 sectors/track. All other track - MFM recording, 256 bytes/sector, 26 sectors/track. |

NOTE: If track format information for floppy is not specified after each reset or power-on, the default mode will be taken from the drive type selection dipswitch as follows:

| Switch Setting | Mode |
|---|---|
| OFF-ON | Single density, single sided (same as track format code 00) |
| OFF-OFF | Single density, double sided (same as track format code 01) |

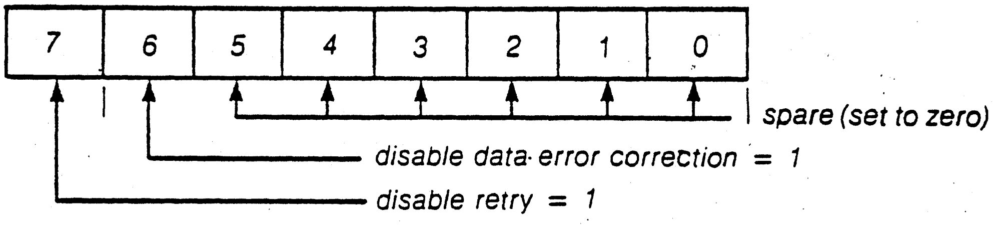
Refer to Section 9.2 for switch setup instructions.

### 5.2 COMMAND FORMAT

### 5.2.1 CLASS 0 COMMANDS

| | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| *byte #1* | *0 0 0* | | | *opcode* | | | | |
| *byte #2* | *LUN* | | | *logical adr2*** *(MS)* | | | | |
| *byte #3* | *logical adr1*** | | | | | | | |
| *byte #4* | *logical adr0*** *(LS)* | | | | | | | |
| *byte #5* | *number of blocks** | | | | | | | |
| *byte #6* | *control**** | | | | | | | |

* *Interleave factor for Format, Check Track Format commands.*
**Refer to Section 5.5 Logical Address.
****The control field is defined as follows:*



CONTROL FIELD

### 5.2.2 CLASS 1 COMMANDS

| | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| *byte #1* | 0 | 0 | 1 | opcode | | | | |
| *byte #2* | 0 | LUN/s | | logical adr2/s* (MS) | | | | |
| *byte #3* | logical adr1/s* | | | | | | | |
| *byte #4* | logical adr0/s* (LS) | | | | | | | |
| *byte #5* | number of blocks | | | | | | | |
| *byte #6* | 0 | LUN/d | | logical adr2/d* (MS) | | | | |
| *byte #7* | logical adr1/d* | | | | | | | |
| *byte #8* | logical adr0/d* (LS) | | | | | | | |
| *byte #9* | spare | | | | | | | |
| *byte #10* | control (section 5.2.1) | | | | | | | |

where 's' indicates the source device and 'd' indicates the destination device.
*Refer to Section 5.5 Logical Address

### 5.2.3 CLASS 6 COMMANDS

| | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| *byte #1* | 1 | 1 | 0 | opcode | | | | |
| *byte #2* | LUN | | | N/A | | | | |
| *byte #3* | N/A | | | | | | | |
| *byte #4* | N/A | | | | | | | |
| *byte #5* | N/A | | | | | | | |
| *byte #6* | Track Format Code | | | | | | | |

NOTE: See Class 6 Command Description for more information and default modes for floppy drives.

## 5.3 STATUS FORMAT

### 5.3.1 Completion Status Byte Format

At the normal termination of a command or following a fatal error, the controller will cause a status byte to be transferred from the controller to the Host. Bit 0, the least significant bit of the status byte, will be set equal to 1 if the controller detects a parity error during a command or data transfer to the controller. Bit 1 will be set = 1 if the controller detects an error condition. Bits 5 and 6 represent the LUN of the device where the error occured. If no error occurs, bit 0 - 4 will be set equal to 0.

Following the transfer of the status byte, the MSG line will be asserted to indicate a completion message. At this time the message consists of a single byte transfer with all bits set = 0.

Prior to an error condition the controller, unless diabled (see section 5.2.1 Control Field), will retry 3 times before posting the error.

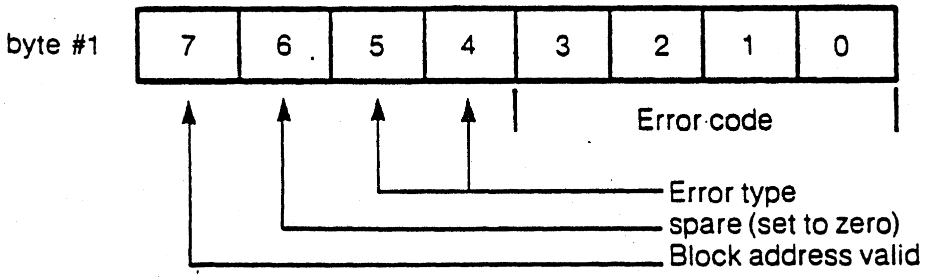
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 | MS | LS<br>LUN | spare<br>(set = 0) | | | Error | Parity error |

Bit 0 Parity error during transfer from host to controller.
Bit 1 Error occured during command execution.
Bit 2-4 Spare (set to zero).
Bit 5-7 Logical unit number of the drive.

### 5.3.2 DRIVE AND CONTROLLER SENSE BLOCK

Following an error indication from the status byte, the Host may perform a REQUEST SENSE command to obtain more detailed information about the error.

The REQUEST SENSE command will transfer a block of 4 bytes to the Host system.



| | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| byte #2 | LUN | | | logical adr2* | | | | |
| byte #3 | logical adr1* | | | | | | | |
| byte #4 | logical adr0* | | | | | | | |

*Refer to Section 5.5 Logical Address

### 5.4 ERROR CODES

#### 5.4.1 TYPE 0 (DRIVE) ERROR CODES

0 No error
1 No Index signal
2 No Seek Complete
3 Write Fault (SA1000 only)
4 Drive not ready
5 Drive not selected (SA1000 only)
6 No Track 00

#### 5.4.2 TYPE 1 (CONTROLLER) ERROR CODES

0 ID read error. ECC or CRC (floppy) error in the ID field (uncorrectable).
1 Uncorrectable data error during a read.
2 ID Address Mark not found (possibly unformated disk).
3 Data Address Mark not found.
4 Record not found. Found correct cylinder and head but not sector.
5 Seek error. R/W head positioned on a wrong cylinder and/or selected a wrong head.
6 DMA Data time out error. No Host acknowledge within 256$\mu$s.
7 Write protected. (SA800/850 only)
8 Correctable data field error. ECC error (automatic correction if not disabled).
9 Bad track found
A Format Error. The controller detected that during the Check Track command, the format on the drive was not as expected.

### 5.4.3 TYPE 2 (COMMAND) ERROR CODES

0 Invalid Command received from the host.<br>
1 Illegal logical sector address. Address is beyond the maximum address for the type of drive.<br>
2 Illegal function for the specified drive.

### 5.5.4 TYPE 3 (MISC) ERROR CODES

0 RAM error. Data error detected during Sector buffer RAM diagnostic.

### 5.5 LOGICAL ADDRESS

The logical address is computed as follows:

Logical adr = (CYADR * HDCYL + HDADR) * SETRK + (SEADR)

Where:
CYADR = cylinder address
HDADR = head address
SEADR = sector address
HDCYL = number of heads per cylinder
SETRK = number of sectors per track

Bit 0 of Logical adr 0 = the least significant bit.
Bit 4 of Logical adr 2 = the most significant bit.

**Note:** All addresses begin with 00.

## 6.0 SECTOR INTERLEAVE CODES

In order to tailor host system data transfer speed to the disk rotational speed, sector interleaving is offered. Sixteen interleave codes are offered numbered 1 to 16. Not all interleave codes will result in optimum sector interleave, therefore the interleave should be chosen carefully. In order to maintain IBM floppy disk compatibility in interleave code of 1 should be used. This will result in a non-interleave condition.

## 6.1 SELECTING THE RIGID DISK INTERLEAVE CODE

The interleave code given during the format command is used to calculate the logical sector number for the rigid disk as follows: Logical Sector = (Physical Sector × Interleave code) (mod 32). Note: when the logical sector number exceeds 31 the next logical sector is the lowest available physical sector. This does not always create a true modulo function.

Two examples of interleave codes are shown:

Interleave code of 2:

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Physical: | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| Logical: | 0 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 |
| Physical: | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| Logical: | 1 | 3 | 5 | 7 | 9 | 11 | 13 | 15 | 17 | 19 | 21 | 23 | 25 | 27 | 29 | 31 |

Interleave code of 11:

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Physical: | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| Logical: | 0 | 11 | 22 | 1 | 12 | 23 | 2 | 13 | 24 | 3 | 14 | 25 | 4 | 15 | 26 | 5 |
| Physcial: | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| Logical: | 16 | 27 | 6 | 17 | 28 | 7 | 18 | 29 | 8 | 19 | 30 | 9 | 20 | 31 | 10 | 21 |

| Code | Number of Disk Revolutions Required to Read One Track | Time available to Transfer one Byte of Data (including controller time) | Minimum Number of Idle Sectors Between Reads |
|---|---|---|---|
| 11 | 3 | 4.7μs | 2 |
| 8 | 4 | 7.0μs | 3 |
| 6 | 6 | 9.4μs | 4 |
| 5 | 7 | 11.7μs | 5 |
| 4 | 8 | 16.4μs | 7 |
| 3 | 11 | 23.4μs | 10 |
| 2 | 16 | 35.1μs | 15 |
| 1 | 32 | 72.5μs | 31 |

- (for SA1400 series controllers operating with SA1000 series drives - double density, 32 sectors, 256 bytes/sector.)

**Note:** Other codes will work, but require more revolutions of the disk to read all sectors of one track.

**TABLE 3.** INTERLEAVE CODE SELECTION CHART*

## 7.0 DIAGNOSTIC PHILSOPHY

### 7.1 BOARD RESIDENT MICRODIAGNOSTIC

Fault Isolation Microdiagnostic (Optional)
The controller can be further checked out off-line by initiating explicit microdiagnostic routines via optional firmware diagnostic sets. The routines are initiated by a set of control switches. Errors will be dislayed in a set of LED's. Each microdiagnostic checks the funtionality of a particular section of the controller and is able to isolate failures in the following major categories:

ALU
Registers
Sector Buffer
ECC Logics

Fault-isolation techniques can be concentrated on the failing section.

## 8.0 STATUS LED ERROR INTERPRETATION

Drive/controller error conditions are displayed on the 8 LED display lights provided near the J10 DC power connector (see Figures 11). The following list of hexadecimal numbered error codes describe error meanings. Note that these error codes do not necessarily match the request sense block error codes. LED number 7 is the MSB.

| | |
|---|---|
| 01 | No Index Detected |
| 02 | No Track Zero Detected |
| 03 | Illegal Logical Sector Address - beyond maximum sectors available for type of drive |
| 04 | Drive Not Selected (SA1000 only) |
| 05 | No Seek Complete Detected |
| 06 | ID Address Mark Not found (unformatted) |
| 07 | Data Address Mark Not found |
| 08 | Seek Error - R/W head not positioned on correct track |
| 09 | Record Not found - found correct cylinder and head but not sector |
| 0A | ID ECC or CRC error (uncorrectable) |
| 0B | DMA Timeout Error - no Host acknowledge within 256μsec after request. |
| 0C | Invalid Command Received from Host |
| 0D | Incorrect Data Address Mark |
| 0E | Incorrect ID Address Mark |
| 0F | Incorrect Cylinder Address |
| 10 | Incorrect Sector Address |
| 11 | Incorrect Head Address |
| 12 | Uncorrectable Data Field ECC or CRC error |
| 13 | Correctable Data Field ECC error |
| 14 | Drive Not Ready |
| 15 | Write Fault (SA1000 and SA4000/4100 only) |
| 16 | Spare |
| 17 | Write Protected (SA800/850 only) |
| 18 | RAM Diagnostic Error |
| 19-1F | Spare |
| 20 | Parity Error |
| 21 | Bad Sector found - a sector within a track that has been flagged bad has been found. |
| 22 | Invalid function for this drive type. |

## 9.0 CONTROLLER OPTION SELECTION

### 9.1 PARITY SELECT JUMPERS

Odd parity may be used by the Host system for data integrity verification. The controller will always output odd parity to the Host system.

Odd parity checking by the controller may be allowed or inhibited by moving a 3 position jumper plug at W2 located near the J6 Host connector (see Figure 11). With jumper at position A + B the controller will test for odd parity on all data input to the controller. With jumper at positon B + C the controller will not check for parity (normally shipped in A + B).

### 9.2 DRIVE TYPE SELECTION DIPSWITCH

The dipswitch settings for various types of drives for the SA1403D are shown below:

Prom Set AS30 — I, II, III, IV　　CUSTOMER FIRMWARE: (DIP SWITCH set-up procedure)

Location: 2H

| Switch Bits | 8　7 | 6　5 | 4　3 | 2　1 | |
|---|---|---|---|---|---|
| Field Definition | LUN 0 Drive Type | LUN 1 Drive Type | LUN 2 Drive Type | LUN 3 Drive Type | OFF<br>ON |

| Drive Type | Switch Setting | | Description | |
|---|---|---|---|---|
| | Even | Odd | | |
| 0 | on | on | SA1002 | 2 heads, 256 cylinders |
| 1 | on | off | SA1004 | 4 heads, 256 cylinders |
| 2 | off | on | SA800 | 1 head, 77 cylinders |
| 3 | off | off | SA850 | 2 heads, 77 cylinders |

| EXAMPLE: | 8　7 | 6　5 | 4　3 | 2　1 | |
|---|---|---|---|---|---|
| LOCATION: 23 | LUN 0 Drive Type<br>on　on | LUN 1 Drive Type<br>off　on | LUN 2 Drive Type<br>on　off | LUN 3 Drive Type<br>off　off | OFF<br>ON |

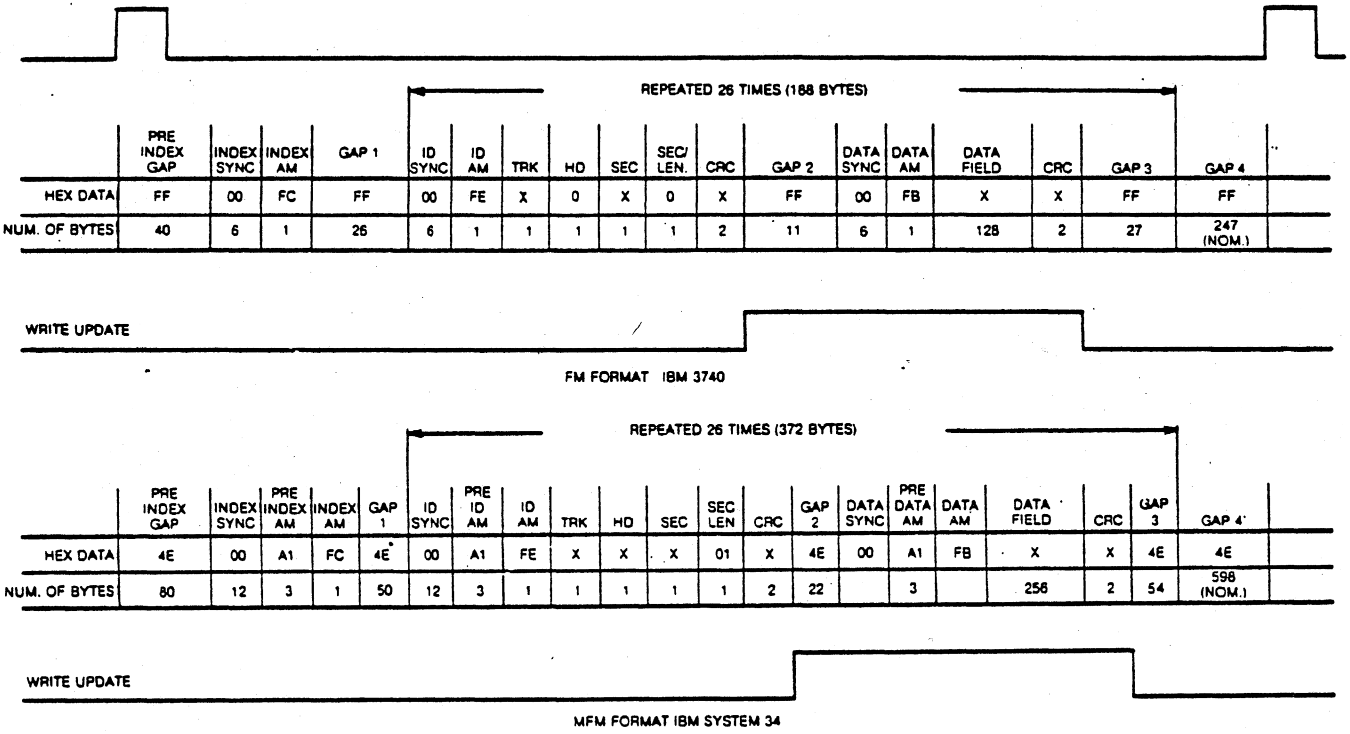
Drive 0 is set up for SA1002
Drive 1 is set up for SA800
Drive 2 is set up for SA1004
Drive 3 is set up for SA850

## 10.0 TRACK FORMAT DESCRIPTION

### 10.1 26 SECTOR FORMAT

The 26 sector format is an IBM compatible format which employes FM single density encoding on all tracks of the single density format (IBM 3740 compatible) and on track 0, side 0 of the double density format. This format yields 26 sectors of 128 bytes per sector.

The remainder of the tracks on the double density formats are encoded with MFM double density which yields 26 sectors of 256 bytes per sector (IBM system 34 compatible). Figure 9 shows the two type of encoding utilized.



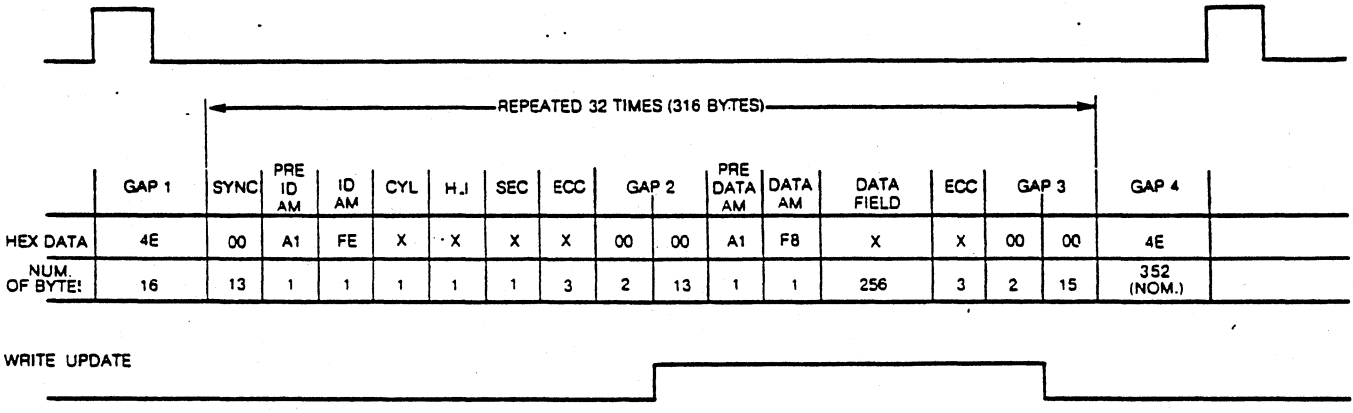
| | PRE INDEX GAP | INDEX SYNC | INDEX AM | GAP 1 | ID SYNC | ID AM | TRK | HD | SEC | SEC/ LEN. | CRC | GAP 2 | DATA SYNC | DATA AM | DATA FIELD | CRC | GAP 3 | GAP 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HEX DATA | FF | 00 | FC | FF | 00 | FE | X | 0 | X | 0 | X | FF | 00 | FB | X | X | FF | FF |
| NUM. OF BYTES | 40 | 6 | 1 | 26 | 6 | 1 | 1 | 1 | 1 | 1 | 2 | 11 | 6 | 1 | 128 | 2 | 27 | 247 (NOM.) |

| | PRE INDEX GAP | INDEX SYNC | PRE INDEX AM | INDEX AM | GAP 1 | ID SYNC | PRE ID AM | ID AM | TRK | HD | SEC | SEC LEN | CRC | GAP 2 | DATA SYNC | PRE DATA AM | DATA AM | DATA FIELD | CRC | GAP 3 | GAP 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HEX DATA | 4E | 00 | A1 | FC | 4E | 00 | A1 | FE | X | X | X | 01 | X | 4E | 00 | A1 | FB | X | X | 4E | 4E |
| NUM. OF BYTES | 80 | 12 | 3 | 1 | 50 | 12 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 22 | | 3 | | 256 | 2 | 54 | 598 (NOM.) |

**FIGURE 9.** 26 SECTOR FORMAT - SA800/850

### 10.2 32 SECTOR FORMAT

The 32 sector format employs MFM encoding on all tracks of the SA1000. This format yields 32 sectors of 256 bytes per sector. Figure 10 shows the 32 sector format.



| | GAP 1 | SYNC | PRE ID AM | ID AM | CYL | H.J | SEC | ECC | GAP 2 | | PRE DATA AM | DATA AM | DATA FIELD | ECC | GAP 3 | | GAP 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HEX DATA | 4E | 00 | A1 | FE | X | X | X | X | 00 | 00 | A1 | F8 | X | X | 00 | 00 | 4E |
| NUM. OF BYTE! | 16 | 13 | 1 | 1 | 1 | 1 | 1 | 3 | 2 | 13 | 1 | 1 | 256 | 3 | 2 | 15 | 352 (NOM.) |

**FIGURE 10.** 32 SECTOR FORMAT - SA1000

## 11.0 DRIVE JUMPER SETTINGS

### 11.1 JUMPER SETTINGS FOR SA800/801 FLOPPY

The following information is contained in the SA800/801 Diskette Storage Drive OEM Manual, Shugart Associates, 1977.

| Jumper Name | Function (Enabled if Jumper Installed) |
|---|---|
| A | Install enable DRSEL to drive selection |
| B | Install, Head Load on Drive Select |
| C | Remove, Drive Select loads heads |
| D | Remove, In Use to LED is disabled |
| DC | Remove, Disable Disk Change to return to controller |
| DS | Install enable stepper on Drive Select |
| DS1-4 | Install one only, DS1 = LUN 0 (Drive Select) |
| HL | Remove, Head load on Drive Select |
| L | Jumper for -5V (remove for -15V), controller requires -5V only |
| T1 | Remove, Head Load terminator |
| T2 | Install, Pullup for Drive Select lines |
| T3 | Install, Direction terminator |
| T4 | Install, Step terminator |
| T5 | Install, Write Data terminator |
| T6 | Install, Write Gate terminator |
| X | Install, Head Load Enable |
| Y | Remove, Disable Hdld from driving LED |
| Z | Install drive select drives in use LED |
| 800 | Install, enables 800 index only operation |
| 801 | Remove, disables 801 mode operation |

### 11.2 JUMPER SETTINGS FOR SA850/851 FLOPPY

**Jumper Name Function (Enabled if Jumper Installed)**

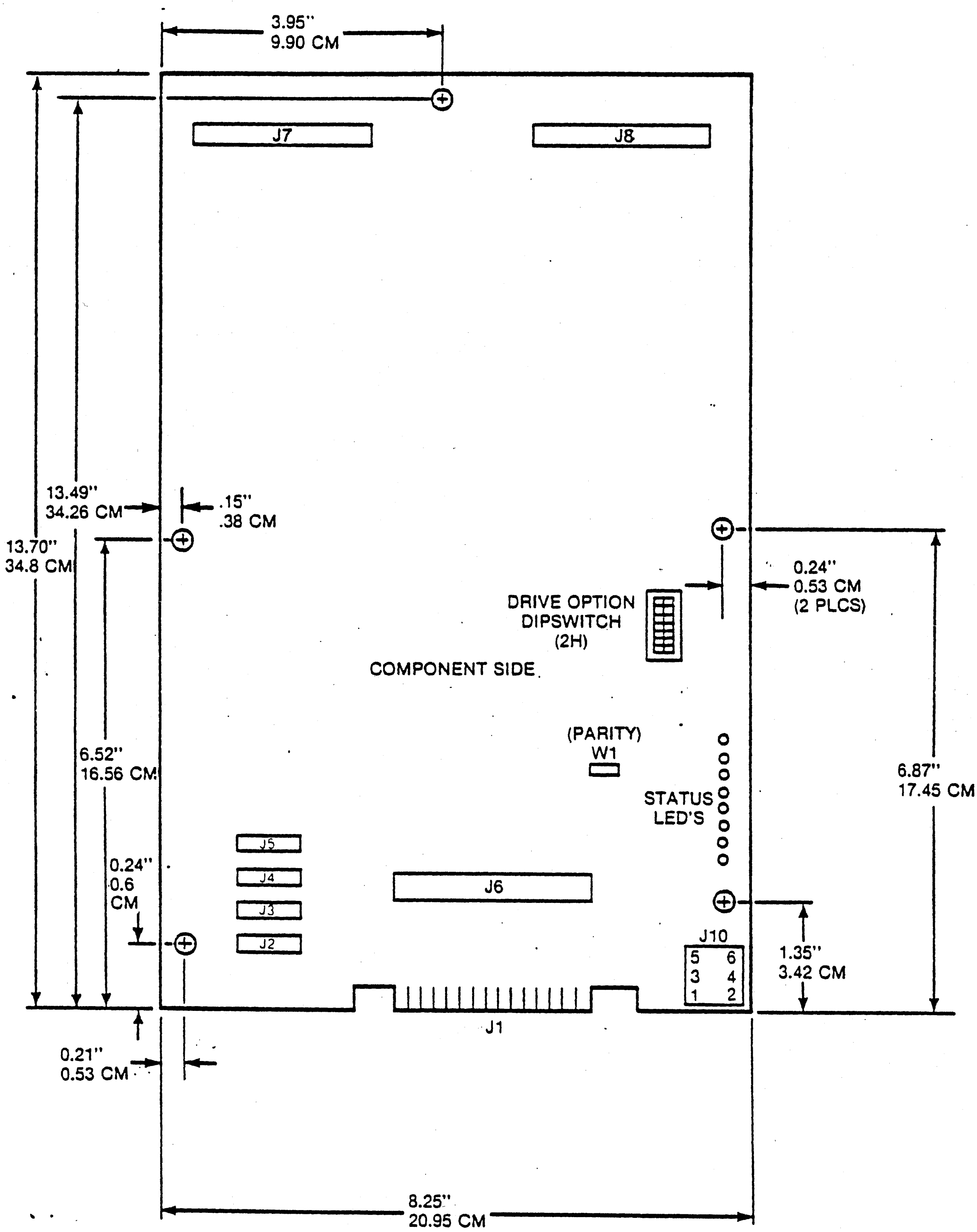
Controller is compatible with the factory jumper configuration. See SA850/851 OEM Manual.

**Note:** Jumpers must be set for SA850, not SA851

### 11.3 JUMPER SETTINGS FOR SA1000 WINCHESTER

**Jumper Name Function (Enabled if Jumper Installed)**

Controller is compatible with the factory jumper configuration. See SA1000 OEM Manual.



ALL TOLERANCES ± .003"

**FIGURE 11.** SA1403D DIMENSIONAL DRAWING

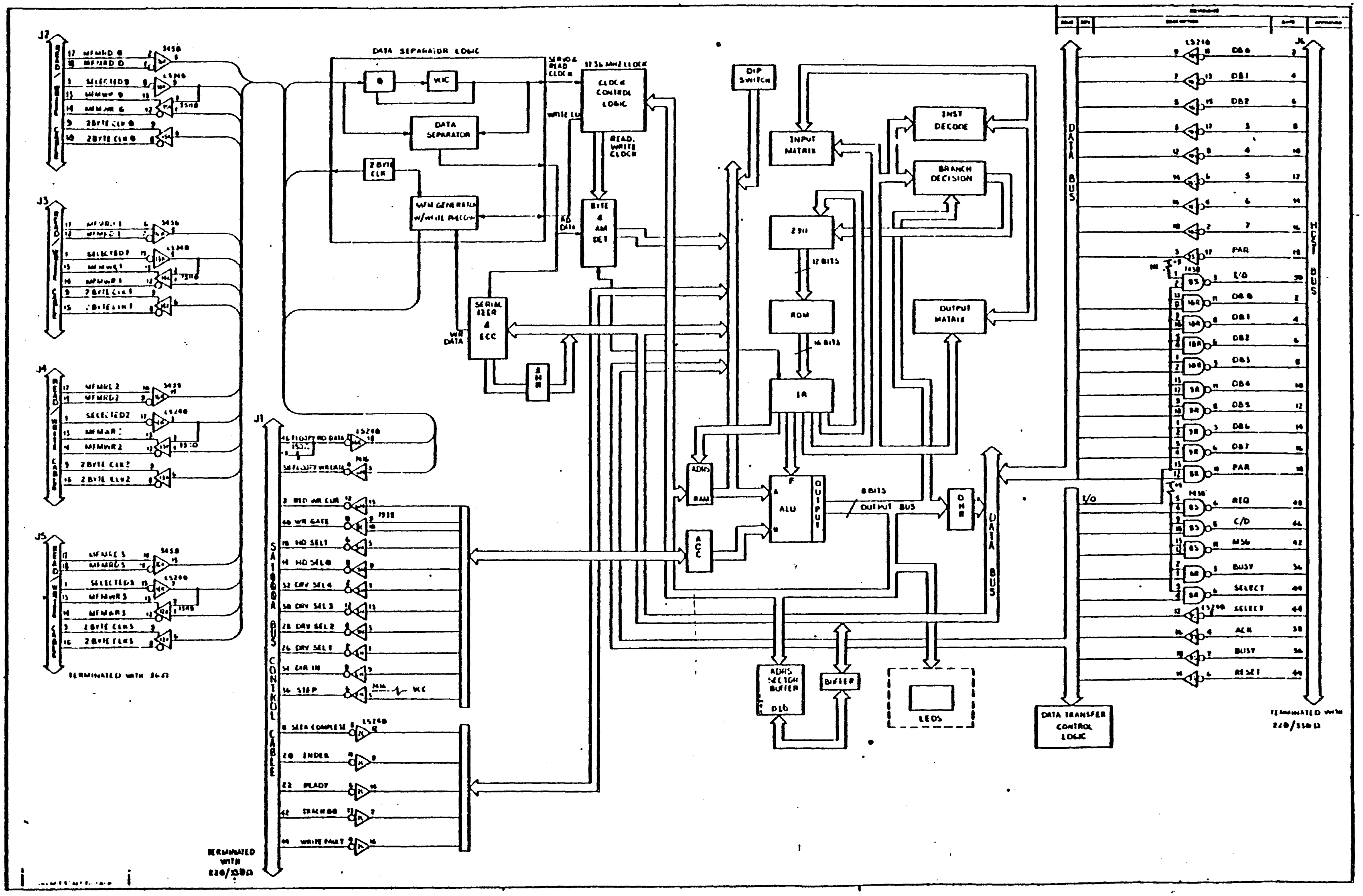


FIGURE 12. SA1403D FUNCTIONAL BLOCK DIAGRAM

## Notes

# APPENDIX A

## CP/M-80 2.2 BIOS Programming Considerations

BIOS provides the operations necessary to access the disk drives and to interface with peripherals. The user interface with the BIOS is through a series of Entry Points. These entry points are "Jump Vectors". Each jump address corresponds to a particular subroutine which performs a specific function. The Base ( + B for the jump vectors) depends on the size of RAM memory.

### BIOS Entry Vector Table

**BIOS Cold Boot**

| | |
|---|---|
| Entry Point: | (Bbase + 00) - Bios |
| Function(s): | This entry is called only by the Boot Loader to initialize CP/M. |
| Argument(s): | None |
| Value(s) Returned: | None |
| Registers Saved: | None |
| Errors Returned: | None |

**BIOS Warm Boot**

| | |
|---|---|
| Entry Point: | (Bbase + 03) - Bwboot |
| Function(s): | Perform a Warm Start by reloading the CCP and BDOS from the disk in the A: drive, returning control to the CCP. |
| Argument(s): | None |
| Value(s) Returned: | None |
| Registers Saved: | None |
| Errors Returned: | None in registers; however, message 'Boot Err' is displayed. |

**BIOS Console Status**

| | |
|---|---|
| Entry Point: | (Bbase + 06) - Bconst |

**BIOS Console Input**

| | |
|---|---|
| Entry Point: | (Bbase + 09) - Bconin |

**BIOS Console Output**

| | |
|---|---|
| Entry point: | (Bbase + 0C) - Bconot |

**BIOS List Output**

| | |
|---|---|
| Entry Point: | (Bbase + 0F) - Bprint |

**BIOS Punch Output**

| | |
|---|---|
| Entry Point: | (Bbase + 12) - Bpunch |

**BIOS Reader Input**

| | |
|---|---|
| Entry Point: | (Bbase + 15) - Breadr |

**BIOS Home Disk**

| | |
|---|---|
| Entry Point: | (Bbase + 18) - Bhome |
| Function(s): | Sets track number to zero in preparation for disk access. |
| Arguments: | None |
| Value(s) Returned: | None |
| Registers Saved: | None |
| Errors Returned: | None |

**BIOS Select Disk**

Entry Point: (Bbase + 1B) - Bseld

Function(s): Select the requested logical disk. The drive that will be logged on in further operations is the default drive (or drive A if the default drive cannot be selected).

Arguments:
(C) = drive to select (00 - 0F)
(E) = even if media identification required
(E) = odd if media identification previously issued and no disks removed/replaced

Value(s) Returned:
(HL) = address of CP/M-compatible Disk Parameter Header if select successful
(HL) = 0 otherwise

Registers Saved: None

Errors Returned: None

**BIOS Set Track**

Entry Point: (Bbase + 1E) - Bsett

Function(s): Stores desired track number in preparation for a disk read or write record call.

Argument(s): (BC) = track number

Value(s) Returned: None

Registers Saved: None

Errors Returned: None

**BIOS Set Sector**

Entry Point (Bbase + 21) - Bsets

Function(s): Stores desired sector number in preparation for a read or write record call.

Argument(s): (BC) = sector number

Value(s) Returned: None

Registers Saved: None

Errors Returned: None

### BIOS Set DMA Address

| | |
|---|---|
| Entry Point: | (Bbase + 24) - Bsetd |
| Function(s): | Stores desired transfer address in preparation for a read or write a record call. |
| Argument(s): | (BC) = transfer address |
| Value(s) Returned: | None |
| Registers Saved: | None |
| Errors Returned: | None |

### BIOS Read Sector

| | |
|---|---|
| Entry Point: | (Bbase + 27) - Bread |
| Function(s) | Transfer one 128 (decimal) byte record from the selected disk to the current DMA transfer address. |
| Argument(s): | Bseld, Bsett, Bsctrn, Bsets, Bsetd previously called. |
| Value(s) Returned: | None |
| Registers Saved: | none |
| Errors Returned: | (A) = 00 if no error<br>(A) = FF if error |

### BIOS Write Sector

| | |
|---|---|
| Entry Point: | (Bbase + 2A) - Bwritt |
| Function(s): | Transfer one 128 (decimal) byte record from the current DMA transfer address to the selected disk. |
| Argument(s): | Bseld, Bsett, Bsctrn, Bsets, Bsetd previously called. |
| Value(s) Returned: | None |
| Registers Saved: | None |
| Errors Returned: | (A) = 00 if no error<br>(A) = FF if error |

### BIOS List Status

| | |
|---|---|
| Entry Point; | (Bbase + 2D) - Bprnts |

**BIOS Sector Translate**

| | |
|---|---|
| Entry Point: | (Bbase + 30) - Bsctrn |
| Function(s): | Translate a logical sector number into a physical sector number in preparation for a call to Bsets, the BIOS set sector call. |
| Argument(s): | (BC) = Sector number<br>(0 < = (BC) < sectors per track<br>(DE) = Skew table address obtained from the CP/M Disk Parameter Header |
| Value(s) Returned: | (HL) = (BC) if (DE) = 0<br>(L) = [(DE) + (BC)] if (DE) = 0<br>(H) = (B) should be 0 |
| Registers Saved: | None |
| Errors Returned: | None |

## Notes

# APPENDIX B

## Monitor Entry Vector Table

| | |
|---|---|
| F000H | Cold start monitor |
| F003H | Warm start monitor |
| F006H | Keyboard status |
| F009H | Keyboard input |
| F00CH | CRT output |
| F00FH | Fast CRT output from C |
| F012H | SIO channel B input status |
| F015H | SIO channel B input |
| F018H | SIO channel B output |
| F01BH | Drive select |
| F01EH | Home r/w head |
| F021H | Seek to track |
| F024H | Read sector |
| F027H | Write sector |
| F02AH | Execute physical driver request |
| F02DH | Set direct CRT cursor |
| F030H | Direct CRT display |
| F033H | CRT memory block move |
| F036H | Return address of disk mapping table |
| F039H | Return address of day variable |
| F03CH | Return configuration status |
| F03FH | SIO channel B output ready status |
| F042H | Set configuration |
| F045H | Start screen print |
| F048H | Accessible 1-second interrupt |
| F04BH | Console status through iobyte |
| F04EH | Console input through iobyte |
| F051H | Console output through iobyte |
| F054H | Printer output through iobyte |
| F057H | Printer status through iobyte |
| F05AH | Communications input ready status |
| F05DH | Communications input data |
| F060H | Communications output data |
| F063H | Communications output ready status |
| F066H | Idle while i/o is pending |
| F069H | Record soft error |

## Notes

# APPENDIX C

## Documented System Storage and Structures

### Z80-A Mode 2 Interrupt Vectors

```
FF00    SIOVO:   DEFS2    ;Z80-A SIO port B xmit buffer empty
FF02    SIOV1:   DEFS2    ;Z80-A SIO port B external/status change
FF04    SIOV2:   DEFS2    ;Z80-A SIO port B receive data available
FF06    SIOV3:   DEFS2    ;Z80-A SIO port B special receive
                          condition
FF08    SIOV4:   DEFS2    ;Z80-A SIO port  A xmit buffer empty
FF0A    SIOV5:   DEFS2    ;Z80-A SIO port A external/status change
FF0C    SIOV6:   DEFS2    ;Z80-A SIO port A receive data available
FF0E    SIOV7:   DEFS2    ;Z80-A SIO port A special receive
                          condition

FF10    CTCVO:   DEFS2    ;Z80-A CTC channel 0 interrupt
FF12*   CTCV1:   DEFS2    ;Z80-A CTC channel 1 interrupt
FF14    CTCV2:   DEFS2    ;Z80-A CTC channel 2 interrupt
FF16*   CTCV3:   DEFS2    ;Z80-A CTC channel 3 interrupt

FF18    SYSVA:   DEFS2    ;System Z80-A PIO port A interrupt
FF1A*   SYSVB:   DEFS2    ;System Z80-A PIO port B interrupt

FF1C    GENVA:   DEFS2    ;General purpose Z80-A PIO port A
                          interrupt
FF1E    GENVB:   DEFS2    ;General purpose Z80-A PIO port B
                          interrupt
```

*Vectors used by the Monitor ROM

### Keyboard Data Input FIFO Variables

```
FF20    fifo:    defs 16  ;Console input fifo
FF30    fifcnt:  defs 1   ;FIFO data counter
FF31    fifin:   defs 1   ;FIFO input pointer
FF32    fifout:  defs 1   ;FIFO output pointer

FF33             defs 1   ;Round address
```

### More Interrupt Vectors

```
FF34    expvec:   defs 8       ;Space for 4 vectors for expansion slot
```

### Available Memory Pointers

```
FF3C    availb:   defs 2       ;Bottom of available memory
FF3E    availt:   defs 2       ;Top of available memory
```

### End of documented storage locations

### Logical to Physical Drive Mapping Tables

Seltab contains two bytes per logical CP/M drive A-P. The first byte is an index into the physical driver address table (see next table). The second byte is a unit number that is passed to the driver by the XQDVR dispatcher.

```
 Seltab:

     A:   defb    1,0     ;Floppy unit 0
     B:   defb    1,1     ;Floppy unit 1
     C:   defb    1,2     ;Floppy unit 2
     D:   defb    1,3     ;Floppy unit 3

     E:   defb    1,4     ;Rigid partition 0
     F:   defb    1,5     ;Rigid partition 1
     G:   defb    1,6     ;Rigid partition 2
     H:   defb    1,7     ;Rigid partition 3
     I:   defb    0,0     ;Error driver
     J:   defb    0,0     ;Error driver
     K:   defb    0,0     ;Error driver
     L:   defb    0,0     ;Error driver
     M:   defb    0,0     ;Error driver
     N:   defb    0,0     ;Error driver
     O:   defb    0,0     ;Error driver
     P:   defb    0,0     ;Error driver
```

**Physical Driver Address Table**

Drvtab contains the addresses of several independent physical disk drivers. By convention, driver number 0 always returns a select error. Unused entries in Seltab should point to this trivial driver.

```
Drvtab:   defw    Selerr   ;Select error physical driver
          defw    Dskdvr   ;Disk driver (WD or SA)
          defw    0        ;Empty physical driver
                           ;Expansion slots

          defw    0
          defw    0
          defw    0
          defw    0
          defw    0-1      ;Mark last entry
```

### Physical Driver Request Block

```
db   command        ;FF = Select
                    ;00 = Write
                    ;01 = Read
ds   1              ;For system use
db   Ldrive         ;Logical drive for request (00 - 0F)
dw   Track          ;Track number for request
dw   Sector         ;Sector number for request
dw   Address        ;Address of sector buffer for request
```

## Time-of-Day and Timer Variables

```
       Milsec:   ds   2     ;Location incremented by CTC1
                            ;Interrupt
                 ds   2     ;(unused)
       Ticker:   ds   2     ;Increments once per second
       Steprt:   ds   1     ;WD1797 step rate
        Motor:   ds   1     ;Disk motor/select timeout (1 Hz)
HL→      Day:    ds   1     ;01-31
        Month:   ds   1     ;01-12
         Year:   ds   1     ;80-99
         Hour:   ds   1     ;00-23
       Minute:   ds   1     ;00-59
       Second:   ds   1     ;00-59
       Linbuf:   ds   80    ;Line buffer
```

## How To Make Monitor Calls from Basic

Several of the monitor function calls return the value in the HL register if the H register equals 0, or return the value at the address pointed to by the HL register if the H register is not zero. This convention allows Microsoft Basic Users to access these functions directly. The examples listed in this section demonstrate this feature of the ROSR ROM.

```
100   '
110   ' Make 820-II Monitor call to get address of day variable, then
120   ' Print Day, Month etc.
130   '
140   DATA Day,Month,Year,Hour,Minute,Second
150   '
160   DEFINT I
170   GETTOD = &HF039:CALL GETTOD(I)          'Return Add. of Day
180   FOR X = 0 TO 5
190       READ X$
200       PRINT USING "\     \ ##;X$,PEEK(I + X)
210   NEXT X
220   END
```

```
100   '
110   ' Do configuration status call & print value returned
120   '
130   DEFINT I
140   GETCON = &HF03C:CALL GETCON(I)          'Get config status
150   PRINT CHR$(26);                'Clear Screen
160   PRINT "The configuration status word is - ";
170   PRINT HEX$(I);
180   PRINT " (Hex)"
190   END
```

```
100  ' Example Using Line Delete To scroll screen up.
110  ' Make 820-II Monitor Call to get address of day variable
120  ' then calculate address of line input buffer variable.
130  '
140  ' Clear screen, fill screen with characters, position
150  ' Cursor back on top line, send line delete code to CRT,
160  ' This moves the line deleted from the top of the screen
170  ' To the input buffer.
180  '
190  ' Recall deleted line from line input buffer & display
200  ' on line 23 of the screen.
210  '
220  '
230  WIDTH 255
240  PRINT CHR$(5);" ";               'Remove cursor
250  DEFINT I
260  GETTOD = &HF039:CALL GETTOD(I) 'Get address of Day Variable
270  I = I + 6              'Line input buffer is at Day + 6
280  PRINT CHR$(26);             'Clear screen
290  FOR X = 1 TO 23
300      PRINT STRING$(80,CHR$(X + 64)); 'Fill Screen
310  NEXT X
320  '
330  FOR M = 1 TO 100                'Do 100 lines
340      PRINT CHR$(30);             'Put Cursor back on top line
350      PRINT CHR$(27);"R";         'Do line delete, move deleted
360                                  'Line to buffer.
370      PRINT CHR$(27);" = ";CHR$(32 + 22);CHR$(32)
380      FOR X = 0 TO 79             'Now print characters back from
390          PRINT CHR$(PEEK(I + X);  'Input buffer
400      NEXT X
410  NEXT M
420  PRINT CHR$(26);CHR$(5);CHR$(2);  'Clear screen and
430  '                                 Restore Cursor.
440  END
```

```
100   ' Example Using Line Insert To scroll screen down.
110   ' Make 820-II Monitor Call to get address of day variable
120   ' then calculate address of line input buffer variable.
130   '
140   ' Clear screen, fill screen with characters, position
150   ' Cursor back on top line, send line insert code to CRT,
160   ' This moves the line deleted from the bottom of the screen
170   ' To the input buffer.
180   '
190   ' Recall deleted line from line input buffer & display
200   ' on the first line of the screen.
210   '
220   '
230   WIDTH 255
240   PRINT CHR$(5);" ";                   'Remove cursor
250   DEFINT I
260   GETTOD = &HF039:CALL GETTOD(I)  'Get address of Day Variable
270   I = I + 6               'Line input buffer is at Day + 6
280   PRINT CHR$(26);           'Clear screen
290   FOR X = 1 TO 23
300       PRINT STRING$(80,CHR$(X + 64)); 'Fill Screen
310   NEXT X
320   '
330   FOR M = 1 TO 100:         'Do 100 lines
340       PRINT CHR$(30);       'Put Cursor back on top line
350       PRINT CHR$(27);"E"; ' Do line insert, move deleted
360                             'Line to buffer.
370       PRINT  CHR$(27);" = ";CHR$(32 + 22);CHR$(32)
380       FOR X = 0 TO 79       'Now print characters back from
390             PRINT CHR$(PEEK(I + X);  'Input buffer
400       NEXT X
410   NEXT M
420   PRINT CHR$(26);CHR$(5);CHR$(2);   'Clear screen and
430   '                                  Restore Cursor.
440   END
```

## Bank Switching

- The Bank control switch is bit 7 of port 1C.
  Bit 7 = 0 = Bank 1 (RAM)
  Bit 7 = 1 = Bank 0 (ROM)

- Change bit 7 only: Bits 0 through 6 should be maintained.

- Bank 0 and 1 are mutually exclusive; data movement to or from one bank will not affect the other.

- When bank switching, the driver code must be executed at C000h or above; the upper 16K (C000h-FFFFh) is common memory to both banks.

For example,

```
DI
IN A,(1Ch)          ;read port
SET 7,a             ;set bit
EI
OUT (1Ch),a         ;output

DI
IN A,(1Ch)
RES 7,a             ;reset bit
EI
OUT (1Ch)
```

```
                                      title   Balcones Operating System for the XEROX 820-II
                                      .z80



                              ;;;     Balcones Operating System for XEROX 820-II.
                              ;
                              ;       Copyright 1982 (C) Balcones Computer Corporation
                              ;
                              ;                       All rights reserved
                              ;
                              ;;                      Robert Burns, Bcc.
                              ;


0191                          rev     defl    401


                                      subttl  Symbol Definitions
                                      page
```

```

FFFF                    true    equ     -1
0000                    false   equ     not true

0000                    debug   equ     false           ;assemble ram loader

                        ;;      Absolute Memory Addresses.
                        ;
0000                    rom     equ     01000h and debug;non resident code base
1800                    romsiz  equ     01000h+((not debug) and 0800h)
1800                    Rx1984  equ     01800h          ;prescription for the future
0800                    Lx1984  equ     00800h          ;length of future
0003                    iobyte  equ     00003h          ;i/o byte
0080                    bootld  equ     00080h          ;boot loader address
ED80                    bootbf  equ     0ed80h          ;boot loader buffer
FF00                    ram     equ     0ff00h          ;system ram page address
F000                    monitr  equ     0f000h          ;resident monitor address
3000                    crtmem  equ     03000h          ;crt memory address
3C00                    crtmax  equ     crtmem+24*128   ;crt maximum address
0030                    crtbas  equ     high crtmem     ;starting page of display ram
003C                    crttop  equ     high crtmax     ;ending page of display ram

                        ;;      I/O Port Addresses.
                        ;
0000                    bauda   equ     00h             ;channel a baud rate generator
0004                    siodpa  equ     04h             ;sio data port A (communications)
0005                    siodpb  equ     05h             ;sio data port B (printer)
0006                    siocpa  equ     06h             ;sio control/status port A
0007                    siocpb  equ     07h             ;sio control/status port B
0008                    gpioda  equ     08h             ;general purpose parallel i/o A data
0009                    gpioca  equ     09h             ;general purpose parallel i/o A control
000A                    gpiodb  equ     0ah             ;general purpose parallel i/o B data
000B                    gpiocb  equ     0bh             ;general purpose parallel i/o B control
000C                    baudb   equ     0ch             ;channel b baud rate generator
0010                    wd1797  equ     10h             ;western digital disk controller base
0014                    scroll  equ     14h             ;crt bottom line scroll register
0018                    ctc     equ     18h             ;quad counter/timer circuit
0018                    ctc0    equ     18h             ;ctc channel 0 (user)
0019                    ctc1    equ     19h             ;ctc channel 1 (msec, screen print)
001A                    ctc2    equ     1ah             ;ctc channel 2 (one second prescaler)
001B                    ctc3    equ     1bh             ;ctc channel 3 (one second)
001C                    syspio  equ     1ch             ;system pio data
001D                    sysctl  equ     1dh             ;system pio control
001E                    kbddat  equ     1eh             ;keyboard data
001F                    kbdctl  equ     1fh             ;keyboard control
0028                    bellof  equ     28h             ;turn bell off
0029                    bellon  equ     29h             ;turn bell on
0030                    slsden  equ     30h             ;select single density
0031                    sldden  equ     31h             ;select double density
0034                    chrom1  equ     34h             ;select ROM 1 character generator
0035                    chrom2  equ     35h             ;select ROM 2 character generator
0036                    lowlite equ     36h             ;select low intensity attribute
0068                    async   equ     68h             ;set internal clocks for asynchronous sio A
0069                    sync    equ     69h             ;set external clocks for  synchronous sio A

```

```
                        ;;      Configuration Status Byte Bit Definitions.
                        ;
  0007                  c.keym  equ     7               ;Keyboard upper bit is passed
  0006                  c.sasi  equ     6               ;Shugart SA-1403D Disk Controller
  0004                  c.five  equ     4               ;Five inch micro floppies

                        ;;      Ascii.
                        ;
  0004                  eot     equ     04h             ;ascii end of text
  000A                  lf      equ     0ah             ;ascii line feed
  000D                  cr      equ     0dh             ;ascii carriage return
  0011                  xon     equ     11h             ;ascii Xon
  0013                  xoff    equ     13h             ;ascii Xoff
  001B                  esc     equ     1bh             ;ascii escape
  001A                  clrs    equ     1ah             ;clear screen

                        ;;      Special Key Constants.
                        ;
  001E                  Helpkey equ     01eh
  009E                  Scrprt  equ     09eh            ;Screen Print key CTRL <HELP>
  009B                  Abort   equ     09bh            ;Automatic Abort  CTRL <ESC>

                        ;;      Bell Constants.
                        ;
  0035                  bltim   equ     35h             ;bell loop time
  0061                  blonc   equ     61h             ;bell on   time
  0061                  blofc   equ     61h             ;bell off  time

                        ;;      Assembly Options.
                        ;
  8000                  o.resv  equ     1000000000000000b       ;reserved
  4000                  o.auto  equ     0100000000000000b       ;auto boot A:
  2000                  o.help  equ     0010000000000000b       ;help command
  1000                  o.prot  equ     0001000000000000b       ;printer protocol
  0800                  o.ddvr  equ     0000100000000000b       ;disk drivers
  0400                  o.baud  equ     0000010000000000b       ;baud rate set command
  0200                  o.inpc  equ     0000001000000000b       ;in command
  0100                  o.outc  equ     0000000100000000b       ;out command
  0080                  o.verf  equ     0000000010000000b       ;verify memory block
  0040                  o.ramt  equ     0000000001000000b       ;simple ram test
  0020                  o.disk  equ     0000000000100000b       ;console disk read/write commands
  0010                  o.esct  equ     0000000000010000b       ;escape command table
  0008                  o.type  equ     0000000000001000b       ;typewriter mode
  0004                  o.fill  equ     0000000000000100b       ;fill memory
  0002                  o.move  equ     0000000000000010b       ;move memory
  0001                  o.term  equ     0000000000000001b       ;terminal scroll driver

  0000                  options defl    debug    and not o.ddvr and not o.esct
  0000                  options defl    options  and not o.disk and not o.resv
  0000                  options defl    options  and not o.verf and not o.fill
  0000                  options defl    options  and not o.ramt

  BFFF                  options defl    (not debug or o.esct) and not o.auto

                        ;;      configuration sector offsets.
                        ;
```

```
EE5F                   z.scra   equu    bootbf+255-32   ;initial screen attribute
EE60                   z.stpr   equ     z.scra+1        ;floppy step rate
EE62                   z.keym   equ     z.stpr+2        ;keyboard mask
EE63                   z.sioA   equ     z.keym+1        ;sio A init
EE6D                   z.sioB   equ     z.sioA+10       ;sio B init
EE77                   z.siom   equ     z.sioB+10       ;clear to send low/high/ignore
EE79                   z.siov   equ     z.siom+2        ;data carrier detect low/high/ignore
EE7B                   z.xonp   equ     z.siov+2        ;Xon/Xoff protocal
EE7D                   z.baua   equ     z.xonp+2        ;comm channel baud rate
EE7E                   z.baub   equ     z.baua+1        ;printer baud rate
EE7F                   z.iobt   equ     z.baub+1        ;initial i/o byte

                       ;;       parallel printer status bits.
                       ;
0007                   p.ackn   equ     7               ;acknowledge
0006                   p.onln   equ     6               ;on line
0005                   p.rdyi   equ     5               ;ready to input
0004                   p.rdyo   equ     4               ;ready to output
0002                   p.strb   equ     2               ;data stobe
0000                   p.auto   equ     0               ;auto LF enable

                                subttl  Code Generation Control Macros Definitions
                                page
```

```

;;      Rom code placement macros.
;
;;      The Common Segment holds the non-resident (banked) portion
;       of the monitor.  This segment is not copied to ram.
;
;;      The Data Segment holds the resident portion of the monitor.
;       It is moved to ram at location MONITR during initialization.
;
;;      The Code Segment holds the various Transient Commands.  Each
;       command is loaded from the ROM to the TPA when it is executed.
;
;;      The following macros keep it all straight.
;
;;      below - Generate code for rom below.
;
below   macro
        segment b               ;;enable common segment
        endm

;;      above - Generate code for ram above.
;
above   macro
        segment d               ;;enable data segment
        endm

;;      Overlay - Generate code for transients.
;
overlay macro   addr
tloc    defl    tloc+$-cloc
addr    equ     tloc+bloc+cloc-Monitr
        segment c               ;;enable code segment
        endm

;;      bseg - activate common segment.
;
bseg    macro
        common  /COMROM/
        defs    comres
sega    defl    $
        endm

;;      segment - Activate Segment.
;
segment macro   s
        update                  ;;update active phase counter
s&space defl    -1              ;;set enabled segment active
        s&seg                   ;;activate segment code placement
        .phase  s&loc           ;;set absolute segment location counter
        endm

;;      update - Update Phase Counters.
;
update  macro
        if      bspace
```

```
                              comres  defl    $-rom+100h-3
                                      endif
                                      irpc    x,<bcd>
                                      if      x&space         ;;if segment active
                                      if      cspace
                                      if      tpal lt ($-cloc)
                              tpal    defl    $-cloc
                                      endif
                                      else
                              x&loc   defl    $               ;;save segment address
                                      endif
                              x&space defl    0               ;;clear segment active
                                      .dephase                ;;revert to relocatable
                                      endif
                                      endm
                                      endm

0000                          bloc    defl    rom             ;establish non-resident code base
F000                          dloc    defl    monitr          ;establish resident code base
0000                          tloc    defl    0               ;establise Transient code base
0000                          tpal    defl    0               ;establish maximum transient length
0000                          bspace  defl    0               ;preset common segment inactive
0000                          cspace  defl    0               ;preset code segment inactive
0000                          dspace  defl    0               ;preset data segment inactive
0000                          comres  defl    0               ;preset common base address

                                      subttl  Ram Loader for Testing Only
                                      page
```

```
Balcones Operating System for the XEROX 820-II  MACRO-80 3.44   09-Dec-81
Ram Loader for Testing Only


                                       bseg
  0000!               +                defs     comres
  0000!                       entry:

  0000!    21 00FD!           xcks:    ld       hl,bbase+movln
  0003!    01 17FF                     ld       bc,romsiz-1
  0006!    1E 00                       ld       e,0             ;preset checksum
  0008!    7E                 xcks1:   ld       a,(hl)
  0009!    23                          inc      hl
  000A!    83                          add      a,e
  000B!    5F                          ld       e,a
  000C!    0B                          dec      bc
  000D!    78                          ld       a,b
  000E!    B1                          or       c
  000F!    20 F7                       jr       nz,xcks1
  0011!    7B                          ld       a,e             ;store twos complement of checksum
  0012!    ED 44                       neg
  0014!    77                          ld       (hl),a          ;store checksum
  0015!    C3 0000                     jp       0

                                       subttl   System Initialization
                                       page
```

```
Balcones Operating System for the XEROX 820-II  MACRO-80 3.44   09-Dec-81
System Initialization


0018!                   bbase:                            ;symbol for accessing non-resident base address
0018!                           defs    100h-($-(entry-3)),-1

00E5                    movln   equ     $-bbase
00FD                    comres  defl    100h-3

                                below                     ;generate non-resident code
0000!                 +         defs    comres

                        ;;      prs - preset storage.
                        ;
                        ;       Entry:  Power up or Reset button.
                        ;
0000    F3              prs:    di                        ;lock up system
0001    AF                      xor     a
0002    3D              prsl:   dec     a                 ;the pause that refershes
0003    20 FD                   jr      nz,prsl
0005    ED 73 FFE0              ld      (rstsp),sp        ;save partial reset state
0009    22 FFE2                 ld      (rsthl),hl        ;in case the luser go boom
000C    E1                      pop     hl                ;pick possible return off stack
000D    22 FFE4                 ld      (rstpc),hl
0010    D9                      exx                       ;give primary registers half a break
0011    1C                      inc     e
0012    31 3839                 ld      sp,3839h          ;load strange values in SP
0015    31 4142                 ld      sp,4142h
0018    4C                      ld      c,h               ;insure
0019    43                      ld      b,e               ;registers
001A    4F                      ld      c,a               ;can
001B    4E                      ld      c,(hl)            ;forget
001C    45                      ld      b,l               ;insure
001D    53                      ld      d,e               ;registers
001E    43                      ld      B,e               ;can
001F    4F                      ld      C,a               ;copy
0020    4D                      ld      C,l
0021    50                      ld      d,b
0022    55                      ld      d,l
0023    54                      ld      d,h
0024    45                      ld      b,l
0025    52                      ld      d,d
0026    08                      ex      af,af'
0027    3E 17                   ld      a,24-1            ;line up bottom of screen
0029    D3 14                   out     (scroll),a        ;init scroll port
002B    21 3000                 ld      hl,crtmem         ;clear display memory
002E    36 20                   ld      (hl),' '
0030    11 3001                 ld      de,crtmem+1
0033    01 0BFF                 ld      bc,crtmax-crtmem-1
0036    ED B0                   ldir                      ;pray the video hardware works
0038    31 F000                 ld      sp,monitr         ;insure monitor ram ok
003B    21 AA55         prs2:   ld      hl,0aa55h         ;walk checker board through ram
003E    C1                      pop     bc                ;read ram
003F    E5                      push    hl                ;write ram fast
0040    D1                      pop     de                ;read ram fast
0041    C5                      push    bc                ;put ram back
```

```
0042    F1                        pop     af                ;and verify it
0043    90                        sub     b
0044    20 76                     jr      nz,errl           ;if ram failure
0046    ED 52                     sbc     hl,de
0048    20 72                     jr      nz,errl           ;if ram or register failure
004A    3B                        dec     sp                ;advance test address
004B    3F                        ccf
004C    ED 7A                     adc     hl,sp
004E    20 EB                     jr      nz,prs2           ;if top of memory not reached
0050    31 0000                   ld      sp,stack          ;set monitor stack
0053    21 0000                   ld      hl,prs            ;set rom address
0056    01 1800                   ld      bc,romsiz
0059    CD 00AF                   call    ccs               ;compute check sum
005C    20 63                     jr      nz,err2           ;if bad rom
005E    21 00E6                   ld      hl,intab          ;point to default variable table
0061    06 00            prs3:    ld      b,0
0063    4E                        ld      c,(hl)            ;set data block length
0064    23                        inc     hl
0065    5E                        ld      e,(hl)            ;set variable address in ram
0066    23                        inc     hl
0067    56                        ld      d,(hl).
0068    23                        inc     hl                ;point to initial values
0069    ED B0                     ldir                      ;copy data from rom to variables in ram
006B    CB 7E                     bit     7,(hl)
006D    28 F2                     jr      z,prs3            ;if more data to preset
006F    23                        inc     hl                ;point to i/o init data table
0070    46               prs4:    ld      b,(hl)            ;set number of bytes to preset
0071.   23                        inc     hl
0072    4E                        ld      c,(hl)            ;set i/o port address
0073    23                        inc     hl
0074    ED B3                     otir                      ;shoot preset data to i/o device
0076    CB 7E                     bit     7,(hl)
0078    28 F6                     jr      z,prs4            ;if more devices require initialization
007A    DB 1E                     in      a,(kbddat)        ;assert PARDY
007C    ED 5E                     im      2                 ;select interrupt mode 2
007E    3E FF                     ld      a,high vectab     ;set interrupt vector page
0080    ED 47                     ld      i,a
0082    21 041B                   ld      hl,rbase          ;set resident base address
0085    11 F000                   ld      de,monitr         ;set monitor address
0088    01 0F00                   ld      bc,ram-monitr     ;set max resident length
008B    ED B0                     ldir                      ;plant monitor upstairs
008D    21 1800                   ld      hl,Rx1984         ;prognosticate
0090    01 0800                   ld      bc,Lx1984
0093    CD 00AF                   call    ccs
0096    20 14                     jr      nz,prs5
0098    2A 1FFD                   ld      hl,(Rx1984+Lx1984-3)
009B    11 55AA                   ld      de,55aah
009E    ED 52                     sbc     hl,de
00A0    21 FAD8                   ld      hl,cmdtab
00A3    11 F360                   ld      de,seltab
00A6    01 FC55                   ld      bc,cloc
00A9    CC 1800                   call    z,Rx1984          ;FutureShock
00AC    C3 FC55          prs5:    jp      signon            ;Signon Resident Monitor

00AF    1E 00            ccs:     ld      e,0               ;preset ckecksum
00B1    7E               ccs1:    ld      a,(hl)
```

```
00B2    23                                   inc     hl
00B3    83                                   add     a,e
00B4    5F                                   ld      e,a
00B5    0B                                   dec     bc
00B6    78                                   ld      a,b
00B7    B1                                   or      c
00B8    20 F7                                jr      nz,ccs1
00BA    B3                                   or      e
00BB    C9                                   ret

00BC    21 00D4                     errl:    ld      hl,errml           ;set ram error message
00BF    18 03                                jr      err
00C1    21 00DD                     err2:    ld      hl,errm2
00C4    11 3024                     err:     ld      de,crtmem+40-(erml/2)
00C7    01 0009                              ld      bc,errml
00CA    ED B0                                ldir
00CC    0B                          err3:    dec     bc                 ;pause a while
00CD    78                                   ld      a,b
00CE    B1                                   or      c
00CF    20 FB                                jr      nz,err3
00D1    C3 0000                              jp      prs                ;try restart again

00D4    52 61 6D 20                 errml:   db      'Ram Error'
00D8    45 72 72 6F
00DC    72
00DD    52 6F 6D 20                 errm2:   db      'Rom Error'
00E1    45 72 72 6F
00E5    72
0009                                errml    equ     ($-errml)/2

                                    ;;       initialize the interrupt vector table
                                    ;
00E6    02                          intab:   defb    2
00E7    FF1A                                 defw    sysvec+2
00E9    F140                                 defw    keysrv             ;parallel keyboard interrupt vector

00EB    06                                   defb    6
00EC    FF12                                 defw    ctcvec+2
00EE    F1FD                                 defw    milli              ;one millisecond interrupt timer
00F0    0000                                 defw    0
00F2    F192                                 defw    timer              ;one second timer interrupt vector
                                    ;
                                    ;        init keyboard fifo
                                    ;
00F4    03                                   defb    3
00F5    FF30                                 defw    fifcnt
00F7    00                                   defb    0                  ;fifo count
00F8    00                                   defb    0                  ;fifo in
00F9    00                                   defb    0                  ;fifo out
                                    ;
                                    ;        initialize the crt display
                                    ;
00FA    08                                   defb    8
00FB    FFAC                                 defw    cursor
00FD    3000                                 defw    crtmem             ;base address is 3000h
00FF    02                                   defb    02                 ;use non-blinking box cursor
```

```
0100   3000                    defw    crtmem          ;direct crt memory output address
0102   17                      defb    23              ;initial scroll base
0103   00                      defb    0               ;initial leadin
0104   00                      defb    0               ;initial attribute
                       ;
                       ;       Initialize configurable parameter addresses
                       ;
0105   0C                      defb    2*numcon
0106   FFBF                    defw    contbl          ;configure table address
0108   F10C            cfinit: defw    siomsk          ;printer output ready mask
010A   F10E                    defw    sioval          ;printer output ready value
010C   F115                    defw    xonenb          ;Xon / Xoff enable/disable (NOP or RET)
010E   FF54                    defw    steprt          ;step rate for wd1797
0110   FFCB                    defw    spare1
0112   FFCC                    defw    spare2
0006                   numcon  equ     ($-cfinit)/2

0114   04                      defb    2*2
0115   FF3C                    defw    availb
0117   F7FD                    defw    iobloc+iobdvs
0119   FC80                    defw    ram-280h

011B   FF                      defb    -1              ;end of variable init table

                       ;;      I/O port initialization.
                       ;
                       ;       initialize system pio for use as bank-switch,
                       ;       configuration select and parallel keyboard input
                       ;

011C   01 1D                   defb    1,sysctl
011E   4F                      defb    01001111b       ;select input mode

011F   01 1C                   defb    1,syspio
0121   80                      defb    10000000b       ;enable ROM

0122   03 1D                   defb    3,sysctl
0124   CF                      defb    11001111b       ;put system pio in bit mode
0125   3F                      defb    00111111b       ;make bits 5, 4, 3, 2, 1,  and 0 be inputs
0126   07                      defb    00000111b       ;disable interrupts

0127   03 1F                   defb    3,kbdctl
0129   4F                      defb    01001111b       ;put keyboard port in input mode
012A   1A                      defb    sysvec+2        ;load keyboard interrupt vector
012B   83                      defb    10000011b       ;enable interrupts
                       ;
                       ;       Initialize Counter Timer Circuit.
                       ;
012C   02 18                   defb    2,ctc0
012E   03                      defb    00000011b       ;reset timer
012F   10                      defb    low ctcvec      ;base interrupt vector for ctc

0130   02 19                   defb    2,ctc1
0132   07                      defb    00000111b       ;start timer, but no interrupts
0133   FA                      defb    250             ;ctc1 period = 1 msec

```

```
0134    02 1A                           defb    2,ctc2
0136    27                              defb    00100111b       ;put ctc2 in timer / 256 mode (64 usec/count)
0137    7D                              defb    125             ;ctc2 period = 8 msec

0138    02 1B                           defb    2,ctc3
013A    C7                              defb    11000111b       ;put ctc3 in counter mode with interrupt
013B    7D                              defb    125             ;ctc3 period = 125*8 msec = 1 second
                                ;
                                ;       initialize sio channel b for asynchronous serial
                                ;       interface to printer or terminal
                                ;
013C    0A 07                           defb    10,siocpb
013E    01                              defb    1               ;select register #1
013F    00                              defb    00000000b       ;disable interrupts
0140    02                              defb    2               ;select register #2
0141    00                              defb    low siovec      ;base sio interrupt vector
0142    03                              defb    3               ;select register #3
0143    41                              defb    01000001b       ;7 bits/rx characters
0144    04                              defb    4               ;select register #4
0145    47                              defb    01000111b       ;16x clock, 1 stop bit, even parity enabled
0146    05                              defb    5               ;select register #5
0147    AA                              defb    10101010b       ;DTR, 7 bits/tx character, Tx enb, RTS

0148    01 0C                           defb    1,baudb
014A    07                              defb    0111b           ;default clock is 1200 bps

                                ;
                                ;       initialize communications port for async modem interface
                                ;
014B    08 06                           defb    8,siocpa
014D    01                              defb    1               ;select register #1
014E    00                              defb    00000000b       ;disable interrupts
014F    03                              defb    3               ;select register #3
0150    41                              defb    01000001b       ;7 bits/rx characters
0151    04                              defb    4               ;select register #4
0152    47                              defb    01000111b       ;16x clock, 1 stop bit, even parity enabled
0153    05                              defb    5               ;select register #5
0154    AA                              defb    10101010b       ;DTR, 7 bits/tx character, Tx enb, RTS

0155    01 00                           defb    1,bauda
0157    05                              defb    0101b           ;default clock is 300 bps

0158    01 68                           defb    1,async         ;set internal Rx+Tx clocks
015A    00                              defb    0
                                ;
                                ;       initialize PIO for Centronics style printer
                                ;
015B    03 09                           defb    3,gpioca
015D    CF                              defb    11001111b       ;mode 3
015E    00                              defb    00000000b       ;all output
015F    07                              defb    00000111b       ;no interrupts

0160    03 0B                           defb    3,gpiocb
0162    CF                              defb    11001111b       ;mode 3
0163    F0                              defb    11110000b       ;upper nibble in, lower out
0164    07                              defb    00000111b       ;no interrupts
```

```

        0165    01 0A                   defb    1,gpiodb
        0167    05                      defb    (1 shl p.strb) or (1 shl p.auto)

        0168    FF                      defb    -1              ;end of i/o init table

                                        subttl  Resident Monitor Entry Points
                                        page
```

```
                                  ;;      Resident monitor entry points.
                                  ;
                                  ;       This Entry Point Vector provides the only reliable access
                                  ;       to services provided by the Resident Monitor.  Any access
                                  ;       to code in the Monitor or its Ram page past the keyboard
                                  ;       variables is not allowed.  Future releases of the Resident
                                  ;       Monitor will always provide compatability with these entry
                                  ;       vectors.
                                  ;
                                  ;       This restriction also applies to the Resident Monitor Ram
                                  ;       Page at the top of memory.  Access to Ram Variables must
                                  ;       be obtained through the appropriate entry vector.
                                  ;
                                          above
0266'                  +                  c&seg
F000    C3 F07C                   cold:   jp      restart         ;monitor restart
F003    C3 FA62                   warm:   jp      prompt          ;monitor entry point
F006    C3 F0CD                   const:  jp      kbdst           ;console status to A
F009    C3 F0D8                   conin:  jp      kbdin           ;console input to A
F00C    C3 F2F1                   conout: jp      crtout          ;console output from A
F00F    C3 F2FE                           jp      fastcrt         ;fast crt output from C
F012    C3 F0E5                           jp      siost           ;sio channel b status to A
F015    C3 F0F0                           jp      sioin           ;sio channel b input to A
F018    C3 F0F8                           jp      sioout          ;sio channel b output from A
F01B    C3 FA17                           jp      select          ;select drive in C
F01E    C3 FA3C                           jp      home            ;home r/w head
F021    C3 FA3E                           jp      seek            ;seek to track in C
F024    C3 FA48                           jp      read            ;read sector  C -> buffer @ HL
F027    C3 FA44                           jp      write           ;write sector C <- buffer @ HL
F02A    C3 F344                           jp      xqdvr           ;execute physical driver request @ HL
F02D    C3 F2B4                           jp      setcur          ;set direct crt cursor from HL
F030    C3 F288                           jp      outcur          ;direct crt display
F033    C3 F2A3                           jp      crtldir         ;crt memory block move ala' LDIR
F036    C3 F097                           jp      getsel          ;return address of disk mapping table to HL
F039    C3 F086                   dayti:  jp      daytim          ;return address of Time-of-Day
F03C    C3 F08B                           jp      config          ;return configuration status
F03F    C3 F105                           jp      siordy          ;sio channel b output ready status
F042    C3 F0A4                           jp      setcon          ;set configuration
F045    C3 F0BF                           jp      ssp             ;start screen print
F048    C3 F13F                   usrsec: jp      nulint          ;user accessible 1 second interrupt
F04B    C3 F7A3                           jp      iocons          ;console status through iobyte
F04E    C3 F7AF                           jp      ioconi          ;console input  through iobyte
F051    C3 F796                           jp      iocono          ;console output through iobyte
F054    C3 F7BB                           jp      iolist          ;printer output through iobyte
F057    C3 F7CC                           jp      iolsts          ;printer status through iobyte
F05A    C3 F770                           jp      comins          ;communications input ready status
F05D    C3 F775                           jp      cominp          ;communications input data to A
F060    C3 F77F                           jp      comout          ;communications output data from C
F063    C3 F788                           jp      comots          ;communications output ready status
F066    C3 F13F                   idle:   jp      nulint          ;idle while i/o is pending
F069    C3 F0D2                   softv:  jp      soft            ;record soft error
F06C                                      defs    16,-1           ;space for option rom linkage

                                          subttl  Monitor Function Processors
                                          page

                                  ;;      Monitor Restart.
                                  ;
  F07C     F3                     restart:di                      ;lock system
  F07D     DB 1C                          in      a,(syspio)
  F07F     F6 80                          or      1 shl 7         ;enable banked rom
  F081     D3 1C                          out     (syspio),a
  F083     C3 0000                        jp      prs             ;reload monitor from rom or ram

                                  ;;      Daytim - Return Address of Time-of-Day.
                                  ;
  F086     11 FF56                daytim: ld      de,day          ;point to day of month
  F089     18 0F                          jr      retval

                                  ;;      Config - Return Configuration Status Byte.
                                  ;
  F08B     3A F0E3                config: ld      a,(mask)        ;turn keyboard mask into c.keym
  F08E     E6 80                          and     080h
  F090     F6 00                          or      0
  F091                            confg   equ     $-1     ;*****=>;This word stored by Preset
  F092     5F                             ld      e,a
  F093     16 01                          ld      d,rev-400       ;return revision level
  F095     18 03                          jr      retval

                                  ;;      getsel - Get address of Select table.
                                  ;
  F097     11 F360                getsel: ld      de,Seltab       ;set select table address

                                  ;;      Retval - Return Value to Caller.
                                  ;
  F09A     24                     retval: inc     h               ;see if high level language call
  F09B     25                             dec     h
  F09C     28 03                          jr      z,retvl         ;if assembly level call
  F09E     73                             ld      (hl),e          ;store answer in variable
  F09F     23                             inc     hl
  F0A0     72                             ld      (hl),d
  F0A1     EB                     retvl:  ex      de,hl           ;leave result in HL as well
  F0A2     FB                     eiret:  ei
  F0A3     C9                             ret

                                  ;;      setcon - set configuration.
                                  ;
  F0A4     7E                     setcon: ld      a,(hl)          ;get configuration table index
  F0A5     CB BF                          res     7,a
  F0A7     FE 06                          cp      numcon
  F0A9     D0                             ret     nc              ;if index out of range
  F0AA     5F                             ld      e,a
  F0AB     7E                             ld      a,(hl)          ;get read/write flag
  F0AC     23                             inc     hl
  F0AD     46                             ld      b,(hl)          ;get configuration data
  F0AE     16 00                          ld      d,0
  F0B0     21 FFBF                        ld      hl,contbl       ;set address of configuration table addresses
  F0B3     19                             add     hl,de
  F0B4     19                             add     hl,de
  F0B5     5E                             ld      e,(hl)          ;get configurable byte address
```

```
F0B6    23                              inc     hl
F0B7    56                              ld      d,(hl)
F0B8    EB                              ex      de,hl
F0B9    CB 7F                           bit     7,a             ;set direction
F0BB    7E                              ld      a,(hl)          ;get previous value
F0BC    C8                              ret     z               ;if asking current configuration
F0BD    70                              ld      (hl),b          ;store new configuration
F0BE    C9                              ret

                                ;;      ssp - start screen print.
                                ;
F0BF    3E 67                   ssp:    ld      a,3+((24+1) shl 2)      ;start with cr/lf
F0C1    32 F20E                         ld      (spact),a
F0C4    AF                              xor     a
F0C5    32 F224                         ld      (spcnt),a
F0C8    3E 81                           ld      a,81h           ;start millisecond timer
F0CA    D3 19                           out     (ctc1),a
F0CC    C9                              ret

                                        subttl  Console / Printer Drivers
                                        page
```

```

                                          above                   ;run this code upstairs
00CD"                +                    d&seg

                                  ;;      kbdst - keyboard status.
                                  ;
                                  ;       Returns A =  0 if no char
                                  ;               A = -1 if char available
                                  ;
F0CD      3A FF30                 kbdst:  ld      a,(fifcnt)      ;get input fifo bytecount
F0D0      B7                              or      a
F0D1      C8                              ret     z               ;if keyboard queue is empty

                                  ;;      soft - record soft error.
                                  ;
F0D2      F6 FF                   soft:   or      -1              ;set ready / error status
F0D4      C9                              ret

                                  ;;      kbdin - Keyboard Input.
                                  ;
                                  ;       Returns A = character
                                  ;
F0D5      CD F066                 kbdin1: call    idle            ;idle cpu
F0D8      CD F0CD                 kbdin:  call    kbdst
F0DB      28 F8                           jr      z,kbdin1        ;loop until keyboard input ready
F0DD      E5                              push    hl
F0DE      CD F130                         call    remove          ;get keyboard entry
F0E1      E1                              pop     hl
F0E2      E6 7F                   kbmask: and     07fh
F0E3                              mask    equu    $-1     ;*****=>;this byte modified by ESC 0/1
F0E4      C9                              ret

                                  ;;      siost - sio channel b input ready status.
                                  ;
F0E5      DB 07                   siost:  in      a,(siocpb)      ;get sio status register
F0E7      E6 01                           and     00000001b
F0E9      C8                              ret     z               ;if no data available
F0EA      3E FF                           ld      a,-1
F0EC      C9                              ret

                                  ;;      sioin - Sio channel b input character.
                                  ;
F0ED      CD F066                 sioin1: call    idle            ;idle cpu
F0F0      CD F0E5                 sioin:  call    siost           ;test console status
F0F3      28 F8                           jr      z,sioin1        ;loop until data is
F0F5      DB 05                           in      a,(siodpb)      ;ready at sio data port
F0F7      C9                              ret

                                  ;;      sioout - Sio channel B output character.
                                  ;
F0F8      F5                      sioout: push    af
F0F9      CD F105                 siox1:  call    siordy
F0FC      CC F066                         call    z,idle          ;idle cpu if transmitter not ready
F0FF      28 F8                           jr      z,siox1
F101      F1                              pop     af
```

```
F102    D3 05                       out     (siodpb),a          ;output data to sio
F104    C9                          ret

                            ;;      siordy - Sio channel B output ready ststus.
                            ;
F105    3E 10               siordy: ld      a,10h               ;reset status latch
F107    D3 07                       out     (siocpb),a
F109    DB 07                       in      a,(siocpb)
F10B    E6 04                       and     00000100b           ;test tbe status bit
F10C                        siomsk  equ     $-1     ;*****=>;modified at run time
F10D    EE 04                       xor     00000100b
F10E                        sioval  equ     $-1     ;*****=>;modified at run time
F10F    28 02                       jr      z,siord1            ;if hardware is ready
F111    AF                          xor     a
F112    C9                          ret
F113    F6 FF               siord1: or      -1                  ;set ready status
F115    00                  xonenb: nop             ;*****=>;put RET here to disable Xon/Xoff
F116    CD F0E5                     call    siost
F119    28 11                       jr      z,siord3            ;if input not available
F11B    CD F0F0                     call    sioin
F11E    E6 7F                       and     7fh
F120    D6 13                       sub     Xoff
F122    28 05                       jr      z,siord2            ;if printer said Stop
F124    D6 FE                       sub     Xon-Xoff
F126    20 04                       jr      nz,siord3           ;if not Resume
F128    2F                          cpl                         ;set printer ready
F129    32 F12D             siord2: ld      (xofflg),a
F12C    3E FF               siord3: ld      a,-1
F12D                        xofflg  equ     $-1     ;*****=>;set ^S pending flag
F12E    B7                          or      a
F12F    C9                          ret

                            ;;      Remove - remove key from fifo.
                            ;
F130    21 FF30             remove: ld      hl,fifcnt           ;decrement fifo count
F133    35                          dec     (hl)
F134    21 FF32                     ld      hl,fifout           ;point hl to fifo output offset
F137    34                  index:  inc     (hl)                ;advance fifo pointer
F138    CB A6                       res     4,(hl)              ;modulo 16
F13A    3E 20                       ld      a,low fifo
F13C    86                          add     a,(hl)              ;index into fifo by offset
F13D    6F                          ld      l,a
F13E    7E                          ld      a,(hl)              ;fetch character in fifo
F13F    C9                  nulint: ret

                                    subttl  Interrupt Service Routines
                                    page
```

```

                              ;;      isr - interrupt service routines.
                              ;
                              service macro
                                      ld      (savstk),sp       ;;;save user stack pointer and
                                      ld      sp,intstk         ;;;switch to local stack
                                      push    hl                ;;;save machine state
                                      push    af
                                      endm

                              ;;      keysrv - parallel keyboard interrupt service.
                              ;
F140                          keysrv: service                   ;save state
F140    ED 73 F1EC      +             ld      (savstk),sp
F144    31 FF50         +             ld      sp,intstk
F147    E5              +             push    hl
F148    F5              +             push    af
F149    C5                            push    bc
F14A    DB 1E                         in      a,(kbddat)        ;read keyboard input port
F14C    2F                            cpl
F14D    FE 9E                         cp      Scrprt
F14F    20 16                         jr      nz,key2           ;if not screen print key
F151    3A F20E                       ld      a,(spact)
F154    B7                            or      a
F155    28 0B                         jr      z,key1            ;if screen not printing now
F157    3E 07                         ld      a,3+(1 shl 2)     ;set state to cr/lf/stop
F159    32 F20E                       ld      (spact),a         ;set screen print state
F15C    AF                            xor     a
F15D    32 F224                       ld      (spcnt),a         ;restart character counter
F160    18 2D                         jr      key5
F162    CD F0BF               key1:   call    ssp               ;start screen print
F165    18 28                         jr      key5
F167    21 FF30               key2:   ld      hl,fifcnt         ;bump input fifo character count
F16A    FE 9B                         cp      Abort             ;check user Abort Key
F16C    28 11                         jr      z,key3            ;warm start system
F16E    4F                            ld      c,a
F16F    7E                            ld      a,(hl)
F170    3C                            inc     a
F171    FE 10                         cp      16
F173    30 1A                         jr      nc,key5           ;exit now if fifo is full
F175    77                            ld      (hl),a
F176    21 FF31                       ld      hl,fifin          ;point hl to fifo input offset
F179    CD F137                       call    index
F17C    71                            ld      (hl),c            ;store character in fifo @ hl
F17D    18 10                         jr      key5
F17F    CD F1EF               key3:   call    retins            ;release Pio interrupt controller
F182    06 03                         ld      b,3
F184    36 00                 key4:   ld      (hl),0            ;clear fifo count
F186    2C                            inc     l                 ;and fifo in/out pointers
F187    10 FB                         djnz    key4
F189    CD F293                       call    crtoff            ;turn crt memory off
F18C    CD F003                       call    warm              ;and warm start system
F18F    C1                    key5:   pop     bc
F190    18 57                         jr      rfi               ;return from interrupt

```

```
                                   ;;      timer - Once per second interrupt.
                                   ;
F192                               timer:  service
F192    ED 73 F1EC     +                   ld      (savstk),sp
F196    31 FF50        +                   ld      sp,intstk
F199    E5             +                   push    hl
F19A    F5             +                   push    af
F19B    2A FF52                            ld      hl,(tikcnt)     ;advance binary seconds counter
F19E    23                                 inc     hl
F19F    22 FF52                            ld      (tikcnt),hl
F1A2    CD F048                            call    usrsec          ;invoke user's interrupt routine
F1A5    21 FF55                            ld      hl,timout       ;decrement disk turn-off timer
F1A8    35                                 dec     (hl)
F1A9    20 06                              jr      nz,timer1       ;exit if not timed out yet
F1AB    DB 1C                              in      a,(syspio)
F1AD    E6 F8                              and     11111000b       ;disable all drive selects which
F1AF    D3 1C                              out     (syspio),a      ;turns off spindle motors
F1B1    C5                         timer1: push    bc
F1B2    06 02                              ld      b,2
F1B4    3E 3B                              ld      a,59
F1B6    21 FF5B                            ld      hl,secs         ;point at wall clock
F1B9    34                         timer2: inc     (hl)            ;increment seconds
F1BA    BE                                 cp      (hl)
F1BB    30 2B                              jr      nc,timer3       ;if not one minute or hour
F1BD    36 00                              ld      (hl),0
F1BF    2B                                 dec     hl
F1C0    10 F7                              djnz    timer2
F1C2    3E 17                              ld      a,23
F1C4    34                                 inc     (hl)            ;increment hours
F1C5    BE                                 cp      (hl)
F1C6    30 20                              jr      nc,timer3       ;if not one day
F1C8    36 00                              ld      (hl),0
F1CA    D5                                 push    de
F1CB    2B                                 dec     hl
F1CC    2B                                 dec     hl
F1CD    4E                                 ld      c,(hl)          ;get month
F1CE    2B                                 dec     hl              ;point to day
F1CF    11 F1F0                            ld      de,dpm-1        ;point to day/month table
F1D2    EB                                 ex      de,hl
F1D3    09                                 add     hl,bc
F1D4    7E                                 ld      a,(hl)          ;get number of days
F1D5    EB                                 ex      de,hl
F1D6    D1                                 pop     de
F1D7    34                                 inc     (hl)            ;increment day
F1D8    BE                                 cp      (hl)
F1D9    30 0D                              jr      nc,timer3       ;if not end of month
F1DB    36 01                              ld      (hl),1          ;reset day in month
F1DD    23                                 inc     hl
F1DE    34                                 inc     (hl)            ;increment month
F1DF    3E 0B                              ld      a,11
F1E1    BE                                 cp      (hl)
F1E2    30 04                              jr      nc,timer3       ;if not new years eve
F1E4    36 01                              ld      (hl),1          ;wrap december to january
F1E6    23                                 inc     hl
F1E7    34                                 inc     (hl)            ;signal Guy Lombardo
F1E8    C1                         timer3: pop     bc
```

```

                                ;;      rfi - return From Interrupt.
                                ;
F1E9    F1                      rfi:    pop     af
F1EA    E1                              pop     hl
F1EB    31 0000                         ld      sp,0            ;restore stack
F1EC                            savstk  equ     $-2     ;*****=>;this word modified at runtime
F1EE    FB                              ei                      ;re-enable interrupts and return
F1EF    ED 4D                   retins: reti

                                ;;      Table of days per month.
                                ;
F1F1    1F                      dpm:    db      31              ;january
F1F2    1C                              db      28              ;febuary
F1F3    1F                              db      31              ;march
F1F4    1E                              db      30              ;april
F1F5    1F                              db      31              ;may
F1F6    1E                              db      30              ;june
F1F7    1F                              db      31              ;july
F1F8    1F                              db      31              ;august
F1F9    1E                              db      30              ;september
F1FA    1F                              db      31              ;october
F1FB    1E                              db      30              ;november
F1FC    1F                              db      31              ;december

                                ;;      milli - Millisecond timer interrupt service.
                                ;
F1FD                            milli:  service
F1FD    ED 73 F1EC          +           ld      (savstk),sp
F201    31 FF50             +           ld      sp,intstk
F204    E5                  +           push    hl
F205    F5                  +           push    af
F206    2A FF50                         ld      hl,(Milsec)
F209    23                              inc     hl              ;increment millisecond counter
F20A    22 FF50                         ld      (Milsec),hl
F20D    3E 00                           ld      a,0             ;set screen print flag
F20E                            spact   equ     $-1     ;*****=>;this byte modified at runtime
F20F    67                              ld      h,a
F210    E6 03                           and     3
F212    28 6D                           jr      z,mil16         ;if not printing screen
F214    6F                              ld      l,a
F215    CD F105                         call    siordy          ;get printer status
F218    28 67                           jr      z,mil16         ;if printer not ready
F21A    2D                              dec     l
F21B    20 48                           jr      nz,mil12        ;if not character print state
F21D    DB 1C                           in      a,(syspio)      ;get pio state
F21F    F5                              push    af
F220    CD F29C                         call    crton
F223    3E 00                           ld      a,0             ;get character count
F224                            spcnt   equ     $-1     ;*****=>;byte modified at runtime
F225    3D                              dec     a
F226    FA F236                         jp      m,mil0          ;if end of line
F229    32 F224                         ld      (spcnt),a
F22C    21 0000                         ld      hl,0            ;set next character address
F22D                            spaddr  equ     $-2     ;*****=>;word modified at runtime
F22F    7E                              ld      a,(hl)
```

```
F230   D3 05                out     (siodpb),a        ;fire hammer
F232   2C                   inc     l                 ;advance screen cursor
F233   AF                   xor     a                 ;do not advance state
F234   18 22                jr      mil11             ;if not end of line
F236   3E 61       mil0:    ld      a,1+(24 shl 2)    ;set address of next print line
F238   94                   sub     h
F239   1F                   rra
F23A   CB 2F                sra     a
F23C   CD F31E              call    cca               ;compute cursor address
F23F   E5                   push    hl                ;save next line address
F240   C5                   push    bc
F241   06 50                ld      b,80              ;delete  trailing blanks
F243   7D                   ld      a,l
F244   80                   add     a,b
F245   6F                   ld      l,a
F246   2D          mil01:   dec     l
F247   7E                   ld      a,(hl)            ;get next character
F248   E6 7F                and     7fh
F24A   FE 20                cp      ' '
F24C   20 02                jr      nz,mil02          ;if not trailing blank
F24E   10 F6                djnz    mil01
F250   78          mil02:   ld      a,b
F251   32 F224              ld      (spcnt),a         ;set number of characters to print
F254   C1                   pop     bc
F255   E1                   pop     hl
F256   3E 03                ld      a,3               ;set CR next state
F258   22 F22D     mil11:   ld      (spaddr),hl       ;set next display address
F25B   21 F20E              ld      hl,spact          ;set state variable
F25E   B6                   or      (hl)              ;advance state
F25F   77                   ld      (hl),a
F260   F1                   pop     af                ;get pio back
F261   D3 1C                out     (syspio),a
F263   18 1C                jr      mil16
F265   2D          mil12:   dec     l                 ;check next state
F266   21 F20E              ld      hl,spact          ;set state address
F269   20 11                jr      nz,mil14          ;if not lf state
F26B   7E                   ld      a,(hl)
F26C   D6 04                sub     1 shl 2           ;advance line counter
F26E   77                   ld      (hl),a
F26F   FE FE                cp      2-(1 shl 2)
F271   20 05                jr      nz,mil13
F273   3E 01                ld      a,1               ;disable ctc interrupt
F275   D3 19                out     (ctc1),a
F277   77                   ld      (hl),a
F278   3E 0A       mil13:   ld      a,lf              ;set line feed
F27A   18 02                jr      mil15
F27C   3E 0D       mil14:   ld      a,cr              ;set carriage return
F27E   D3 05       mil15:   out     (siodpb),a        ;move paper or carriage
F280   35                   dec     (hl)
F281   C3 F1E9     mil16:   jp      rfi               ;return from interrupt

                            subttl  Crt Driver
                            page
```

```

                      ;;        setcur - set direct display cursor position.
                      ;
F284  22 FFAF         setcur:   ld       (dircur),hl      ;set up cursor address
F287  C9                        ret

                      ;;        outcur - store character directly to crt memory.
                      ;
F288  CD F29C         outcur:   call     crton            ;turn on crt bank
F28B  2A FFAF                   ld       hl,(dircur)      ;fetch direct cursor
F28E  71                        ld       (hl),c           ;store character
F28F  23                        inc      hl
F290  22 FFAF                   ld       (dircur),hl

                      ;;        crtoff - turn crt ram off.
                      ;
F293  F3              crtoff:   di                        ;lock pio access
F294  DB 1C                     in       a,(syspio)
F296  CB BF           crtof1:   res      7,a              ;reset crt bank enable
F298  FB                        ei                        ;unlock pio access
F299  D3 1C           crton1:   out      (syspio),a
F29B  C9                        ret

                      ;;        crton - turn crt ram on.
                      ;
F29C  F3              crton:    di                        ;lock time-out interrupt
F29D  DB 1C                     in       a,(syspio)       ;get pio status
F29F  CB FF                     set      7,a              ;enable bank
F2A1  18 F6                     jr       crton1

                      ;;        block move from/to crt memory.
                      ;
                      ;         Entry:   HL = Source address
                      ;                  DE = Destination address
                      ;                  BC = Number of bytes to move
                      ;                  A  = 0 - Move crt ram to crt ram
                      ;                  A  < 0 - Move sys ram to crt ram
                      ;                  A  > 0 - Move crt ram to sys ram
                      ;
F2A3  ED 73 F31B      crtldir:ld         (usrstk),sp      ;do not use callers stack
F2A7  31 FFE0                   ld       sp,crtstk        ;since it may disappear
F2AA  A7                        and      a                ;set entry conditions
F2AB  CD F29C                   call     crton
F2AE  28 37                     jr       z,crtmv          ;block move within crt ram
F2B0  F2 F2B5                   jp       p,ldir2          ;if move from crt ram to system ram
F2B3  EE 80           ldir1:    xor      80h
F2B5  D3 1C           ldir2:    out      (syspio),a       ;enable source bank
F2B7  E5                        push     hl               ;save move source address
F2B8  21 FFB0                   ld       hl,-80           ;count down one transfer buffer
F2BB  ED 4A                     adc      hl,bc
F2BD  E3                        ex       (sp),hl          ;save overflow, retrieve source address
F2BE  FA F2C4                   jp       m,ldir3          ;if less than one buffer
F2C1  01 0050                   ld       bc,80            ;transfer one buffer
F2C4  C5              ldir3:    push     bc               ;save byte count
F2C5  D5                        push     de               ;save destination address
```

```
F2C6     11 FF5C                       ld      de,linbuf       ;set upper buffer
F2C9     ED B0                         ldir                    ;move data to upper ram
F2CB     D1                            pop     de
F2CC     C1                            pop     bc
F2CD     DB 1C                         in      a,(syspio)      ;enable destination bank
F2CF     EE 80                         xor     80h
F2D1     D3 1C                         out     (syspio),a
F2D3     E5                            push    hl              ;save source address
F2D4     21 FF5C                       ld      hl,linbuf       ;set upper  buffer
F2D7     ED B0                         ldir                    ;move data from buffer to destination
F2D9     E1                            pop     hl
F2DA     C1                            pop     bc              ;retrieve bytes left to transfer
F2DB     78                            ld      a,b
F2DC     A7                            and     a
F2DD     FA F2E9                       jp      m,crtmvo        ;no more move, turn crt ram off and return
F2E0     B1                            or      c
F2E1     28 06                         jr      z,crtmvo        ;if no more
F2E3     DB 1C                         in      a,(syspio)
F2E5     18 CC                         jr      ldirl           ;continue transfer one buffer at a crack

F2E7     ED B0                 crtmv:  ldir
F2E9     CD F293               crtmvo: call    crtoff          ;turn crt ram off
F2EC     ED 7B F31B                    ld      sp,(usrstk)
F2F0     C9                            ret

                                       subttl  Resident Crt Driver.
                                       page
```

```

                          ;;      crtout - Crt Output Driver.
                          ;
                          ;       Entry:  Character in register A
                          ;               16 bytes of stack space available
                          ;       Exit:   Char displayed, all registers saved
                          ;
F2F1    E5                crtout: push    hl              ;maintain users registers on his stack
F2F2    D5                        push    de
F2F3    C5                        push    bc
F2F4    F5                        push    af
F2F5    4F                        ld      c,a             ;set character to process
F2F6    CD F2FE                   call    fastcrt         ;process character quickly
F2F9    F1                        pop     af              ;restore callers registers
F2FA    C1                        pop     bc
F2FB    D1                        pop     de
F2FC    E1                        pop     hl
F2FD    C9                        ret

                          ;;      fastcrt - fast crt driver.
                          ;
                          ;       Entry:  Character in C
                          ;       Exit:   The only register preserved is SP
                          ;               Peeking in register A reveals valuable characters.
                          ;
F2FE    ED 73 F31B        fastcrt:ld      (usrstk),sp     ;do not use callers stack
F302    31 FFE0                   ld      sp,crtstk       ;since it may disappear
F305    DD E5                     push    ix
F307    DB 1C                     in      a,(syspio)      ;read system pio
F309    B7                        or      a               ;set bank enable status
F30A    F5                        push    af              ;save status for exit code
F30B    CD F29C                   call    crton           ;turn on crt memory
F30E    FB                        ei                      ;enable interrupts
F30F    CD 0169                   call    crtdvr          ;execute crt driver rom
F312    F1                        pop     af              ;get previous bank enable status
F313    F4 F293                   call    p,crtoff        ;disable bank now if it was disabled on entry
F316    DD E1                     pop     ix
F318    3E 00                     ld      a,0             ;sneak balcones golden characters to FAST users
F319                      gold    equ     $-1
F31A    31 F31B                   ld      sp,usrstk       ;restore callers stack
F31B                      usrstk  equ     $-2     ;*****=>;this operand word is modified at runtime
F31D    C9                        ret

                          ;;      cca - compute cursor address.
                          ;
                          ;       Entry:  A = Row
                          ;
F31E    67                cca:    ld      h,a
F31F    3A FFB1                   ld      a,(base)
F322    84                        add     a,h
F323    3C                cca1:   inc     a               ;entry with base absolute
F324    D6 18             cca2:   sub     24              ;ditto
F326    30 FC                     jr      nc,cca2
F328    C6 78                     add     a,24+2*crtbas
F32A    67                        ld      h,a
```

```
F32B    2E 00                       ld      l,0
F32D    CB 2C                       sra     h
F32F    CB 1D                       rr      l
F331    C9                          ret

                            ;;      rstatt - Restore Previous Attribute.
                            ;
F332    01 0000             rstatt: ld      bc,0            ;execute previous attribute routine
F333                        lstatt  equ     $-2
F335    C5                          push    bc
F336    C9                          ret

F337    E5                  setprv: push    hl
F338    21 01CF                     ld      hl,setlow
F339                        prvatt  equ     $-2
F33B    22 F333                     ld      (lstatt),hl
F33E    ED 43 F339                  ld      (prvatt),bc
F342    E1                          pop     hl
F343    C9                          ret

                                    subttl  Rom-resident Crt Driver
                                    page
```

```

                                      below                       ;execute in banked rom
0000!                +                defs     comres

                            ;;        crtdvr - Crt Driver Proper.
                            ;
0169    2A FFAC             crtdvr:   ld       hl,(cursor)        ;set cursor address
016C    3A FFB4                       ld       a,(chrsav)         ;retrieve character under cursor
016F    77                            ld       (hl),a             ;replace character under cursor
0170    32 F319                       ld       (gold),a           ;bury balcones gold
0173    3A FFB2                       ld       a,(leadin)         ;set leadin state
0176    B7                            or       a
0177    20 1D                         jr       nz,crtd2           ;if processing escape sequence
0179    3A F0E3                       ld       a,(mask)           ;get keyboard mask
017C    A1                            and      c
017D    4F                            ld       c,a
017E    FE 20                         cp       ' '
0180    38 14                         jr       c,crtd2            ;if control code
0182    3A FFB3             crtd1:    ld       a,(attrib)
0185    B1                            or       c
0186    77                            ld       (hl),a             ;store displayable character
0187    2C                            inc      l                  ;advance pointer to next column
0188    7D                            ld       a,l
0189    E6 7F                         and      01111111b          ;extract column# from hl
018B    FE 50                         cp       80
018D    38 0A                         jr       c,crtd3            ;if end of line not reached
018F    AD                            xor      l
0190    6F                            ld       l,a                ;return cursor to left side
0191    CD 02F7                       call     lfeed              ;execute line feed
0194    18 03                         jr       crtd3
0196    CD 023D             crtd2:    call     contrl             ;process control character
0199    22 FFAC             crtd3:    ld       (cursor),hl        ;save cursor pointer for next time
019C    7E                            ld       a,(hl)             ;get character at new cursor location
019D    32 FFB4                       ld       (chrsav),a         ;save for next time 'CRTOUT' is called
01A0    3A FFAE                       ld       a,(csrchr)         ;get cursor character
01A3    FE 20                         cp       ' '
01A5    C8                            ret      z                  ;if no cursor
01A6    4F                            ld       c,a
01A7    7E                            ld       a,(hl)
01A8    CB BF                         res      7,a
01AA    FE 20                         cp       ' '
01AC    79                            ld       a,c                ;set character used for cursor
01AD    28 03                         jr       z,crtd4            ;if character is a space
01AF    7E                            ld       a,(hl)             ;toggle attribute
01B0    EE 80                         xor      80h
01B2    77                  crtd4:    ld       (hl),a             ;store cursor character
01B3    C9                            ret

                            ;;        multi - Process multiple character escape sequence.
                            ;
01B4    EB                  multi:    ex       de,hl              ;unconditionally reset the lead-in
01B5    36 00                         ld       (hl),0             ;state to zero
01B7    EB                            ex       de,hl
01B8    3D                            dec      a
01B9    20 4E                         jr       nz,setxy1          ;if not initial state
```

```
01BB    79                              ld      a,c             ;get second character of sequence

                                        if      (options and o.esct) ne 0
                        ;;              Escape table search
                        ;
01BC    E5                              push    hl
01BD    21 028A                         ld      hl,esctab
01C0    01 0011                         ld      bc,esctbl
01C3    ED B1           search:         cpir
01C5    09                              add     hl,bc
01C6    09                              add     hl,bc
01C7    09                              add     hl,bc
01C8    4E                              ld      c,(hl)
01C9    23                              inc     hl
01CA    46                              ld      b,(hl)
01CB    E1                              pop     hl
01CC    C0                              ret     nz
01CD    C5                              push    bc
01CE    C9                              ret
                                        endif                   ;options and o.esct

                        ;;              Set attribute modes.
                        ;
01CF    D3 36           setlow:         out     (lowlite),a     ;set lo-light mode
01D1    C3 F337                         jp      setprv

01D4    D3 35           setbli:         out     (chrom2),a      ;select rom 2
01D6    AF                              xor     a               ;select standard char set
01D7    18 08                           jr      mode1

01D9    D3 35           setinv:         out     (chrom2),a      ;select rom 2
01DB    18 02                           jr      mode

01DD    D3 34           setgra:         out     (chrom1),a      ;select rom 1
01DF    3E 40           mode:           ld      a,40h           ;select alternate char set
01E1    CD F337         mode1:          call    setprv          ;set up previous attribute
01E4    47                              ld      b,a
01E5    F3                              di                      ;lock system
01E6    DB 1C                           in      a,(syspio)      ;read system pio
01E8    CB B7                           res     6,a             ;clear rom select bit
01EA    B0                              or      b
01EB    FB                              ei                      ;unlock
01EC    D3 1C                           out     (syspio),a      ;set or reset display mode
01EE    C9                              ret

                        ;;              Enable/disable (D7) display of selected attribute mode
                        ;
01EF    3E 80           enatr:          ld      a,80h
01F1    06                              db      6 ;ld b,        ;skip xor
01F2    AF              disatr:         xor     a
01F3    32 FFB3         dis1:           ld      (attrib),a
01F6    C9                              ret

                        ;;              setmsk - Select 7 or 8 bit data  from keyboard
                        ;
01F7    0F              setmsk:         rrca                    ;get low order bit as upper bit mask
```

```
01F8    F6 7F                   or      7fh
01FA    4F                      ld      c,a
01FB    11 F0E3                 ld      de,mask
01FE    1A                      ld      a,(de)
01FF    32 F319                 ld      (gold),a        ;stash balcones gold
0202    79                      ld      a,c
0203    12                      ld      (de),a          ;store keyboard mask
0204    C9                      ret

                        ;;      Process cursor position sequence.
                        ;
0205    3E 02           setxy:  ld      a,2
0207    12                      ld      (de),a          ;make leadin=2 next time
0208    C9                      ret

0209    3D              setxy1: dec     a
020A    20 10                   jr      nz,m3tst        ;if not in state 2
020C    6F                      ld      l,a             ;clear low cursor pos
020D    3E 03                   ld      a,3
020F    12                      ld      (de),a          ;set state 3 for next time
0210    79              setrow: ld      a,c
0211    E6 7F                   and     07fh            ;strip parity bit
0213    D6 20                   sub     ' '
0215    D8                      ret     c               ;if illegal character
0216    FE 18                   cp      24
0218    D0                      ret     nc
0219    C3 F31E                 jp      cca             ;compute cursor address

021C    3D              m3tst:  dec     a
021D    20 0C                   jr      nz,m4tst        ;if not ready for column
021F    79              setcol: ld      a,c
0220    E6 7F                   and     07fh            ;strip parity bit
0222    D6 20                   sub     ' '             ; of esc,'=',row,col sequence
0224    D8                      ret     c
0225    FE 50                   cp      80
0227    D0                      ret     nc
0228    B5                      or      l               ;merge in col# with l
0229    6F                      ld      l,a
022A    C9                      ret

022B    3D              m4tst:  dec     a
022C    20 04                   jr      nz,m5tst        ;if not escape state 4
022E    D1                      pop     de              ;pitch address of crtd3
022F    C3 0182                 jp      crtd1           ;display character in C

0232    3A FFAE         m5tst:  ld      a,(csrchr)
0235    32 F319                 ld      (gold),a        ;stash balcones gold
0238    79                      ld      a,c
0239    32 FFAE                 ld      (csrchr),a      ;store new cursor character
023C    C9                      ret

                        ;;      contrl - process control character.
                        ;
023D    11 FFB2         contrl: ld      de,leadin       ;point at leadin state
0240    D2 01B4                 jp      nc,multi        ;if multi code sequence in progress
0243    FE 05                   cp      'E'-64
```

```
0245    D8                     ret     c               ;control char is out of range
0246    E5                     push    hl              ;save cursor
0247    21 024A                ld      hl,ctltab-('E'-64)*2
024A    06 00                  ld      b,0
024C    09                     add     hl,bc           ;index through control character table
024D    09                     add     hl,bc
024E    4E                     ld      c,(hl)
024F    23                     inc     hl
0250    46                     ld      b,(hl)          ;get address of control subroutine
0251    E1                     pop     hl
0252    C5                     push    bc
0253    C9                     ret                     ;execute control code driver

                               if      (options and o.esct) ne 0
0254    02C5           ctltab: defw    defcur          ;Ctrl-e is define new cursor character
0256    F332                   defw    rstatt          ;Ctrl-f is restore previous attribute mode
0258    032F                   defw    bell            ;Ctrl-g is the bell
025A    02CE                   defw    bakspc          ;Ctrl-h is cursor left
025C    031F                   defw    tab             ;Ctrl-i is tab
025E    02F7                   defw    lfeed           ;Ctrl-j is cursor down
0260    02DC                   defw    upcsr           ;Ctrl-k is cursor up
0262    02D4                   defw    forspc          ;Ctrl-l is cursor right
0264    02F2                   defw    return          ;Ctrl-m is carriage return
0266    02C0                   defw    nono            ;Ctrl-n is not acceptable
0268    02C0                   defw    nono            ;Ctrl-o is not acceptable
026A    02C0                   defw    nono            ;Ctrl-p is not acceptable
026C    0361                   defw    clreos          ;Ctrl-q is clear to end-of-screen
026E    02C0                   defw    nono            ;Ctrl-r is not acceptable
0270    02C0                   defw    nono            ;Ctrl-s is not acceptable
0272    02C0                   defw    nono            ;Ctrl-t is not acceptable
0274    02C0                   defw    nono            ;Ctrl-u is not acceptable
0276    02C0                   defw    nono            ;Ctrl-v is not acceptable
0278    02C0                   defw    nono            ;Ctrl-w is not acceptable
027A    0344                   defw    clreol          ;Ctrl-x is clear to end-of-line
027C    02C0                   defw    nono            ;Ctrl-y is not acceptable
027E    0357                   defw    clrscn          ;Ctrl-z is clear screen
0280    02BD                   defw    escape          ;Ctrl-[ is escape
0282    02C0                   defw    nono            ;Ctrl-\ is not acceptable
0284    02C0                   defw    nono            ;Ctrl-] is not acceptable
0286    02C9                   defw    homeup          ;Ctrl-^ is home up
0288    02C1                   defw    stuff           ;Ctrl-_ is display control chars

0036                   ctlsiz  equ     $-ctltab

                       ;;      Escape sequence table.
                       ;
                       ;       Maintains functional compatibility with terminals supporting
                       ;       ADM-3a style supersets.
                       ;
028A    28             esctab: db      '('             ;disable attribute
028B    29                     db      ')'             ;enable atribute
028C    2A                     db      '*'             ;clear screen
028D    30                     db      '0'             ;strip keyboard upper bit
028E    31                     db      '1'             ;pass keyboard upper bit
028F    34                     db      '4'             ;char font and blinking
0290    35                     db      '5'             ;char font and graphics
```

```
0291    36                      db      '6'             ;char font and blinking
0292    37                      db      '7'             ;char font and inverse video
0293    38                      db      '8'             ;char font and lo-light
0294    3D                      db      '='             ;position cursor
0295    45                      db      'E'             ;line insert
0296    51                      db      'Q'             ;character insert
0297    52                      db      'R'             ;line delete
0298    57                      db      'W'             ;character delete
0299    54                      db      'T'             ;clear to end of line
029A    59                      db      'Y'             ;clear to end of screen
0011                    esctbl  equ     $-esctab

029B    0361            escadr: defw    clreos
029D    0344                    defw    clreol
029F    03F5                    defw    chrdel
02A1    037C                    defw    lindel
02A3    03DC                    defw    chrins
02A5    03A4                    defw    linins
02A7    0205                    defw    setxy
02A9    01CF                    defw    setlow
02AB    01D9                    defw    setinv
02AD    01D4                    defw    setbli
02AF    01DD                    defw    setgra
02B1    01D4                    defw    setbli
02B3    01F7                    defw    setmsk
02B5    01F7                    defw    setmsk
02B7    0357                    defw    clrscn
02B9    01EF                    defw    enatr
02BB    01F2                    defw    disatr
                                if1
                                if      ($-escadr)/2 ne esctbl
                                .printx Escape table mismatch
                                endif
                                endif
                                endif                   ;o.esct and options

                        ;;      escape - Initialize escape sequence.
                        ;
02BD    3E 01           escape: ld      a,1
02BF    12                      ld      (de),a          ;set sequence state
02C0    C9              nono:   ret                     ;for escape processing

                        ;;      stuff - Enable next char to be stored directly.
                        ;
02C1    3E 04           stuff:  ld      a,4
02C3    12                      ld      (de),a          ;set sequence state
02C4    C9                      ret                     ;for control char output mode

                        ;;      defcur - Enable next chara to be new cursor.
                        ;
02C5    3E 05           defcur: ld      a,5
02C7    12                      ld      (de),a
02C8    C9                      ret

                        ;;      homeup - Move cursor to upper left.
                        ;
```

```
02C9    0E 20            homeup: ld      c,' '           ;use cursor addressing routine
02CB    C3 0210                  jp      setrow          ;to do homeup almost for free

                         ;;      bakspc - Move cursor left.
                         ;
02CE    7D               bakspc: ld      a,l             ;check for left margin
02CF    E6 7F                    and     01111111b
02D1    C8                       ret     z               ;abort if in leftmost column
02D2    2D                       dec     l               ;back up cursor pointer
02D3    C9                       ret

                         ;;      forspc - Move cursor right.
                         ;
02D4    7D               forspc: ld      a,l             ;check for rightmost colunm
02D5    E6 7F                    and     01111111b
02D7    FE 4F                    cp      79
02D9    D0                       ret     nc              ;do nothing if already there
02DA    2C                       inc     l
02DB    C9                       ret                     ;else advance the cursor pointer

                         ;;      upscr - Move cursor up.
                         ;
02DC    11 FF80          upcsr:  ld      de,-128         ;subtract 1 from row# component
02DF    19                       add     hl,de           ; of cursor pointer in hl
02E0    7C                       ld      a,h
02E1    FE 30                    cp      crtbas          ;check for underflow of pointer
02E3    D0                       ret     nc
02E4    26 3B                    ld      h,crttop-1      ;wrap cursor around modulo 3k
02E6    C9                       ret

                         ;;      dncsr - Move cursor down.
                         ;
02E7    11 0080          dncsr:  ld      de,128          ;add 1 to row# component
02EA    19                       add     hl,de           ; of cursor pointer in hl
02EB    7C                       ld      a,h
02EC    FE 3C                    cp      crttop          ;check for overflow of pointer
02EE    D8                       ret     c
02EF    26 30                    ld      h,crtbas        ;reset pointer modulo 128*24
02F1    C9                       ret

                         ;;      return - Move cursor to left side.
                         ;
02F2    7D               return: ld      a,l             ;clear column
02F3    E6 80                    and     10000000b
02F5    6F                       ld      l,a             ;move cursor pointer back
02F6    C9                       ret                     ; to start of line

                         ;;      lfeed - Move cursor down with scroll.
                         ;
02F7    7D               lfeed:  ld      a,l
02F8    17                       rla
02F9    7C                       ld      a,h
02FA    17                       rla                     ;extract row# component of hl
02FB    E6 1F                    and     00011111b
02FD    4F                       ld      c,a             ;copy row# into c for scroll test
02FE    CD 02E7                  call    dncsr           ;move cursor to next row down
```

```
0301    3A FFB1                 ld      a,(base)        ;test if cursor was on bottom row
0304    91                      sub     c               ;of screen before moving down
0305    32 F319                 ld      (gold),a        ;send scroll flag back to fast users
0308    C0                      ret     nz              ;exit if not at bottom
0309    E5                      push    hl              ;prepare scroll screen up
030A    3A F31C                 ld      a,(usrstk+1)
030D    3C                      inc     a
030E    C4 040F                 call    nz,bbg          ;bury balcones gold, unless monitor running
0311    CD 0341                 call    clrlin          ;fill top line with spaces
0314    29                      add     hl,hl
0315    7C                      ld      a,h             ;get row# component of hl into a
0316    E6 1F                   and     00011111b
0318    32 FFB1                 ld      (base),a        ;store new base line#
031B    D3 14                   out     (scroll),a      ;scroll top line to bottom
031D    E1                      pop     hl              ;restore cursor
031E    C9                      ret

                        ;;      tab - Move cursor to next tab stop.
                        ;
031F    11 0008         tab:    ld      de,8            ;tabs are every 8 columns
0322    7D                      ld      a,l             ;get column component of
0323    E6 78                   and     01111000b       ;previous tab position
0325    83                      add     a,e
0326    FE 50                   cp      80
0328    D0                      ret     nc              ;if next tab column past end of line
0329    7D                      ld      a,l
032A    E6 F8                   and     11111000b       ;advance cursor to next tab stop
032C    6F                      ld      l,a
032D    19                      add     hl,de
032E    C9                      ret

                        ;;      bell - Move speaker back and forth.
                        ;
032F    3E 35           bell:   ld      a,bltim         ;Bell time constant
0331    D3 29           belll:  out     (bellon),a      ;push speaker out
0333    06 61                   ld      b,blonc         ;set Bell on time constant
0335    10 FE                   djnz    $               ;pause B*2 micro seconds
0337    D3 28                   out     (bellof),a      ;yank speaker in
0339    06 61                   ld      b,blofc         ;set Bell off time constant
033B    10 FE                   djnz    $
033D    3D                      dec     a
033E    20 F1                   jr      nz,belll        ;if more noise to make
0340    C9                      ret

                        ;;      clrlin - Clear line.
                        ;
0341    CD 02F2         clrlin: call    return          ;return cursor and fall through clreol

                        ;;      clreol - Clear to end of line.
                        ;
0344    7D              clreol: ld      a,l
0345    E6 7F                   and     01111111b       ;get column component of cursor posistion
0347    FE 50                   cp      80
0349    D0                      ret     nc              ;if someone busted curpos
034A    ED 44                   neg
034C    C6 50                   add     a,80            ;calculate number of characters to clear
```

```
034E    47                      ld      b,a
034F    7D                      ld      a,l             ;save cursor column
0350    36 20           clrl:   ld      (hl),' '        ;clear next location
0352    2C                      inc     l
0353    10 FB                   djnz    clrl            ;if end of line not clear
0355    6F                      ld      l,a             ;restore cursor column
0356    C9                      ret

                        ;;      clrscn - clear visible screen memory.
                        ;
0357    21 3000         clrscn: ld      hl,crtmem       ;home cursor
035A    3E 17                   ld      a,23
035C    32 FFB1                 ld      (base),a        ;put line 23 at bottom of screen
035F    D3 14                   out     (scroll),a      ;note scroll register gets A8-A12, not d0-d7

                        ;;      clreos - clear to end of screen.
                        ;
0361    CD 0344         clreos: call    clreol          ;clear remainder of current row
0364    E5                      push    hl              ;save cursor location
0365    ED 4B FFB1      clrsl:  ld      bc,(base)       ;set bottom screen row to c
0369    7D                      ld      a,l
036A    17                      rla
036B    7C                      ld      a,h
036C    17                      rla                     ;get row# component of hl into a
036D    E6 1F                   and     00011111b
036F    B9                      cp      c
0370    28 08                   jr      z,clrs2         ;if hl is on bottom row of screen
0372    CD 02E7                 call    dncsr           ;point hl to next row
0375    CD 0341                 call    clrlin          ;and fill that line with spaces
0378    18 EB                   jr      clrsl
037A    E1              clrs2:  pop     hl              ;restore original cursor pointer
037B    C9                      ret

                        ;;      lindel - Line delete.
                        ;
037C    E5              lindel: push    hl              ;save cursor address
037D    CD 040F                 call    bbg             ;bury balcones gold
0380    29                      add     hl,hl
0381    7C                      ld      a,h
0382    E6 1F                   and     00011111b       ;extract row
0384    ED 4B FFB0              ld      bc,(base-1)     ;get base screen row in b
0388    CD 03D1         lindl:  call    smp             ;set move parameters
038B    B8                      cp      b
038C    28 10                   jr      z,lind2         ;if last line
038E    C5                      push    bc              ;b=last line, c=row
038F    01 0050                 ld      bc,80
0392    ED B0                   ldir
0394    C1                      pop     bc
0395    79                      ld      a,c
0396    3C                      inc     a
0397    FE 18                   cp      24
0399    38 ED                   jr      c,lindl
039B    AF                      xor     a               ;wrap
039C    18 EA                   jr      lindl           ;move next line
039E    EB              lind2:  ex      de,hl
039F    CD 0341         lind3:  call    clrlin
```

```
03A2    E1                  pop     hl              ;restore original cursor
03A3    C9                  ret

                    ;;      linins - Line insert.
                    ;
03A4    E5          linins: push    hl              ;save cursor position
03A5    3E 17               ld      a,23            ;get bottom line
03A7    CD F31E             call    cca             ;compute cursor address
03AA    CD 040F             call    bbg             ;bury balcones gold
03AD    E1                  pop     hl
03AE    E5                  push    hl
03AF    29                  add     hl,hl
03B0    7C                  ld      a,h
03B1    E6 1F               and     00011111b       ;extract cursor row
03B3    47                  ld      b,a
03B4    3A FFB1             ld      a,(base)        ;set last line
03B7    B8          lini1:  cp      b
03B8    28 13               jr      z,lini3         ;if move complete
03BA    3D                  dec     a
03BB    F2 03C0             jp      p,lini2
03BE    3E 17               ld      a,23
03C0    CD 03D1     lini2:  call    smp             ;set move parameters
03C3    EB                  ex      de,hl
03C4    C5                  push    bc
03C5    01 0050             ld      bc,80
03C8    ED B0               ldir
03CA    C1                  pop     bc
03CB    18 EA               jr      lini1           ;move next line
03CD    E1          lini3:  pop     hl
03CE    E5                  push    hl              ;restore cursor
03CF    18 CE               jr      lind3           ;clear cursor line

                    ;;      smp - Set move parameters.
                    ;
03D1    4F          smp:    ld      c,a             ;save row
03D2    CD F324             call    cca2
03D5    EB                  ex      de,hl
03D6    79                  ld      a,c
03D7    CD F323             call    cca1
03DA    79                  ld      a,c
03DB    C9                  ret

                    ;;      chrins - Character insert.
                    ;
03DC    E5          chrins: push    hl
03DD    7D                  ld      a,l             ;set cursor column
03DE    E6 7F               and     01111111b       ;set move length = 79-column
03E0    ED 44               neg
03E2    C6 4F               add     a,79
03E4    47                  ld      b,a             ;number of chars to move
03E5    7E                  ld      a,(hl)          ;get char under cursor
03E6    36 20               ld      (hl),' '        ;clear char under cursor
03E8    28 06               jr      z,chrin2        ;if cursor in last column
03EA    2C          chrin1: inc     l
03EB    4E                  ld      c,(hl)
03EC    77                  ld      (hl),a
```

```
03ED     79                        ld      a,c
03EE     10 FA                     djnz    chrin1
03F0     32 F319         chrin2:   ld      (gold),a        ;shift line into the gold mine
03F3     E1                        pop     hl
03F4     C9                        ret

                         ;;        chrdel - Character delete.
                         ;
03F5     E5              chrdel:   push    hl
03F6     7D                        ld      a,l
03F7     E6 7F                     and     01111111b       ;isolate cursor column
03F9     ED 44                     neg
03FB     C6 4F                     add     a,79
03FD     4F                        ld      c,a             ;number of chars to move = 79-column
03FE     06 00                     ld      b,0
0400     54                        ld      d,h
0401     5D                        ld      e,l
0402     1A                        ld      a,(de)
0403     32 F319                   ld      (gold),a        ;mine balcones gold
0406     23                        inc     hl
0407     C4 0418                   call    nz,ldirx
040A     EB                        ex      de,hl
040B     36 20                     ld      (hl),' '        ;blank last char on line
040D     E1                        pop     hl              ;restore cursor
040E     C9                        ret

                         ;;        bbg - bury balcones gold.
                         ;
040F     CD 02F2         bbg:      call    return
0412     11 FF5C                   ld      de,linbuf
0415     01 0050                   ld      bc,80
0418     ED B0           ldirx:    ldir
041A     C9                        ret

                                   subttl  Logical to Physical Driver Executioner
                                   page
```

```

                                         above                      ;code goes in ram
        0518!              +             d&seg

                                 ;;      Xqdvr - Execute Physical Driver.
                                 ;
                                 ;       Entry:  HL = Pointer to Physical Drive Request Block
                                 ;
                                 ;
        F344    23               xqdvr:  inc     hl                 ;point at physical unit
        F345    E5                       push    hl
        F346    23                       inc     hl
        F347    5E                       ld      e,(hl)             ;set logical drive
        F348    21 F360                  ld      hl,Seltab          ;Set driver mapping table address
        F34B    16 00                    ld      d,0
        F34D    19                       add     hl,de              ;index into driver select table
        F34E    19                       add     hl,de
        F34F    5E                       ld      e,(hl)             ;set physical driver index
        F350    23                       inc     hl
        F351    7E                       ld      a,(hl)             ;set physical unit
        F352    21 F380                  ld      hl,Drvtab          ;set Driver table address
        F355    19                       add     hl,de
        F356    19                       add     hl,de
        F357    5E                       ld      e,(hl)             ;set physical driver address
        F358    23                       inc     hl
        F359    56                       ld      d,(hl)
        F35A    E1                       pop     hl                 ;recover request block address
        F35B    77                       ld      (hl),a             ;store physical unit
        F35C    2B                       dec     hl
        F35D    D5                       push    de                 ;execute physical driver
        F35E    C9                       ret

                                         subttl  Physical Disk Driver Area
                                         page
```

```

                            ;;        Physical Disk Driver Area.
                            ;
                                      above
035F"                   +             d&seg
                            ;;        Waste space to get drivers on page boundry.
                            ;
F35F                        Wasted:
000F                        bndry     equ     0fh
                                      if      ($ and bndry) ne 0
F35F                                  defs    bndry+1-($ and bndry),-1
                                      endif

                            ;;        Logical to Physical Drive Mapping Tables.
                            ;
                            ;         Seltab contains two bytes per logical CP/M drive A-P.
                            ;         The first byte is an index into the physical driver
                            ;         address table below.  The second byte is a unit number
                            ;         that is  passed to the driver by the standard deblocker.
                            ;
F360                        Seltab:

F360    01 00               .A:       defb    1,0                 ;Floppy Unit 0
F362    01 01               .B:       defb    1,1                 ;Floppy Unit 1
F364    01 02               .C:       defb    1,2                 ;Floppy Unit 2
F366    01 03               .D:       defb    1,3                 ;Floppy Unit 3

F368    01 04               .E:       defb    1,4                 ;Rigid Partition 0
F36A    01 05               .F:       defb    1,5                 ;Rigid Partition 1
F36C    01 06               .G:       defb    1,6                 ;Rigid Partition 2
F36E    01 07               .H:       defb    1,7                 ;Rigid Partition 3

F370    00 00               .I:       defb    0,0                 ;Error Driver
F372    00 00               .J:       defb    0,0                 ;Error Driver
F374    00 00               .K:       defb    0,0                 ;Error Driver
F376    00 00               .L:       defb    0,0                 ;Error Driver

F378    00 00               .M:       defb    0,0                 ;Error Driver
F37A    00 00               .N:       defb    0,0                 ;Error Driver
F37C    00 00               .O:       defb    0,0                 ;Error Driver
F37E    00 00               .P:       defb    0,0                 ;Error Driver

                            ;;        Physical Driver Address Table.
                            ;
                            ;         Dvrtab contains the addresses of several independent
                            ;         physical disk drivers.  By convention, driver # 0 always
                            ;         returns a select error.
                            ;
F380    F42A                Drvtab:   defw    Selerr              ;select error physical driver
F382    F4B0                          defw    Dskdvr              ;Disk driver (WD or SA)
F384    0000                          defw    0                   ;Empty physical driver expansion slots
F386    0000                          defw    0
F388    0000                          defw    0
F38A    0000                          defw    0
F38C    0000                          defw    0
```

```
F38E    FFFF                       defw    0-1              ;mark last empty expansion slot

                           ;;      Overlaid Monitor Ram Address Definitions.
                           ;
FC80                       dirbuf  equ     0fc80h           ;director buffer
FD00                       chk00   equ     0fd00h           ;Directory Check Vector for Floppy Drive 0
FD20                       chk01   equ     0fd20h           ;Directory Check Vector for Floppy Drive 1
FD40                       chk02   equ     0fd40h           ;Directory Check Vector for Floppy Drive 2
FD60                       chk03   equ     0fd60h           ;Directory Check Vector for Floppy Drive 3
0000                       chk04   equ     0                ;No Check Vector for Rigid Partition 0
0000                       chk05   equ     0                ;No Check Vector for Rigid Partition 1
0000                       chk06   equ     0                ;No Check Vector for Rigid Partition 2
0000                       chk07   equ     0                ;No Check Vector for Rigid Partition 3

FD80                       all00   equ     0fd80h           ;Floppy Drive 0 Allocation Vector
FDA0                       all01   equ     0fda0h           ;Floppy Drive 1 Allocation Vector
FDC0                       all02   equ     0fdc0h           ;Floppy Drive 2 Allocation Vector
FDE0                       all03   equ     0fde0h           ;Floppy Drive 3 Allocation Vector
FE00                       all04   equ     0fe00h           ;Rigid Partition Allocation vectors
FE80                       all05   equ     0fe80h
FEC0                       all06   equ     0fec0h
FEE0                       all07   equ     0fee0h

                                   subttl  Disk Parameter Headers
                                   page
```

```

                                  ;;      Disk Parameter Headers.
                                  ;
  F390     0000 0000              Dpbase: dw      0,0,0,0         ;Floppy Drive 0
  F394     0000 0000
  F398     FC80 0000                      dw      dirbuf,0
  F39C     FD00 FD80                      dw      chk00,al100

  F3A0     0000 0000                      dw      0,0,0,0         ;Floppy Drive 1
  F3A4     0000 0000
  F3A8     FC80 0000                      dw      dirbuf,0
  F3AC     FD20 FDA0                      dw      chk01,al101

  F3B0     0000 0000                      dw      0,0,0,0         ;Floppy Drive 2
  F3B4     0000 0000
  F3B8     FC80 0000                      dw      dirbuf,0
  F3BC     FD40 FDC0                      dw      chk02,al102

  F3C0     0000 0000                      dw      0,0,0,0         ;Floppy Drive 3
  F3C4     0000 0000
  F3C8     FC80 0000                      dw      dirbuf,0
  F3CC     FD60 FDE0                      dw      chk03,al103

  F3D0     0000 0000                      dw      0,0,0,0         ;Rigid Partition 0
  F3D4     0000 0000
  F3D8     FC80 F470                      dw      dirbuf,Dpbrg4
  F3DC     0000 FE00                      dw      chk04,al104

  F3E0     0000 0000                      dw      0,0,0,0         ;Rigid Partition 1
  F3E4     0000 0000
  F3E8     FC80 F480                      dw      dirbuf,Dpbrg5
  F3EC     0000 FE80                      dw      chk05,al105

  F3F0     0000 0000                      dw      0,0,0,0         ;Rigid Partition 2
  F3F4     0000 0000
  F3F8     FC80 F490                      dw      dirbuf,Dpbrg6
  F3FC     0000 FEC0                      dw      chk06,al106

  F400     0000 0000                      dw      0,0,0,0         ;Rigid Partition 3
  F404     0000 0000
  F408     FC80 F4A0                      dw      dirbuf,Dpbrg7
  F40C     0000 FEE0                      dw      chk07,al107

                                          subttl  Sector Translate Tables
                                          page
```

```

                                        ;;      Sector Translation Tables.
                                        ;
                                        ;       For 8 inch single density drives.
                                        ;       Skew by 6
                                        ;
        F410    01 07 0D 13             trn6:   db      01,07,13,19
        F414    19 05 0B 11                     db      25,05,11,17
        F418    17 03 09 0F                     db      23,03,09,15
        F41C    15 02 08 0E                     db      21,02,08,14
        F420    14 1A 06 0C                     db      20,26,06,12
        F424    12 18 04 0A                     db      18,24,04,10
        F428    10 16                           db      16,22

        F42A    21 0000                 selerr: ld      hl,0
        F42D    F6 FF                           or      -1
        F42F    C9                              ret

                                                subttl  Floppy Disk Parameter Blocks
                                                page
```

```

                                  ;;        Floppy Disk Parameter Blocks, one per media format.
                                  ;
F430                              dpb8s:
                                  ;         Single Density, Single side

F430    001A                                dw      26                ;spt
F432    03 07 00                            db      3,7,0             ;blkshf, blkmsk, nullmsk
F435    00F2 003F                           dw      242,63,192,16,2 ;dsw,dirm,alloc01,chksiz,trk off
F439    00C0 0010
F43D    0002
F43F    00                                  db      0                 ;128 byte sectors

                                  ;         Single Density, Double Side

F440    001A                                dw      26                ;spt
F442    04 0F 01                            db      4,15,1            ;blkshf, blkmsk, nullmsk
F445    00F6 007F                           dw      246,127,192,16,2;dsw,dirm,alloc01,chksiz,trk off
F449    00C0 0010
F44D    0002
F44F    00                                  db      0                 ;128 byte sectors

F450                              dpb8d:
                                  ;         Double Density, Single Side

F450    0034                                dw      2*26              ;spt
F452    04 0F 01                            db      4,15,1            ;blkshf, blkmsk, nullmsk
F455    00F2 007F                           dw      242,127,192,32,2;dsw,dirm,alloc01,chksiz,trk off
F459    00C0 0020
F45D    0002
F45F    81                                  db      81h               ;256 byte sectors, track zero single density

                                  ;         Double Density, Double Side

F460    0034                                dw      2*26              ;spt
F462    05 1F 03                            db      5,31,3            ;blkshf, blkmsk, nullmsk
F465    00F6 007F                           dw      246,127,192,32,2;dsw,dirm,alloc01,chksiz,trk off
F469    00C0 0020
F46D    0002
F46F    81                                  db      81h               ;256 byte sectors, track zero single density

                                            subttl  Micro Floppy Disk Parameter Blocks
                                            page
```

```
F470                          dpb5s:

                              ;      Single Density, Single Side

F470      0012                       dw     18               ;spt
F472      03 07 00                   db     3,7,0            ;blkshf, blkmsk, nulmsk
F475      0052 001F                  dw     82,31,128,8,3    ;dsw,dirm,alloc01,chksiz,trk off
F479      0080 0008
F47D      0003
F47F      00                         db     0                ;128 byte sectors

                              ;      Single Density, Double Side

F480      0012                       dw     18               ;spt
F482      03 07 00                   db     3,7,0            ;blkshf, blkmsk, nulmsk
F485      00AC 001F                  dw     172,31,128,8,3   ;dsw,dirm,alloc01,chksiz,trk off
F489      0080 0008
F48D      0003
F48F      00                         db     0                ;128 byte sectors

F490                          dpb5d:

                              ;      Double Density, Single Side

F490      0022                       dw     17*2             ;spt
F492      03 07 00                   db     3,7,0            ;blkshf, blkmsk, nulmsk
F495      009C 003F                  dw     156,63,192,16,3 ;dsw,dirm,alloc01,chksiz,trk off
F499      00C0 0010
F49D      0003
F49F      81                         db     81h              ;256 byte sectors, track zero single density

                              ;      Double Density, Double Side

F4A0      0022                       dw     17*2             ;spt
F4A2      04 0F 01                   db     4,15,1           ;blkshf, blkmsk, nulmsk
F4A5      00A2 003F                  dw     162,63,192,16,3 ;dsw,dirm,alloc01,chksiz,trk off
F4A9      00C0 0010
F4AD      0003
F4AF      81                         db     81h              ;256 byte sectors, track zero single density

                                     subttl  Western Digital WD-1797-02 Floppy Disk Driver
                                     page
```

```

;;      Standard Disk Driver Interface Definitions.
;
;       The main entry point (FLOPPY) is called with HL pointing
;       to a disk driver request block.  All information is passed
;       in this request as follows:
;
;       HL->    db      command ;1 = read, 0 = write, -1 = select dph
;               db      phunit  ;physical unit for request (0-3)
;               db      cpunit  ;CP/M logical drive for request (0-15)
;               dw      track   ;CP/M track number (offset already applied)
;               dw      sector  ;Phys sector number (after deblocking)
;               dw      address ;CP/M dma transfer address
;
        subttl  Assembly Constants
        page
```

```


0066                          NMI     equ     00066h          ;address of non maskable interrupt

                              ;;      WD 1797 I/O port addresses.
                              ;
0010                          wdsr    equ     10h             ;status
0010                          wdcr    equ     10h             ;command
0011                          wdtr    equ     11h             ;track
0012                          wdsn    equ     12h             ;sector
0013                          wddt    equ     13h             ;data
001C                          wdsl    equ     1ch             ;drive select port
0030                          wdsd    equ     30h             ;select single density
0031                          wddd    equ     31h             ;select double density

                              ;;      External Disk Parameter Tables.
                              ;

0007                          fm.un   equ     7
0004                          fm.ds   equ     4
0005                          fm.dd   equ     5
0006                          fm.fv   equ     6
00A0                          fm.ddss equ     (1 shl fm.dd) or (1 shl fm.un)

004D                          ntrk8   equ     77
0028                          ntrk5   equ     40

0004                          c.8in   equ     4
0005                          c.two   equ     5
0006                          timou   equ     6               ;motor / select time out
000A                          dpbofs  equ     10              ;offset in dph for dpb address

                                      subttl  Floppy Disk Driver Proper
                                      page
```

```

                                   ;;      Western Digital Floppy Disk Driver.
                                   ;
F4B0    CD F647         Dskdvr: call    rdc             ;un hang busy controller
F4B3    7E                      ld      a,(hl)          ;set command
F4B4    23                      inc     hl              ;point to unit
F4B5    32 F4E7                 ld      (rdop),a
F4B8    3C                      inc     a
F4B9    28 55                   jr      z,selec         ;if select command
F4BB    06 0A                   ld      b,10            ;set retry count
F4BD    C5              flop1:  push    bc              ;save count
F4BE    E5                      push    hl              ;save command
F4BF    7E                      ld      a,(hl)          ;set unit select
F4C0    CD F544                 call    selunt
F4C3    FA F506                 jp      m,flop5         ;if unit not ready
F4C6    23                      inc     hl
F4C7    23                      inc     hl
F4C8    4E                      ld      c,(hl)          ;set track low
F4C9    CD F5A3                 call    seekx           ;position disk
F4CC    4E                      ld      c,(hl)          ;retrieve track low
F4CD    20 37                   jr      nz,flop5        ;if unrecoverable error
F4CF    23                      inc     hl              ;track high
F4D0    23                      inc     hl
F4D1    13                      inc     de              ;point to second byte of track table entry
F4D2    1A                      ld      a,(de)          ;get diskette type
F4D3    E6 18                   and     18h
F4D5    7E                      ld      a,(hl)          ;sector low
F4D6    20 06                   jr      nz,flop2        ;if single density, cp/m skews
F4D8    79                      ld      a,c             ;get current logical track
F4D9    B7                      or      a
F4DA    7E                      ld      a,(hl)          ;set sector
F4DB    28 01                   jr      z,flop2         ;if single density track zero
F4DD    3C                      inc     a               ;translate for double density
F4DE    D3 12           flop2:  out     (wdsn),a        ;set sector to read in 1791
F4E0    23                      inc     hl              ;skip sector high
F4E1    23                      inc     hl              ;dmal
F4E2    5E                      ld      e,(hl)          ;set transfer address to HL
F4E3    23                      inc     hl              ;dmah
F4E4    56                      ld      d,(hl)
F4E5    EB                      ex      de,hl
F4E6    3E 00                   ld      a,0             ;set read/write switch
F4E7                    rdop    equ     $-1
F4E8    B7                      or      a
F4E9    0E A8                   ld      c,0a8h          ;preset write command
F4EB    3E A3                   ld      a,0a3h          ;set second part of OUTI
F4ED    28 03                   jr      z,flop3         ;if write
F4EF    0E 88                   ld      c,088h          ;turn write command into read command
F4F1    3D                      dec     a               ;turn OUTI into INI
F4F2    32 F4FE         flop3:  ld      (rdwra),a       ;set up i/o direction
F4F5    3E 00                   ld      a,0
F4F6                    rdwrs   equ     $-1             ;set side compare flag
F4F7    81                      add     a,c
F4F8    4F                      ld      c,a
F4F9    CD F61D                 call    stc             ;start transfer
F4FC    76              flop4:  halt                    ;wait for DRQ or INT
```

```
F4FD    ED A2                   ini                     ;transfer next byte
F4FE                    rdwra   equ     $-1
F4FF    20 FB                   jr      nz,flop4        ;if transfer not complete
F501    CD F639                 call    ttc             ;terminate transfer command
F504    E6 DF                   and     0dfh            ;set error bits
F506    E1              flop5:  pop     hl              ;recover command pointer
F507    C1                      pop     bc
F508    C8                      ret     z               ;if no errors
F509    D8                      ret     c               ;if 5.25" not ready
F50A    CD F069                 call    softv
F50D    10 AE                   djnz    flop1           ;if retry not exceeded
F50F    C9                      ret

                        ;;      select - select dph for unit.
                        ;
F510    7E              selec:  ld      a,(hl)          ;set unit
F511    FE 04                   cp      4
F513    D2 F42A                 jp      nc,selerr       ;if bad unit select
F516    26 00                   ld      h,0
F518    CD F039                 call    dayti           ;set address of timers
F51B    2B                      dec     hl              ;point to motor timer
F51C    22 F559                 ld      (mtradr),hl
F51F    2B                      dec     hl              ;point to configurable step rate
F520    22 F66E                 ld      (stpadr),hl     ;store address of step rate for media selector
F523    26 00                   ld      h,0
F525    6F                      ld      l,a
F526    29                      add     hl,hl           ;multiply by 2**4
F527    29                      add     hl,hl
F528    29                      add     hl,hl
F529    29                      add     hl,hl
F52A    11 F390                 ld      de,Dpbase       ;set address of disk parameter headers
F52D    19                      add     hl,de           ;set dph address
F52E    E5                      push    hl
F52F    CD F65A                 call    smf             ;set media format
F532    E1                      pop     hl
F533    CA F42A                 jp      z,selerr        ;if no media
F536    71                      ld      (hl),c          ;store translate table
F537    23                      inc     hl
F538    70                      ld      (hl),b
F539    01 000A                 ld      bc,dpbofs
F53C    09                      add     hl,bc           ;point to dpb addr and clear carry
F53D    72                      ld      (hl),d          ;fill in dpb address
F53E    2B                      dec     hl
F53F    73                      ld      (hl),e
F540    ED 42                   sbc     hl,bc           ;point back to dph
F542    AF                      xor     a
F543    C9                      ret

                        ;;      select physical unit.
                        ;
F544    4F              selunt: ld      c,a             ;save select
F545    EB                      ex      de,hl
F546    21 F700                 ld      hl,trktbl+1     ;set track / density table address
F549    06 00                   ld      b,0
F54B    09                      add     hl,bc
F54C    09                      add     hl,bc
```

```
F54D    22 F6D1                 ld      (smfa),hl       ;save address for media selector
F550    EB                      ex      de,hl
F551    1A                      ld      a,(de)          ;get previous density switch
F552    1B                      dec     de              ;point to track word
F553    CD F598                 call    selden          ;select density
F556    3E 06                   ld      a,timou         ;start motor / select timer
F558    32 F559                 ld      (mtradr),a
F559                    mtradr  equ     $-2             ;address filled in by once only routine
F55B    FB                      ei                      ;insure clock enabled
F55C    CB 89                   res     1,c             ;map C->A, D->B
F55E    DB 1C                   in      a,(wdsl)        ;read current select
F560    47                      ld      b,a
F561    E6 F8                   and     not 7
F563    B1                      or      c               ;insert new select
F564    3C                      inc     a               ;0-1, 1-2
F565    D3 1C                   out     (wdsl),a        ;select drive
F567    A8                      xor     b
F568    E6 03                   and     3
F56A    28 25                   jr      z,sel3          ;if drive select identical
F56C    3E FF                   ld      a,-1            ;force track position recovery
F56E    12                      ld      (de),a
F56F    CB 60                   bit     c.8in,b         ;test 8/5 status
F571    20 1E                   jr      nz,sel3         ;if 8"
F573    CD F647                 call    rdc             ;set type I status
F576    06 08                   ld      b,2*4           ;watch for four holes (8 transitions)
F578    E5              sellw:  push    hl
F579    2A F559                 ld      hl,(mtradr)     ;get address of motor select timer
F57C    7E                      ld      a,(hl)
F57D    E1                      pop     hl
F57E    D6 04                   sub     timou-2         ;look for 1-2 seconds
F580    D8                      ret     c               ;if drive not spinning
F581    DB 10                   in      a,(wdsr)
F583    E6 02                   and     2
F585    28 F1           sel2:   jr      z,sellw         ;if index not under light
F587    3A F585                 ld      a,(sel2)        ;switch index polarity
F58A    EE 08                   xor     8               ;(jr z) xor (jr nz)
F58C    32 F585                 ld      (sel2),a
F58F    10 E7                   djnz    sellw           ;wait for at least three revolutions
F591    DB 10           sel3:   in      a,(wdsr)        ;set ready status
F593    E6 80                   and     80h
F595    C9                      ret

F596    3E 18           seldns: ld      a,18h           ;set track zero single density
F598    32 F632         selden: ld      (dsw),a         ;store switch for read/write routines
F59B    E6 18                   and     18h
F59D    D3 31                   out     (wddd),a        ;pre-select dual density
F59F    C8                      ret     z               ;if dual density
F5A0    D3 30                   out     (wdsd),a        ;select single density
F5A2    C9                      ret

                        ;;      seek - position disk.

                        ;
F5A3    79              seekx:  ld      a,c             ;set new track
F5A4    B7                      or      a
F5A5    CC F596                 call    z,seldns        ;force single density track 0
F5A8    13                      inc     de
```

```
F5A9    1A                      ld      a,(de)
F5AA    1B                      dec     de
F5AB    E6 01                   and     1
F5AD    28 15                   jr      z,sek1          ;if one sided diskette
F5AF    DB 1C                   in      a,(wdsl)
F5B1    CB 67                   bit     c.8in,a
F5B3    06 4D                   ld      b,ntrk8         ;set number of eight inch tracks
F5B5    20 02                   jr      nz,sek0         ;if 8" drives
F5B7    06 28                   ld      b,ntrk5
F5B9    79              sek0:   ld      a,c             ;set seek track
F5BA    B8                      cp      b
F5BB    3E 00                   ld      a,0             ;preset side 0
F5BD    38 05                   jr      c,sek1          ;if side 0
F5BF    79                      ld      a,c
F5C0    90                      sub     b               ;wrap to side 1
F5C1    4F                      ld      c,a
F5C2    3E 02                   ld      a,2             ;set side 1
F5C4    32 F4F6         sek1:   ld      (rdwrs),a       ;store F1 (update SSO)
F5C7    87                      add     a,a             ;move into select port position
F5C8    47                      ld      b,a
F5C9    F3                      di
F5CA    DB 1C                   in      a,(wdsl)
F5CC    CB 97                   res     2,a
F5CE    B0                      or      b
F5CF    FB                      ei
F5D0    D3 1C                   out     (wdsl),a        ;send out REAL SSO
F5D2    1A                      ld      a,(de)          ;check current position
F5D3    D3 11                   out     (wdtr),a        ;inform 1797 of current track
F5D5    B9                      cp      c
F5D6    28 17                   jr      z,seek3         ;if position ok, load head
F5D8    3C                      inc     a               ;check for forced recovery
F5D9    CC F5F8                 call    z,rse           ;recover seek errors
F5DC    28 0D                   jr      z,seek1         ;if error not recoverable
F5DE    79              seek0:  ld      a,c             ;set new track
F5DF    D3 13                   out     (wddt),a        ;in data register
F5E1    3E 1C                   ld      a,1ch           ;set seek with verify command
F5E3    CD F643                 call    isc             ;issue step command
F5E6    E6 98                   and     98h
F5E8    79                      ld      a,c             ;update current track
F5E9    28 02                   jr      z,seek2         ;if no errors
F5EB    F6 FF           seek1:  or      -1              ;force recovery next time
F5ED    12              seek2:  ld      (de),a
F5EE    C9                      ret
F5EF    CD F647         seek3:  call    rdc             ;set type I status
F5F2    E6 20                   and     20h             ;test head load
F5F4    28 E8                   jr      z,seek0         ;if head is not loaded
F5F6    AF              retzr:  xor     a               ;say seek complete
F5F7    C9                      ret

                        ;;      rse - recover seek error.
                        ;
F5F8    C5              rse:    push    bc
F5F9    CD F605                 call    rdid            ;read id mark
F5FC    20 05                   jr      nz,rse1         ;if track position identified
F5FE    CD F641                 call    recal           ;recalibrate
F601    E6 04                   and     4               ;verify track zero flag set
```

```
F603     C1                    rsel:   pop     bc
F604     C9                            ret

                               ;;      rdid - read id mark.
                               ;
F605     0E C4                 rdid:   ld      c,0c4h           ;set Read Address Command
F607     CD F61D                       call    stc              ;start transfer command
F60A     76                            halt                     ;wait for interrupt
F60B     ED 40                         in      b,(c)            ;first byte is track
F60D     76                            halt
F60E     ED 48                         in      c,(c)            ;second byte is side, pitch next 4
F610     CD F639                       call    ttc              ;terminate transfer command
F613     E6 98                         and     98h              ;ignore lost data
F615     20 04                         jr      nz,rdid1         ;if track not identified
F617     78                            ld      a,b
F618     D3 11                         out     (wdtr),a         ;tell 1797 track head is on now
F61A     F6                            defb    0f6h             ;or xra to set NZ
F61B     AF                    rdid1:  xor     a                ;set track not found
F61C     C9                            ret

                               ;;      stc - start transfer command.
                               ;
F61D     F3                    stc:    di                       ;lock normal interrupts
F61E     3A 0066                       ld      a,(NMI)          ;save byte at NMI address
F621     32 F63A                       ld      (ttca),a
F624     3E C9                         ld      a,0c9h           ;store RET there
F626     32 0066                       ld      (NMI),a
F629     79                            ld      a,c              ;retrieve command
F62A     01 1413                       ld      bc,wddt+20*256   ;1797 access timer / data port
F62D     D3 10                         out     (wdcr),a         ;issue command
F62F     10 FE                         djnz    $                ;pause 60 usec
F631     3E 00                         ld      a,0
F632                           dsw     equ     $-1              ;density switch
F633     E6 18                         and     18h              ;say ready and density
F635     C8                            ret     z                ;if double density
F636     06 80                         ld      b,128            ;set 128 byte single density sectors
F638     C9                            ret

                               ;;      ttc - terminate transfer command.
                               ;
F639     3E 00                 ttc:    ld      a,0              ;restore location 66
F63A                           ttca    equ     $-1
F63B     32 0066                       ld      (NMI),a
F63E     FB                            ei                       ;take interrupts now
F63F     18 0A                         jr      woc              ;wait for 1797 to complete

                               ;;      recalibrate drive.
                               ;
F641     AF                    recal:  xor     a                ;set restore command / track 0
F642     12                            ld      (de),a           ;set track zero

                               ;;      isc - issue step command.
                               ;
F643     F6 01                 isc:    or      1                ;insert step rate
F644                           stepr   equ     $-1      ;*****=>;modify here for step rate change
F645     18 02                         jr      icc
```

```
F647    3E D0           rdc:    ld      a,0d0h          ;terminate and set type I status

                        ;;      icc  - issue controller command.
                        ;
F649    D3 10           icc:    out     (wdcr),a        ;issue 1797 command

                        ;;      woc  - wait operation complete.
                        ;
F64B    3E 14           woc:    ld      a,20            ;set 60 usec delay
F64D    3D              woc1:   dec     a
F64E    20 FD                   jr      nz,woc1
F650    CD F066         woc2:   call    idle            ;idle cpu
F653    DB 10                   in      a,(wdsr)        ;set 1797 status
F655    CB 47                   bit     0,a
F657    20 F7                   jr      nz,woc2         ;if busy, wait
F659    C9                      ret

                                subttl  Media Format Selector
                                page

                        ;
                        ;;      smf - set media format.
                        ;
                        ;       entry:  unit in A
                        ;
                        ;       exit:   DE = dpb address
                        ;               BC = translate table
                        ;
F65A    CD F544         smf:    call    selunt          ;select unit
F65D    FA F5F6                 jp      m,retzr         ;if disk not ready
F660    21 F6D5                 ld      hl,dtype
F663    36 A0                   ld      (hl),fm.ddss    ;start out double density, single side, retry
F665    DB 1C                   in      a,(wdsl)        ;read select status
F667    CB 67                   bit     c.8in,a         ;test 8" / 5" status
F669    20 02                   jr      nz,smf0         ;if 8 inch drives
F66B    CB F6                   set     fm.fv,(hl)      ;move up to 5.25" dpbs
F66D    3A F66E         smf0:   ld      a,(stpadr)      ;set configurable step rate for 8" drives
F66E                    stpadr  equ     $-2
F670    E6 03                   and     3               ;just so seeks aren't formats
F672    32 F644                 ld      (stepr),a       ;save step rate in seek command
F675    CD F641         smf0a:  call    recal           ;establish position
F678    E6 84                   and     84h
F67A    C8                      ret     z               ;if not on track zero
F67B    FA F5F6                 jp      m,retzr         ;if unit not ready
F67E    D3 31                   out     (wddd),a        ;set double density
F680    3E FF                   ld      a,-1
F682    12                      ld      (de),a          ;clear drive on track
F683    3E 02                   ld      a,2             ;use track 2 for density select
F685    D3 13                   out     (wddt),a
F687    3E 18                   ld      a,18h           ;seek / no verify
F689    CD F643                 call    isc             ;issue seek command
F68C    3E 1C                   ld      a,1ch           ;find id mark
F68E    D3 10                   out     (wdcr),a        ;start verify
F690    01 0000                 ld      bc,0            ;set timers
F693    10 FE           smf1:   djnz    $               ;pause
F695    DB 10                   in      a,(wdsr)
F697    CB 47                   bit     0,a
F699    28 08                   jr      z,smf1a         ;if command completed
F69B    0D                      dec     c
F69C    20 F5                   jr      nz,smf1         ;if more time
F69E    CD F647                 call    rdc             ;terminate seek
F6A1    3E 18                   ld      a,18h           ;set pseudo record not found
F6A3    E6 18           smf1a:  and     18h             ;check record not found / crc error
F6A5    13                      inc     de              ;point to density word in track table
F6A6    12                      ld      (de),a
F6A7    1B                      dec     de
F6A8    28 14                   jr      z,smf2          ;if density select successful
F6AA    D3 30                   out     (wdsd),a        ;use single density
F6AC    3E 1C                   ld      a,1ch           ;verify single density
F6AE    CD F643                 call    isc             ;issue seek
F6B1    E6 18                   and     18h
F6B3    28 07                   jr      z,smf1b         ;if single density successful
F6B5    CB 7E                   bit     fm.un,(hl)      ;test retry
F6B7    CB BE                   res     fm.un,(hl)      ;clear retry
```

```
F6B9     20 BA                        jr      nz,smf0a        ;if retry
F6BB     C9                           ret                     ;return select error
F6BC     CB AE              smf1b:    res     fm.dd,(hl)      ;back up to single density dpbs
F6BE     CB BE              smf2:     res     fm.un,(hl)      ;clear retry
F6C0     DB 1C                        in      a,(wdsl)
F6C2     CB D7                        set     2,a             ;select side 2
F6C4     D3 1C                        out     (wdsl),a
F6C6     CD F605                      call    rdid            ;read id mark
F6C9     28 09                        jr      z,smf4          ;if no id found, must be one side
F6CB     0D                           dec     c
F6CC     20 06                        jr      nz,smf4         ;if side 1 ID not read
F6CE     CB E6                        set     fm.ds,(hl)      ;bump up to two sided dpbs
F6D0     21 F6D1                      ld      hl,smfa         ;set double sided status in track table
F6D1                        smfa      equ     $-2
F6D3     34                           inc     (hl)
F6D4     21 0000            smf4:     ld      hl,0            ;set diskette type
F6D5                        dtype     equ     $-2
F6D7     7D                           ld      a,l             ;save type
F6D8     4C                           ld      c,h             ;preset no translate
F6D9     44                           ld      b,h
F6DA     11 F430                      ld      de,dpb8s        ;set base of disk parameter blocks
F6DD     19                           add     hl,de
F6DE     EB                           ex      de,hl           ;return DPB address in DE
F6DF     CB 6F                        bit     fm.dd,a
F6E1     C0                           ret     nz              ;if diskette is double density
F6E2     01 F6ED                      ld      bc,trn5         ;preset 5.25" skew table
F6E5     CB 77                        bit     fm.fv,a
F6E7     C0                           ret     nz              ;if diskette is small
F6E8     01 F410                      ld      bc,trn6         ;set 8" translate
F6EB     3C                           inc     a               ;force NZ
F6EC     C9                           ret

                            ;;        Skew by 5 translate table.
                            ;
F6ED     01 06 0B 10        trn5:     db      01,06,11,16
F6F1     03 08 0D 12                  db      03,08,13,18
F6F5     05 0A 0F 02                  db      05,10,15,02
F6F9     07 0C 11 04                  db      07,12,17,04
F6FD     09 0E                        db      09,14

F6FF     7F 00 C0 00        trktbl:   db      7fh,0,0c0h,0,20h,0,2,0,81h
F703     20 00 02 00
F707     81

F708                        rigdpb    equ     0f708h
F770                        iobloc    equ     0f770h

                                      above
0708"                 +               d&seg

                                      .dephase
                                      .phase  0f470h
F470                        sasstr    equ     $

                                      Subttl  Rigid Partition Disk Parameter Blocks.
                                      page
```

```

                              ;       There are 16 4k Blocks per pseudo track.
                              ;       Track Zero (2 Cylinders) are reserved for CP/M boot.
                              ;
0040                          Nt4     equ     64              ;Number of Tracks on Partition 0
0020                          Nt5     equ     32              ;Number of Tracks on Partition 1
0010                          Nt6     equ     16              ;Number of Tracks on Partition 2
0010                          Nt7     equ     16              ;Number of Tracks on Partition 3

0000                          ..      aset    0               ;First usable track
                                      irpc    n,<4567>
                              ..      aset    ..+1            ;reserve system track
                              Dsm&n   equ     Nt&n*16-17
                              Rtk&n   equ     ..
                              ..      aset    ..+Nt&n-1
                              Dpbrg&n:dw      512             ;spt
                                      db      5,31            ;blkshf, blkmsk
                                      db      3+2*(Dsm&n ge 256);exm
                                      dw      Dsm&n           ;dsm
                                      dw      511             ;dirmax
                                      db      -1              ;alloc0 (reserve additional dir space)
                                      db      0               ;alloc1
                                      dw      0               ;check size
                                      dw      Rtk&n           ;track offset
                                      db      1               ;256 byte sectors
                                      endm
F470    0200            +     Dpbrg&4:dw      512             ;spt
F472    05 1F           +             db      5,31            ;blkshf, blkmsk
F474    01              +             db      3+2*(Dsm&4 ge 256);exm
F475    03EF            +             dw      Dsm&4           ;dsm
F477    01FF            +             dw      511             ;dirmax
F479    FF              +             db      -1              ;alloc0 (reserve additional dir space)
F47A    00              +             db      0               ;alloc1
F47B    0000            +             dw      0               ;check size
F47D    0001            +             dw      Rtk&4           ;track offset
F47F    01              +             db      1               ;256 byte sectors
F480    0200            +     Dpbrg&5:dw      512             ;spt
F482    05 1F           +             db      5,31            ;blkshf, blkmsk
F484    01              +             db      3+2*(Dsm&5 ge 256);exm
F485    01EF            +             dw      Dsm&5           ;dsm
F487    01FF            +             dw      511             ;dirmax
F489    FF              +             db      -1              ;alloc0 (reserve additional dir space)
F48A    00              +             db      0               ;alloc1
F48B    0000            +             dw      0               ;check size
F48D    0041            +             dw      Rtk&5           ;track offset
F48F    01              +             db      1               ;256 byte sectors
F490    0200            +     Dpbrg&6:dw      512             ;spt
F492    05 1F           +             db      5,31            ;blkshf, blkmsk
F494    03              +             db      3+2*(Dsm&6 ge 256);exm
F495    00EF            +             dw      Dsm&6           ;dsm
F497    01FF            +             dw      511             ;dirmax
F499    FF              +             db      -1              ;alloc0 (reserve additional dir space)
F49A    00              +             db      0               ;alloc1
F49B    0000            +             dw      0               ;check size
F49D    0061            +             dw      Rtk&6           ;track offset
```

```
F49F    01             +       db      1              ;256 byte sectors
F4A0    0200           +  Dpbrg&7:dw      512            ;spt
F4A2    05 1F          +       db      5,31           ;blkshf, blkmsk
F4A4    03             +       db      3+2*(Dsm&7 ge 256);exm
F4A5    00EF           +       dw      Dsm&7          ;dsm
F4A7    01FF           +       dw      511            ;dirmax
F4A9    FF             +       db      -1             ;alloc0 (reserve additional dir space)
F4AA    00             +       db      0              ;alloc1
F4AB    0000           +       dw      0              ;check size
F4AD    0071           +       dw      Rtk&7          ;track offset
F4AF    01             +       db      1              ;256 byte sectors

                               subttl  SA1403 - Shugart / DTC SASI Driver
                               page
```

```


                        ;;      SA-1403D SASI driver.
                        ;
 EE00                   rgdbuf  equ     0ee00h          ;rigid parameter load buffer

                        ;;      Sasi Pio Port Addresses.
                        ;
 0011                   pioAs   equ     11h             ;Pio A Status
 0010                   pioAd   equ     pioAs xor 01b
 0013                   pioBs   equ     pioAs xor 10b
 0012                   pioBd   equ     pioAs xor 11b

 0010                   Sasid   equ     pioAd           ;bus data
 0012                   Sasic   equ     pioBd           ;bus control
 0012                   Sasis   equ     pioBd           ;bus status

 001C                   syspio  equ     1ch             ;system configuration port

                        ;;      Sasi controller status bit definitions.
                        ;
 0000                   b.bsy   equ     00              ;(in)  controller busy status
 0001                   b.msg   equ     01              ;(in)  status byte completion status
 0002                   b.cd    equ     02              ;(in)  control byte or data byte transfer
 0003                   b.req   equ     03              ;(in)  controller request for data/command
 0004                   b.io    equ     04              ;(in)  data transfer direction
 0005                   b.sel   equ     05              ;(out) controller select
 0006                   b.par   equ     06              ;(in)  buss parity error
 0007                   b.rst   equ     07              ;(out) controller reset

                        ;;      Logical Unit Assignments.
                        ;
 0000                   falun   equ     0               ;A: Lun
 0001                   fblun   equ     1               ;B: Lun
 0000                   fclun   equ     0               ;C: Lun
 0002                   fdlun   equ     2               ;D: Lun
 0003                   rglun   equ     3               ;E: Lun

                                subttl  Sasi Class Code Definitions
                                page
```

```

                              ;;      Class Command Codes for Prom Set AS31*
                              ;
                              ;       DTC Reference Manual Dated February 4, 1981.
                              ;
                              ;;      class  0 commands.
                              ;
0000                          c.trdy  equ     00h             ;test ready status
0001                          c.recal equ     01h             ;recalibrate drive
0002                          c.rsyn  equ     02h             ;request syndrome
0003                          c.rqsn  equ     03h             ;request sense after error
0004                          c.fmat  equ     04h             ;format drive
0005                          c.vtrk  equ     05h             ;verify track format
0006                          c.ftrk  equ     06h             ;format single track
0007                          c.flaw  equ     07h             ;format track with flaw
0008                          c.read  equ     08h             ;read data
0009                          c.wrpr  equ     09h             ;write protect sector
000A                          c.writ  equ     0ah             ;write data
000B                          c.seek  equ     0bh             ;initiate seek
000C                          c.init  equ     0ch             ;inititialize drive

                              ;;      Class 6 commands.
                              ;
00C0                          c.flpy  equ     0c0h            ;define floppy disk format

                              ;;      Floppy Format Codes.
                              ;
0000                          fmds    equ     0               ;double side bit
0001                          fmdd    equ     1               ;double density bit
0002                          fm.sz   equ     2               ;sector size bit
0003                          fm.wr   equ     3               ;log2(fm.ddds+1)

0000                          fm.sdss equ     00h             ;Single Density, Single Sided
0001                          fm.sdds equ     01h             ;Single Density, Double Sided
0006                          fmddss  equ     06h             ;Double Density, Single Sided
0007                          fm.ddds equ     07h             ;Double Density, Double Sided
0080                          fm.hard equ     80h             ;Rigid

                              ;;      Class 7 commands.
                              ;
00E0                          c.tram  equ     0e0h            ;test ram buffer

                              ;;      Message Macros.
                              ;
                              pmsg    macro   n,msg
                                      if1
                                      .printx +MSG N+
                                      endif
                                      endm

                              phex    macro   n,m
                                      .radix  16
                                      pmsg    %(n),<m>
                                      .radix  10
                                      endm
```

```

                                subttl  Sasi Physical Driver.
                                page
```

```

                                 ;;      Sa1403 - Sasi Physical Driver.
                                 ;

F4B0    06 06                    Sa1403: ld      b,6             ;set retry count
F4B2    7E                       sas0a:  ld      a,(hl)          ;set driver operation
F4B3    23                               inc     hl              ;point to unit
F4B4    3C                               inc     a
F4B5    28 49                            jr      z,sselec        ;if select DPH
F4B7    E5                               push    hl
F4B8    C5                               push    bc
F4B9    3D                               dec     a
F4BA    3E 0A                            ld      a,c.writ        ;preset write opcode
F4BC    28 02                            jr      z,sas0
F4BE    3E 08                            ld      a,c.read        ;assume read
F4C0    32 F6F0                  sas0:   ld      (opcode),a      ;set Sasi opcode
F4C3    7E                               ld      a,(hl)          ;get driver unit
F4C4    E5                               push    hl
F4C5    CD F5AF                          call    mlu             ;map to logical unit
F4C8    E1                               pop     hl
F4C9    23                               inc     hl              ;ignore cpm dsk
F4CA    23                               inc     hl              ;track low
F4CB    56                               ld      d,(hl)          ;set track
F4CC    23                               inc     hl
F4CD    23                               inc     hl
F4CE    5E                               ld      e,(hl)          ;set sector
F4CF    CD F6D7                          call    cwp             ;check write protect
F4D2    20 22                            jr      nz,sas2         ;if write protected and track > 0
F4D4    E5                               push    hl              ;save request block address
F4D5    CD F5C2                          call    mpa             ;map physical address to logical address
F4D8    21 F6F0                          ld      hl,opcode
F4DB    CD F643                          call    iccs            ;issue controller command
F4DE    E1                               pop     hl              ;get pointer to low sector back
F4DF    23                               inc     hl              ;ignore sector high
F4E0    23                               inc     hl              ;dma low
F4E1    5E                               ld      e,(hl)
F4E2    23                               inc     hl              ;dma high
F4E3    56                               ld      d,(hl)
F4E4    EB                               ex      de,hl           ;set transfer address to HL
F4E5    06 00                            ld      b,0             ;set sector length
F4E6                             seclen  equ     $-1
F4E7    3A F6F0                          ld      a,(opcode)
F4EA    FE 0A                            cp      c.writ
F4EC    28 05                            jr      z,sas1          ;if write command
F4EE    CD F65F                          call    tdi             ;transfer data in
F4F1    18 03                            jr      sas2
F4F3    CD F656                  sas1:   call    tdo             ;transfer data out
F4F6    C1                       sas2:   pop     bc
F4F7    E1                               pop     hl
F4F8    2B                               dec     hl
F4F9    C8                               ret     z               ;if no errors
F4FA    CD F069                          call    softv           ;report soft error
F4FD    10 B3                            djnz    sas0a           ;if more retries
F4FF    C9                               ret                     ;return error

```

```
        subttl  Physical Driver Select
        page
```

```

                               ;;      Select - Physical Driver Select.
                               ;
        F500    7E             sselec: ld      a,(hl)          ;set physical unit
        F501    FE 08                  cp      8               ;verify in range
        F502                   numunt  equ     $-1
        F503    3F                     ccf
        F504    D4 F50E                call    nc,smfs         ;set media format
        F507    D0                     ret     nc              ;if media identified

                               ;;      selerr - Select Error Driver.
                               ;
        F508    21 0000        xselerr: ld     hl,0            ;Select Error Driver
        F50B    F6 FF          selerl: or      -1
        F50D    C9                     ret

                               ;;      smfs - Set Media Format.
                               ;
                               ;       entry:  A = Driver unit index
                               ;       Exit:   HL = DPH address, if no carry
                               ;
        F50E    CD F6F6        smfs:   call    first           ;execute first time only routine
        F511    CD F5AF                call    mlu             ;map to logical unit
        F514    EB                     ex      de,hl           ;get dph index to hl
        F515    7D                     ld      a,l             ;and A
        F516    29                     add     hl,hl           ;index *16
        F517    29                     add     hl,hl
        F518    29                     add     hl,hl
        F519    29                     add     hl,hl
        F51A    11 F390                ld      de,Dpbase       ;set base of Disk Parameter Headers
        F51D    19                     add     hl,de
        F51E    FE 04                  cp      4
        F520    D0                     ret     nc              ;if rigid unit
        F521    E5                     push    hl              ;save dph address
        F522    3E 80                  ld      a,80h           ;disable error recovery
        F524    32 F6F5                ld      (dctrl),a
        F527    32 F5F1                ld      (lastfm+1),a
        F52A    0A                     ld      a,(bc)          ;always try double side first
        F52B    F6 01                  or      1 shl fmds
        F52D    02                     ld      (bc),a
        F52E    3E 07                  ld      a,8-1           ;try each type two times
        F530    32 F53D        smfs1:  ld      (smfsa),a       ;set retry count
        F533    C5                     push    bc              ;save define format table address
        F534    CD F57A                call    cdd             ;check drive density
        F537    C1                     pop     bc
        F538    60                     ld      h,b             ;set format table address
        F539    69                     ld      l,c
        F53A    28 14                  jr      z,smfs2         ;if diskette type identified
        F53C    3E 00                  ld      a,0
        F53D                   smfsa   equ     $-1             ;diskette type retry counter
        F53E    D6 01                  sub     1
        F540    38 31                  jr      c,smfs4         ;if media not identified
        F542    35                     dec     (hl)            ;advance disk type code
        F543    F2 F548                jp      p,smfs1a        ;if no wrap
        F546    36 07                  ld      (hl),fm.ddds
```

```
F548    CB 4E           smfsla: bit     fmdd,(hl)       ;test for double density
F54A    20 E4                   jr      nz,smfsl        ;if double density
F54C    CB 96                   res     fm.sz,(hl)      ;set sector size = 128
F54E    18 E0                   jr      smfsl           ;try more diskette types
F550    57              smfs2:  ld      d,a             ;preset no translate
F551    5A                      ld      e,d
F552    CB 4E                   bit     fmdd,(hl)
F554    20 03                   jr      nz,smfs3        ;if diskette is double density
F556    11 F410                 ld      de,trn6         ;set single density translate
F559    E1              smfs3:  pop     hl              ;get dph address
F55A    E5                      push    hl
F55B    73                      ld      (hl),e          ;store translate address
F55C    23                      inc     hl
F55D    72                      ld      (hl),d
F55E    11 0009                 ld      de,10-1
F561    19                      add     hl,de           ;point to dpb address in dph
F562    0A                      ld      a,(bc)          ;get selected format
F563    E6 03                   and     3
F565    EB                      ex      de,hl
F566    6F                      ld      l,a
F567    29                      add     hl,hl           ;index by 16
F568    29                      add     hl,hl
F569    29                      add     hl,hl
F56A    29                      add     hl,hl
F56B    01 F430                 ld      bc,dpb8s        ;set dpb base
F56E    09                      add     hl,bc           ;set dpb address (clears carry)
F56F    EB                      ex      de,hl           ;recover dpb pointer address in dph
F570    73                      ld      (hl),e
F571    23                      inc     hl
F572    72                      ld      (hl),d
F573    E1              smfs4:  pop     hl              ;get dph address
F574    3E 00                   ld      a,0             ;enable error recovery
F576    32 F6F5                 ld      (dctrl),a
F579    C9                      ret

                        ;;      cdd - check drive density.
                        ;
F57A    0A              cdd:    ld      a,(bc)          ;get attempted side
F57B    E6 01                   and     1               ;try side 1 on ds, 0 on ss
F57D    11 0201                 ld      de,2*256+1
F580    28 02                   jr      z,cdd0          ;if single side
F582    16 4F                   ld      d,77+2          ;use back side
F584    CD F5C2         cdd0:   call    mpa             ;map physical address
F587    21 F6F0                 ld      hl,opcode
F58A    36 08                   ld      (hl),c.read
F58C    CD F643                 call    iccs            ;issue controller command
F58F    CD F6CE                 call    sim             ;set input mode
F592    CD F687         cdd1:   call    wfr             ;wait for req
F595    20 04                   jr      nz,cdd2         ;if timeout or status, not data requested
F597    ED 78                   in      a,(c)           ;eat sector
F599    18 F7                   jr      cdd1
F59B    CD F669         cdd2:   call    wcc             ;wait command complete
F59E    C9                      ret

                        ;;      p2l - Physical to Logical Mapping Table.
                        ;
```

```
                                ;       First byte is the SA1403 Logical Unit Number
                                ;       Second byte is extended drive format code
                                ;
F59F     00 00                  p21:    db      falun shl 5,fm.sdss     ;Floppy Drive 0
F5A1     20 01                          db      fblun shl 5,fm.sdds     ;Floppy Drive 1
F5A3     00 06                          db      falun shl 5,fmddss      ;Floppy Drive 0
F5A5     40 07                          db      fdlun shl 5,fm.ddds     ;Floppy Drive 2
F5A7     60 80                          db      rglun shl 5,fm.hard     ;Rigid Partition 0
F5A9     60 80                          db      rglun shl 5,fm.hard     ;Rigid Partition 1
F5AB     60 80                          db      rglun shl 5,fm.hard     ;Rigid Partition 2
F5AD     60 80                          db      rglun shl 5,fm.hard     ;Rigid Partition 3

                                ;;      Mlu - Map Logical Unit.
                                ;
                                ;       Entry:  A  =  Physical Driver Unit from Deblocker
                                ;       Exit:   DE =  dph index
                                ;               BC = pointer to format code
                                ;               Sasi LUN stored in command block
                                ;
F5AF     21 F59F                mlu:    ld      hl,p21          ;set Rigid Physical to Logical map table
F5B2     16 00                          ld      d,0
F5B4     5F                             ld      e,a
F5B5     19                             add     hl,de           ;point to table entry
F5B6     19                             add     hl,de
F5B7     7E                             ld      a,(hl)          ;get Sasi LUN
F5B8     32 F6F1                        ld      (lun),a         ;store in read/write command
F5BB     32 F6EB                        ld      (deflun),a      ;store in define command
F5BE     23                             inc     hl              ;point to format descriptor
F5BF     44                             ld      b,h
F5C0     4D                             ld      c,l
F5C1     C9                             ret

                                ;;      Mpa - Map Physical Address.
                                ;
                                ;       Entry:  BC = p21 format code address
                                ;               D  = Track
                                ;               E  = Sector
                                ;
                                ;       Exit:   Logical Address set in command block
                                ;               Seclen set for transfer
                                ;               Controller notified of floppy format
                                ;
F5C2     21 F4E6                mpa:    ld      hl,seclen       ;preset sector length
F5C5     36 00                          ld      (hl),0
F5C7     EB                             ex      de,hl           ;preset Laddr = Paddr for rigid
F5C8     0A                             ld      a,(bc)          ;get drive format code
F5C9     FE 80                          cp      fm.hard
F5CB     28 46                          jr      z,mpa5          ;if Rigid Partition
F5CD     FE 06                          cp      fmddss
F5CF     38 06                          jr      c,mpa1          ;if single density
F5D1     2C                             inc     l               ;advance sector from 0->25 to 1->26
F5D2     7C                             ld      a,h
F5D3     B7                             or      a
F5D4     20 04                          jr      nz,mpa2         ;if not on track zero
F5D6     2D                             dec     l
F5D7     3E 80                  mpa1:   ld      a,128           ;set short sector
```

```
F5D9    12                          ld      (de),a
F5DA    0A              mpa2:       ld      a,(bc)
F5DB    CB 47                       bit     fmds,a
F5DD    28 0A                       jr      z,mpa22         ;if not double sided disk
F5DF    7C                          ld      a,h             ;map first 77 tracks to side zero
F5E0    FE 4D                       cp      77
F5E2    38 02                       jr      c,mpa21         ;if side zero tracks
F5E4    D6 4D                       sub     77              ;offset to back side
F5E6    3F              mpa21:      ccf
F5E7    8F                          adc     a,a
F5E8    67                          ld      h,a
F5E9    E5              mpa22:      push    hl              ;save track/sector
F5EA    0A                          ld      a,(bc)          ;get floppy format
F5EB    2A F6EB                     ld      hl,(deflun)     ;get new unit
F5EE    67                          ld      h,a
F5EF    11 FFFF                     ld      de,-1           ;get previously used format/lun
F5F0                    lastfm      equ     $-2
F5F2    22 F5F0                     ld      (lastfm),hl     ;save this format/unit for next time
F5F5    B7                          or      a
F5F6    ED 52                       sbc     hl,de
F5F8    28 0C                       jr      z,mpa3          ;if unit and format same as last time
F5FA    32 F6EF                     ld      (flpfrm),a
F5FD    21 F6EA                     ld      hl,deflpy       ;issue define floppy command
F600    CD F643                     call    iccs
F603    CD F669                     call    wcc
F606    E1              mpa3:       pop     hl              ;recover track / sector
F607    44                          ld      b,h             ;set track
F608    11 001A                     ld      de,26           ;compute sector-26-1+(Track+1)*26
F60B    62                          ld      h,d             ;clear upper track
F60C    37                          scf
F60D    ED 52                       sbc     hl,de           ;adjust sector
F60F    04                          inc     b               ;force one pass
F610    19              mpa4:       add     hl,de           ;multiply track by sectors/track
F611    10 FD                       djnz    mpa4            ;if multiply incomplete
F613    7C              mpa5:       ld      a,h             ;swap H & L
F614    65                          ld      h,l
F615    6F                          ld      l,a
F616    22 F6F2                     ld      (addrh),hl      ;Store address in command block
F619    C9                          ret

                                    subttl  Sasi Bus Control Interface
                                    page
```

```

                        ;;      gca - get controller attention.
                        ;
F61A    CD F6AD         gca:    call    reset           ;reset controller if required
F61D    7E                      ld      a,(hl)          ;get command
F61E    FE 01                   cp      c.recal
F620    3E 0A                   ld      a,9+1           ;set 9+ second time-out
F622    28 02                   jr      z,gca0          ;if recalibrate, use long time-out
F624    3E 03                   ld      a,2+1           ;use short time-out
F626    32 F627         gca0:   ld      (gcaa),a
F627                    gcaa    equu    $-2     ;*****=>;monitor one second timer address goes here
F629    CD F6D2                 call    som             ;set output mode
F62C    3E 01                   ld      a,1             ;Set sasi controller address
F62E    D3 10                   out     (Sasid),a
F630    3E 20                   ld      a,1 shl b.sel   ;assert Select Line
F632    D3 12                   out     (Sasic),a
F634    DB 12           gca1:   in      a,(Sasis)       ;get sasi status
F636    0F                      rrca                    ;get busy bit in C
F637    38 06                   jr      c,gca2          ;if controller is ready
F639    CD F6A5                 call    cft             ;check for time-out
F63C    F2 F634                 jp      p,gca1          ;if not timed out
F63F    AF              gca2:   xor     a
F640    D3 12                   out     (Sasic),a       ;drop Select
F642    C9                      ret

                        ;;      iccs  - issue Controller Command.
                        ;
                        ;       HL => Sasi command block
                        ;
F643    7E              iccs:   ld      a,(hl)          ;peek at opcode
F644    FE 04                   cp      c.fmat
F646    C8                      ret     z               ;do not allow format entire disk
F647    CD F61A                 call    gca             ;get controller attention
F64A    01 0610                 ld      bc,Sasid+6*256  ;set port / command block length
F64D    CD F687         iccs1:  call    wfr             ;wait for REQ
F650    C8                      ret     z               ;if data requested
F651    ED A3                   outi                    ;send next byte
F653    20 F8                   jr      nz,iccs1
F655    C9                      ret

                        ;;      tdo - transmit data out.
                        ;
F656    CD F687         tdo:    call    wfr             ;wait for req
F659    20 0E                   jr      nz,wcc          ;if not data requested
F65B    ED B3                   otir                    ;pitch sector out
F65D    18 0A                   jr      wcc

                        ;;      tdi - transmit data in.
                        ;
F65F    CD F6CE         tdi:    call    sim             ;set input mode
F662    CD F687                 call    wfr             ;wait for req
F665    20 02                   jr      nz,wcc          ;if status, not data requested
F667    ED B2                   inir                    ;read sector

                        ;;      wcc  - wait command complete.
```

```
                                ;
F669    CD F6CE                 wcc:    call    sim             ;set input mode
F66C    CD F687                         call    wfr             ;wait for REQ
F66F    28 2A                           jr      z,ecr           ;if controller not providing status
F671    ED 78                           in      a,(c)           ;read completion status
F673    E6 03                           and     3               ;ignore unused bits
F675    47                              ld      b,a
F676    CD F687                         call    wfr             ;wait for REQ
F679    28 20                           jr      z,ecr           ;if not status
F67B    DB 12                           in      a,(Sasis)       ;recover status
F67D    CB 4F                           bit     b.msg,a
F67F    28 1A                           jr      z,ecr           ;if not message byte
F681    ED 78                           in      a,(c)           ;read message byte
F683    20 16                           jr      nz,ecr          ;if last byte not zero
F685    B0                              or      b               ;set Sasi error status byte
F686    C9                              ret

                                ;;      wfr - wait for REQ.
                                ;
                                ;       Exit:   A < 0   Timer Expired
                                ;               A = 0   Request is for data
                                ;               A > 0   Request is for control
                                ;
F687    CD F6A5                 wfr:    call    cft             ;check for time-out
F68A    FA F69A                         jp      m,wfrl          ;if controller hung
F68D    DB 12                           in      a,(Sasis)       ;read sasi status
F68F    CB 5F                           bit     b.req,a
F691    28 F4                           jr      z,wfr           ;if request not asserted
F693    CB 77                           bit     b.par,a         ;check buss parity
F695    20 03                           jr      nz,wfrl         ;if parity error
F696                            wfra    equ     $-1
F697    E6 04                           and     1 shl b.cd      ;test control / data bit
F699    C9                              ret
F69A    F1                      wfrl:   pop     af              ;pitch return address

                                ;;      ecr - Enable Controller Reset.
                                ;
F69B    AF                      ecr:    xor     a               ;enable controller reset next time
F69C    32 F6AD                         ld      (reset),a       ;by placing NOP at reset entry point
F69F    F6 FF                           or      -1              ;return error status
F6A1    32 F5F0                         ld      (lastfm),a      ;force define floppy format
F6A4    C9                              ret

                                ;;      Cft - Check for Time-out.
                                ;
F6A5    CD F066                 cft:    call    idle            ;idle cpu
F6A8    3A 0000                         ld      a,(0)
F6A9                            cfta    equ     $-2     ;*****=>;This word gets the address of the timer
                                        public  cfta
F6AB    B7                              or      a
F6AC    C9                              ret

                                ;;      Reset - Reset Controller.
                                ;
                                ;       This routine is called prior to every command that is
                                ;       issued to the controller, but disables itself after
```

```
                                  ;       running.  When, and if the controller times-out, this
                                  ;       routine is re-enabled.  Thus, the controller will be
                                  ;       reset again before the next command is issued.
                                  ;
        F6AD    00                reset:  nop                     ;*****=>;Note RET gets put here after reset
                                                                  ;      NOP gets put there if time-out
        F6AE    3E CF                     ld      a,11001111b     ;initialize pio in mode 3
        F6B0    D3 13                     out     (pioBs),a
        F6B2    3E 5F                     ld      a,01011111b     ;d7, d5 are outputs
        F6B4    D3 13                     out     (pioBs),a
        F6B6    3E 80                     ld      a,1 shl b.rst   ;assert reset to controller
        F6B8    D3 12                     out     (Sasic),a
        F6BA    AF                        xor     a
        F6BB    D3 12                     out     (Sasic),a       ;de-assert reset
        F6BD    3E C9                     ld      a,0c9h
        F6BF    32 F6AD                   ld      (reset),a       ;disable reset until time-out
        F6C2    E5                        push    hl
        F6C3    21 F6E8                   ld      hl,rgrecal
        F6C6    CD F643                   call    iccs            ;issue recursive rigid recalibrate
        F6C9    CD F669                   call    wcc
        F6CC    E1                        pop     hl
        F6CD    C9                        ret

                                  ;;      Sim - Set Input Mode.
                                  ;
        F6CE    3E 4F             sim:    ld      a,01001111b     ;set pio A input mode
        F6D0    18 02                     jr      soml

                                  ;;      Som - Set Output Mode.
                                  ;
        F6D2    3E 0F             som:    ld      a,00001111b     ;set pio A output mode
        F6D4    D3 11             soml:   out     (pioAs),a
        F6D6    C9                        ret

                                  ;;      cwp - check write protect.
                                  ;
        F6D7    0A                cwp:    ld      a,(bc)          ;get drive type
        F6D8    E6 80                     and     fm.hard
        F6DA    C8                        ret     z               ;if not rigid disk access
        F6DB    3E 00                     ld      a,0             ;get dirty parameter flag
        F6DC                      rdonly  equ     $-1
        F6DD    B7                        or      a
        F6DE    C8                        ret     z               ;if not write protected
        F6DF    7A                        ld      a,d
        F6E0    B7                        or      a
        F6E1    C8                        ret     z               ;if track zero request
        F6E2    3A F6F0                   ld      a,(opcode)
        F6E5    D6 08                     sub     c.read          ;allow reads, but no writes to file system
        F6E7    C9                        ret

                                          subttl  Sasi Command Blocks
                                          page
```

```



                                ;;      Sasi Command Blocks.
                                ;

F6E8    01                      rgrecal:db      c.recal
F6E9    60                      reclun: db      3 shl 5

F6EA    C0                      deflpy: db      c.flpy          ;define floppy format
F6EB    00                      deflun: db      0
F6EC    00 00 00                        db      0,0,0
F6EF    00                      flpfrm: db      0

F6F0    00                      opcode: db      0               ;Class code / Operation
F6F1    00                      lun:    db      0               ;Logical Unit & Logical Address 20-16
F6F2    00                      addrh:  db      0               ;               Logical Address 15-8
F6F3    00                      addrl:  db      0               ;               Logical Address  7-0
F6F4    01                      nblk:   db      1               ;Number of Blocks
F6F5    00                      dctrl:  db      0               ;Error Retry Disable Control word

                                        subttl  Overlayable Initialization Code
                                        page
```

```

                                 ;;      First - First time only.
                                 ;
F6F6    F5                       first:  push    af
                                         phex    $-dskdvr,<SASI Resident Length is>
0010                       +             .radix  16
000A                       +             .radix  10
F6F7    3E C9                            ld      a,0c9h          ;nuke self first time
F6F9    32 F6F6                          ld      (first),a
F6FC    26 00                            ld      h,0             ;indicate return register value
F6FE    CD F039                          call    dayti           ;get address of monitor timer
F701    2B                               dec     hl
F702    22 F6A9                          ld      (cfta),hl       ;store address of timer for check routine
F705    22 F627                          ld      (gcaa),hl       ;and for command startup

F708    21 F767                  first1: ld      hl,cnfdpb       ;point to physical driver read command
F70B    CD F4B0                          call    sa1403          ;read partition parameters
F70E    B7                               or      a
F70F    CC F723                          call    z,cpb           ;if no errors then check parameter blocks
F712    28 0D                            jr      z,first2        ;if parameters are loaded
F714    21 F76C                          ld      hl,cnfdpb+5     ;try backup heads
F717    7E                               ld      a,(hl)          ;get logical sector
F718    C6 20                            add     a,32            ;advance to next head
F71A    77                               ld      (hl),a
F71B    20 EB                            jr      nz,first1       ;if 4 heads and 2 cylinders not attempted
F71D    2F                               cpl                     ;set tracks > 0 read only
F71E    32 F6DC                          ld      (rdonly),a
F721    F1                       first2: pop     af
F722    C9                               ret

                                 ;;      cpb - check parameter blocks.
                                 ;
F723    21 EE00                  cpb:    ld      hl,rgdbuf       ;point to dpb buffer
F726    3A F76C                          ld      a,(cnfdpb+5)    ;get sector this dpb set came from
F729    FE 20                            cp      32
F72B    20 04                            jr      nz,cpb1         ;if not primary set
F72D    7E                               ld      a,(hl)
F72E    FE E5                            cp      0e5h
F730    C8                               ret     z               ;use default dpbs if none configured
F731    11 000F                  cpb1:   ld      de,16-1         ;set offset from high spt to deblock control
F734    06 04                            ld      b,4             ;verify 4 dpbs
F736    7E                       cpb2:   ld      a,(hl)          ;set low sectors / track
F737    B7                               or      a
F738    C0                               ret     nz              ;if bummer sectors / track
F739    19                               add     hl,de           ;advance to deblock control
F73A    7E                               ld      a,(hl)
F73B    E6 87                            and     87h
F73D    CB 2F                            sra     a
F73F    CB 2F                            sra     a
F741    C0                               ret     nz              ;if bad deblocking constant
F742    23                               inc     hl
F743    10 F1                            djnz    cpb2
F745    2B                               dec     hl
F746    11 F4AF                          ld      de,Dpbrg4+16*4-1
F749    01 0040                          ld      bc,16*4
```

```
F74C    ED B8                       lddr                          ;move dpbs into place
F74E    01 0010                     ld      bc,16                 ;set 16 bytes/dpx
F751    11 F3DE                     ld      de,Dpbase+4*16+14 ;point at alloc vector pointer
F754    21 F47D                     ld      hl,Dpbrg4+13          ;point at reserved tracks
F757    3E 04                       ld      a,4                   ;count off 4 partitions
F759    F5                  cpb3:   push    af
F75A    7E                          ld      a,(hl)                ;get reserved tracks for partition
F75B    3D                          dec     a                     ;just so nice numbers come out
F75C    87                          add     a,a                   ;16 blks/track / 8 blks/byte = 2 bytes/track
F75D    12                          ld      (de),a                ;store low allocation vector address
F75E    09                          add     hl,bc                 ;advance to next dpb
F75F    EB                          ex      de,hl
F760    09                          add     hl,bc                 ;advance to next dph
F761    EB                          ex      de,hl
F762    F1                          pop     af
F763    3D                          dec     a
F764    20 F3                       jr      nz,cpb3               ;if more to allocate
F766    C8                          ret     z                     ;return success

F767    01 04 00            cnfdpb: db      01,4,0                ;read partition 0
F76A    0000                        dw      0                     ;track zero
F76C    0020                        dw      32                    ;sector 32
F76E    EE00                        dw      rgdbuf                ;rigid parameter table buffer

0300                        sasidl  equ     $-sasstr
                                    .dephase
FA08                        dloc    defl    dloc+sasidl
                                    .phase  dloc

                                    above
0A08"               +               d&seg

FA08                        Dvrlmt:                               ;disk driver limit

FA08                        rqtop   equ     $                     ;set required top of resident monitor

FA08    21 0000             slerr:  ld      hl,0
FA0B    F6 FF                       or      -1
FA0D    C9                          ret

                                    subttl  820 Style Disk Driver Emulator
                                    page
```

```

                                ;;      820 Style Disk Driver Emulator.
                                ;
                                        above                   ;generate code in ram
        0A0E"                           d&seg

        FA0E    FF              phycmd: defb    -1              ;physical Driver Command
        FA0F    FF              phyunt: defb    -1              ;physical unit
        FA10    00              phydrv: defb    00              ;logical unit
        FA11    0000            phytrk: defw    00              ;track
        FA13    0001            physec: defw    01              ;sector
        FA15    ED80            phydma: defw    bootbf          ;dma address

                                ;;      Select - Select Unit for I/O.
                                ;
                                ;       Entry:  C  = Unit
                                ;       Exit:   A  = 0  if no errors
                                ;               A  = -1 if errors
                                ;
        FA17    79              select: ld      a,c             ;set drive selected
        FA18    FE 08                   cp      8
        FA1A    30 1D                   jr      nc,sel1
        FA1C    32 FA10                 ld      (phydrv),a      ;save logical CP/M drive
        FA1F    21 FA5A                 ld      hl,seltbl       ;set select table address
        FA22    06 00                   ld      b,0
        FA24    09                      add     hl,bc           ;index into select table
        FA25    7E                      ld      a,(hl)
        FA26    B7                      or      a
        FA27    EB                      ex      de,hl
        FA28    67                      ld      h,a             ;in case previous select worked, say no dph
        FA29    6F                      ld      l,a             ;to internal routines
        FA2A    C8                      ret     z               ;if drive has already been selected
        FA2B    D5                      push    de              ;save table address
        FA2C    06 FF                   ld      b,-1            ;set Select operation
        FA2E    CD FA51                 call    xqphys          ;execute physical driver
        FA31    7D                      ld      a,l             ;get returned dph address
        FA32    B4                      or      h
        FA33    D1                      pop     de              ;retrieve select table address
        FA34    28 03                   jr      z,sel1          ;if select unsuccessful
        FA36    AF                      xor     a               ;return no errors
        FA37    12                      ld      (de),a          ;prevent more density re-selects
        FA38    C9                      ret
        FA39    F6 FF           sel1:   or      -1              ;return error
        FA3B    C9                      ret

                                ;;      Home - Position to track zero.
                                ;
        FA3C    0E 00           home:   ld      c,0             ;force track zero

                                ;;      Seek - Seek Track.
                                ;
                                ;       Entry:  C  = Track to read/write from next
                                ;
        FA3E    79              seek:   ld      a,c
        FA3F    32 FA11                 ld      (phytrk),a
```

```
FA42    AF                          xor     a               ;return no errors
FA43    C9                          ret

                            ;;      Write - Write Physical Sector.
                            ;
FA44    06 00               write:  ld      b,0             ;set Write operation
FA46    18 02                       jr      rdwr

                            ;;      Read - Read Physical Sector.
                            ;
FA48    06 01               read:   ld      b,1             ;set read operation

                            ;;      Rdwr - Read/Write Processor.
                            ;
                            ;       Entry:  C  = Sector
                            ;               HL = Transfer Address
                            ;       Exit:   A  = 0 if no errors
                            ;               A  = -1 if errors
                            ;
FA4A    79                  rdwr:   ld      a,c
FA4B    32 FA13                     ld      (physec),a      ;set physical sector
FA4E    22 FA15                     ld      (phydma),hl     ;set transfer address

                            ;;      xqphys - Internal Execute Physical Driver.
                            ;
                            ;       Entry:  B  = -1 for Select
                            ;               B  =  0 for Write
                            ;               B  =  1 for Read
                            ;
FA51    21 FA0E             xqphys: ld      hl,phycmd       ;point to physical command block
FA54    70                          ld      (hl),b          ;store operation
FA55    CD F344                     call    xqdvr           ;execute driver
FA58    B7                          or      a               ;set flags
FA59    C9                          ret

                            ;;      Emulator Disk I/O Ram.
                            ;
FA5A    FF FF FF FF         seltbl: defb    -1,-1,-1,-1     ;drive already selected table
FA5E    FF FF FF FF                 defb    -1,-1,-1,-1

                                    subttl  Command processor
                                    page
```

```

                                   above                   ;put code upstairs
0A62"             +                d&seg
                          ;;       prompt user for command.
                          ;
FA62    FB                prompt:  ei
FA63    31 0000                    ld      sp,stack        ;reset system stack
FA66    CD FC3D                    call    pnext
FA69    0D 0A                      defb    cr,lf
FA6B    2A 20                      defm    '* '
FA6D    04                         defb    eot
FA6E    21 FF5C                    ld      hl,linbuf
FA71    0E 50                      ld      c,80            ;buffer of 80 chars (ver. 2.0)
FA73    CD FB37                    call    getlin          ;input a bufered console line
FA76    38 51                      jr      c,what          ;print 'what ?' if input error
FA78    3A FF5C           autobt:  ld      a,(linbuf)      ;get first character in line
FA7B    FE 0D                      cp      cr
FA7D    28 E3                      jr      z,prompt        ;jump if a null line
FA7F    D6 40                      sub     '@'
FA81    FE 1B                      cp      'Z'-'@'+1
FA83    30 44                      jr      nc,what         ;if not letter
FA85    87                         add     a,a
FA86    4F                         ld      c,a
FA87    06 00                      ld      b,0
FA89    21 FAD9                    ld      hl,cmdtab+1     ;index command table with character
FA8C    09                         add     hl,bc
FA8D    7E                         ld      a,(hl)
FA8E    2B                         dec     hl
FA8F    6E                         ld      l,(hl)          ;get address of command processor
FA90    67                         ld      h,a
FA91    E6 80                      and     80h
FA93    20 17                      jr      nz,prmt1        ;if resident command
FA95    11 FC55                    ld      de,cloc         ;move transient command to RAM area
FA98    D5                         push    de
FA99    01 0299                    ld      bc,tpamax       ;set length of largest transient
FA9C    F3                         di
FA9D    DB 1C                      in      a,(syspio)
FA9F    B7                         or      a
FAA0    F5                         push    af
FAA1    F4 F29C                    call    p,crton         ;enable rom if disabled
FAA4    ED B0                      ldir
FAA6    F1                         pop     af
FAA7    F4 F293                    call    p,crtoff        ;disable rom if enabled
FAAA    FB                         ei
FAAB    E1                         pop     hl              ;set execution address
FAAC    E5                prmt1:   push    hl
FAAD    CD FC36                    call    crlf
FAB0    FD 21 FF5D                 ld      iy,linbuf+1
FAB4    CD FB5F                    call    params          ;input numeric parameters from
FAB7    DD E1                      pop     ix              ;line buffer and test if error
FAB9    2A FFB5                    ld      hl,(param1)
FABC    ED 5B FFB7                 ld      de,(param2)
FAC0    ED 4B FFB9                 ld      bc,(param3)
FAC4    CD FAD6                    call    jpix            ;call subroutine @ ix
FAC7    30 99                      jr      nc,prompt       ;go back to prompt if no errors
```

```

 FAC9   CD FC3D             what:   call    pnext
 FACC   20 77 68 61                 defm    ' what?'
 FAD0   74 3F
 FAD2   07                          defb    'G'-64           ;say 'what ?' and squeal
 FAD3   04                          defb    eot
 FAD4   18 8C                       jr      prompt

 FAD6   DD E9               jpix:   jp      (ix)             ;call subroutine @ ix

 FAD8   177B                cmdtab: defw    help             ;@ - Help user
 FADA   11B8                        defw    boot             ;a - boot cp/m
 FADC   1353                        defw    baud             ;b - bit rate
 FADE   1436                        defw    block            ;c - memory block move
 FAE0   12F2                        defw    memdmp           ;d - dump memory in hex/ascii
 FAE2   1315                        defw    view             ;e - enter memory
 FAE4   1428                        defw    fill             ;f - fill memory
 FAE6   12DB                        defw    goto             ;g - goto program
 FAE8   14E2                        defw    term             ;h - host terminal
 FAEA   13CA                        defw    incmd            ;i - read from input port
 FAEC   FAC9                        defw    what             ;j - not used
 FAEE   FAC9                        defw    what             ;k - not used
 FAF0   11B8                        defw    boot             ;l - load system
 FAF2   1315                        defw    view             ;m - memory examine/change
 FAF4   FAC9                        defw    what             ;n - not used
 FAF6   13F1                        defw    outcmd           ;o - write to output port
 FAF8   1459                        defw    proto            ;p - printer protocol
 FAFA   FAC9                        defw    what             ;q - not used
 FAFC   1367                        defw    dskcmd           ;r - display disk sector data
 FAFE   FAC9                        defw    what             ;s - not used
 FB00   1477                        defw    type             ;t - typewriter mode
 FB02   FAC9                        defw    what             ;u - not used
 FB04   1443                        defw    vercmd           ;v - memory block compare
 FB06   1367                        defw    dskcmd           ;w - disc sector write command
 FB08   13FB                        defw    test             ;x - ram diagnostic
 FB0A   FAC9                        defw    what             ;y - not used
 FB0C   FAC9                        defw    what             ;z - not used
 0036                       cmdsiz  equ     $-cmdtab

 FB0E   BE                  check:  cp      (hl)
 FB0F   C8                          ret     z                ;return if (hl)=a
 FB10   F5                          push    af
 FB11   CD FB22                     call    mdata            ;print what was actually read
 FB14   CD FC3D                     call    pnext
 FB17   73 68 6F 75                 defm    'should='
 FB1B   6C 64 3D
 FB1E   04                          defb    eot
 FB1F   F1                          pop     af
 FB20   18 07                       jr      put2j

 FB22   CD FC36             mdata:  call    crlf
 FB25   CD FC16                     call    put4hs
 FB28   7E                          ld      a,(hl)
 FB29   C3 FC1B             put2j:  jp      put2hs

                                    subttl  Console support routines
 3347                                        page
```

```

                                ;;      getlin - read line into buffer.
                                ;
FB2C    3E 40                   gethlp: ld      a,'@'
FB2E    32 FF5C                         ld      (linbuf),a
FB31    3E 0D                           ld      a,cr
FB33    32 FF5D                         ld      (linbuf+1),a
FB36    C9                              ret
FB37    41                      getlin: ld      b,c             ;save max line length parameter in b
FB38    CD FC27                 glinl:  call    echo            ;get a character from the console
FB3B    FE 1E                           cp      Helpkey
FB3D    28 ED                           jr      z,gethlp        ;if user needs help
FB3F    77                              ld      (hl),a
FB40    FE 0D                           cp      cr              ;check for carriage return
FB42    C8                              ret     z               ;if end of line
FB43    FE 08                           cp      'H'-64          ;check for ctl-h backspace
FB45    28 09                           jr      z,glin4
FB47    FE 20                           cp      ' '
FB49    D8                              ret     c               ;other control characters are illegal
FB4A    23                              inc     hl              ;store character in buffer
FB4B    0D                              dec     c
FB4C    20 EA                           jr      nz,glinl        ;get another if there's more room
FB4E    37                              scf
FB4F    C9                              ret                     ;return with carry=1 if too
                                                                ;many characters are entered
FB50    2B                      glin4:  dec     hl              ;delete last character from buffer
FB51    CD FC3D                         call    pnext
FB54    20 08                           defb    ' ','H'-64      ;delete character from screen
FB56    04                              defb    eot
FB57    0C                              inc     c
FB58    78                              ld      a,b             ;set max line length
FB59    91                              sub     c
FB5A    30 DC                           jr      nc,glinl        ;if backspace not past the start of the line
FB5C    C9                              ret

FB5D    FD 23                   para0:  inc     iy              ;advance character scan
FB5F    01 00FF                 params: ld      bc,low -1       ;set parameter index
FB62    FD 7E 00                        ld      a,(iy+0)        ;fetch character
FB65    D6 0D                           sub     cr
FB67    C8                              ret     z               ;if no parameters
FB68    D6 13                           sub     ' '-cr
FB6A    28 F1                           jr      z,para0         ;if leading blanks
FB6C    0C                      paral:  inc     c               ;advance parameter index
FB6D    CB 51                           bit     2,c
FB6F    37                              scf
FB70    C0                              ret     nz              ;error if > 4 numbers entered
FB71    C5                      para2:  push    bc              ;save parameter count
FB72    CD FBDA                         call    gethex          ;read a number from line buffer
FB75    C1                              pop     bc
FB76    DD 21 FFB5              para4:  ld      ix,paraml       ;point to parameter storage area
FB7A    DD 09                           add     ix,bc           ;add parameter count in bc
FB7C    DD 09                           add     ix,bc
FB7E    DD 75 00                        ld      (ix+0),l
FB81    DD 74 01                        ld      (ix+1),h        ;store data returned from 'GETHEX'
FB84    FE 20                           cp      ' '
```

```
FB86    28 E4                    jr      z,paral         ;get another item if space
FB88    FE 2C                    cp      ','
FB8A    28 E0                    jr      z,paral         ;get another item if comma
FB8C    79                       ld      a,c             ;set parameter count
FB8D    3C                       inc     a
FB8E    C9                       ret

                        ;;       dump - dump memory.
                        ;
FB8F    E5              dump:    push    hl              ;save starting address
FB90    CD FC16                  call    put4hs          ;print starting address in hex
FB93    CD FC1E                  call    space
FB96    06 10                    ld      b,16
FB98    3E 0F           dump2:   ld      a,16-1          ;skip 3 columns on 16 byte boundry
FB9A    CD FC23                  call    dmpfmt
FB9D    3E 07                    ld      a,8-1           ;skip 2 columns on 8 byte boundry
FB9F    CD FC23                  call    dmpfmt
FBA2    3E 03                    ld      a,4-1           ;skip 1 column  on 4 byte boundry
FBA4    CD FC23                  call    dmpfmt
FBA7    7E                       ld      a,(hl)          ;get a data byte @ hl
FBA8    23                       inc     hl
FBA9    CD FC1B                  call    put2hs          ;print the data in hex
FBAC    10 EA                    djnz    dump2           ;repeat 16 times
FBAE    CD FC1E                  call    space
FBB1    E1                       pop     hl              ;restore starting address
FBB2    06 10                    ld      b,16
FBB4    3E 1F           dump3:   ld      a,1fh           ;force next character
FBB6    CD F00C                  call    conout
FBB9    7E                       ld      a,(hl)          ;get back data byte @ hl
FBBA    23                       inc     hl
FBBB    CD F00C                  call    conout          ;print ascii character in a
FBBE    10 F4                    djnz    dump3
FBC0    CD F006                  call    const           ;check console status
FBC3    28 0C                    jr      z,dump4         ;if char not ready
FBC5    CD F009                  call    conin           ;read char
FBC8    FE 0D                    cp      cr
FBCA    C8                       ret     z               ;if user abort
FBCB    CD F009                  call    conin           ;pause while user examines display
FBCE    FE 0D                    cp      cr
FBD0    C8                       ret     z               ;if user found it
FBD1    CD FC36         dump4:   call    crlf            ;send end of line
FBD4    1B                       dec     de
FBD5    7A                       ld      a,d
FBD6    B3                       or      e
FBD7    20 B6                    jr      nz,dump         ;if dump not complete
FBD9    C9                       ret

                        ;;       gethex converts ascii to binary.
                        ;
                        ;        carry set on illegal conversion result
                        ;        terminating character returns in a.
                        ;        hl returns with 16 bit binary integer
                        ;
FBDA    21 0000         gethex:  ld      hl,0            ;preset result
FBDD    54                       ld      d,h
FBDE    5D                       ld      e,l
```

```
FBDF    29                gnum1:  add     hl,hl           ;multiply result by 16
FBE0    29                        add     hl,hl
FBE1    29                        add     hl,hl
FBE2    29                        add     hl,hl
FBE3    19                        add     hl,de           ;append next digit
FBE4    FD 7E 00          gnum3:  ld      a,(iy+0)        ;get next character from line buffer
FBE7    4F                        ld      c,a
FBE8    FD 23                     inc     iy              ;advance buffer address
FBEA    CD FBF3                   call    hexbin          ;convert one ascii hex to binary
FBED    5F                        ld      e,a
FBEE    30 EF                     jr      nc,gnum1
FBF0    79                        ld      a,c             ;return first non hex digit
FBF1    B7                        or      a
FBF2    C9                        ret

                          ;;      hexbin - convert hex to binary.
                          ;
FBF3    D6 30             hexbin: sub     '0'
FBF5    D8                        ret     c
FBF6    FE 0A                     cp      10
FBF8    3F                        ccf
FBF9    D0                        ret     nc
FBFA    D6 07                     sub     7
FBFC    FE 0A                     cp      10
FBFE    D8                        ret     c
FBFF    FE 10                     cp      16
FC01    3F                        ccf
FC02    C9                        ret

FC03    F5                put2hx: push    af
FC04    1F                        rra
FC05    1F                        rra
FC06    1F                        rra
FC07    1F                        rra
FC08    CD FC0C                   call    putnib
FC0B    F1                        pop     af
FC0C    E6 0F             putnib: and     00001111b
FC0E    C6 90                     add     a,90h
FC10    27                        daa
FC11    CE 40                     adc     a,40h
FC13    27                        daa
FC14    18 0A                     jr      output

FC16    7C                put4hs: ld      a,h
FC17    CD FC03                   call    put2hx
FC1A    7D                        ld      a,l
FC1B    CD FC03           put2hs: call    put2hx

                          ;;      space - output space.
                          ;
FC1E    3E 20             space:  ld      a,' '           ;fall through to output space

FC20    C3 F00C           output: jp      conout          ;display character

                          ;;      dmpfmt - Dump Command Output Formatter.
                          ;
```

```
FC23    A5                    dmpfmt: and     1               ;check address boundry
FC24    C0                            ret     nz              ;if not on boundry
FC25    18 F7                         jr      space           ;skip one column

                              ;;      echo - read and echo console character.
                              ;
                              ;       Echo inputs one character from the console
                              ;       device, prints it on the console output and
                              ;       then returns it in the A register in upper case.
                              ;
FC27    CD F009               echo:   call    conin           ;input a character and echo it
FC2A    FE 1E                         cp      Helpkey
FC2C    C8                            ret     z               ;do not echo help key
FC2D    CD F00C                       call    conout
FC30    FE 61                         cp      'a'
FC32    D8                            ret     c               ;if not lower case
FC33    D6 20                         sub     'a'-'A'         ;convert lower case to upper case
FC35    C9                            ret

                              ;;      crlf - carriage return-linefeed.
                              ;
FC36    CD FC3D               crlf:   call    pnext           ;print next message
FC39    0D 0A 04                      defb    cr,lf,eot
FC3C    C9                            ret

                              ;;      pnext - print message after call.
                              ;
FC3D    E3                    pnext:  ex      (sp),hl         ;set message address
FC3E    7E                            ld      a,(hl)
FC3F    23                            inc     hl
FC40    E3                            ex      (sp),hl         ;set return address
FC41    FE 04                         cp      eot
FC43    C8                            ret     z
FC44    CD F00C                       call    conout
FC47    18 F4                         jr      pnext

                                      if      options and (o.move or o.verf)
                              ;;      set block address for move and verify.
                              ;
FC49    EB                    blocad: ex      de,hl
FC4A    B7                            or      a               ;clear carry
FC4B    ED 52                         sbc     hl,de           ;get diffrence between
FC4D    EB                            ex      de,hl           ;hl & de for bytecount
FC4E    D5                            push    de              ;exchange de,bc
FC4F    50                            ld      d,b
FC50    59                            ld      e,c
FC51    C1                            pop     bc
FC52    03                            inc     bc              ;get count+1 into bc
FC53    C9                            ret
                                      endif
FC54    C9                            ret

                                      subttl  Transient Command Area
                                      page
```

```

FC55                            cloc    defl    $               ;establish overlay execution address
                                        overlay start
0C55"                 +                 c&seg
                                ;;      signon - Announce System Ready.
                                ;
FC55      08                    signon: ex      af,af'
FC56      CD F293                       call    crtoff          ;disable rom/ram
FC59      08                            ex      af,af'
FC5A      28 4A                         jr      z,sign4         ;if Rx1984 loaded disk driver
FC5C      08                            ex      af,af'          ;get syspio data
FC5D      21 F091                       ld      hl,confg        ;point to configuration byte
FC60      CB 47                         bit     0,a
FC62      28 24                         jr      z,sign3         ;if SASI interface present
FC64      F3                            di
FC65      3E CF                         ld      a,11001111b     ;set Pio B in Bit Mode
FC67      D3 1D                         out     (sysctl),a
FC69      3E 38                         ld      a,00111000b     ;turn around d0,1,2
FC6B      D3 1D                         out     (sysctl),a
FC6D      D3 1C                         out     (syspio),a      ;drop all drive selects
FC6F      3E D0                         ld      a,0d0h          ;reset wd-1797-02
FC71      D3 10                         out     (wd1797),a
FC73      10 FE                 sign1:  djnz    sign1           ;wait 1797 not busy
FC75      DB 1C                         in      a,(syspio)
FC77      CB 67                         bit     c.five,a
FC79      3E 02                         ld      a,2             ;preset 10 msec step rate
FC7B      20 04                         jr      nz,sign2        ;if not 5"
FC7D      CB E6                         set     c.five,(hl)
FC7F      3E 03                         ld      a,3             ;set long step
FC81      D3 10                 sign2:  out     (wd1797),a      ;restore / unload heads
FC83      32 FF54                       ld      (steprt),a
FC86      18 1E                         jr      sign4
FC88      CB F6                 sign3:  set     c.sasi,(hl)     ;set Sasi card installed
FC8A      21 F708                       ld      hl,Rigdpb       ;set address of rigid dpb
FC8D      11 F470                       ld      de,dpb5s        ;set address of 5.25" floppy dpb
FC90      01 0300                       ld      bc,Sasidl       ;set sasi driver length
FC93      ED B0                         ldir                    ;Move driver down
FC95      E6 02                         and     2
FC97      20 0D                         jr      nz,sign4        ;if not A/E swap
FC99      21 F361                       ld      hl,Seltab+1
FC9C      06 08                         ld      b,8
FC9E      7E                    sign3a: ld      a,(hl)
FC9F      EE 04                         xor     4
FCA1      77                            ld      (hl),a
FCA2      23                            inc     hl
FCA3      23                            inc     hl
FCA4      10 F8                         djnz    sign3a

FCA6      CD FC3D               sign4:  call    pnext
FCA9      1A                            defb    clrs            ;clear screen
FCAA      1B 38                         defb    esc,'8'         ;set low light as default mode
FCAC      38 32 30 2D                   defm    '820-II v '
FCB0      49 49 20 76
FCB4      20
FCB5      34 2E 30 31                   defb    rev/100+'0','.',(rev mod 100)/10+'0',(rev mod 10)+'0'
```

```
FCB9    20 1F 1C 20                 defm    ' ',31,28;' 1982 Xerox Corp'
FCBD    31 39 38 32
FCC1    20 58 65 72
FCC5    6F 78 20 43
FCC9    6F 72 70
FCCC    0D 0A                       defb    cr,lf
FCCE    0A                          defb    lf
FCCF    4C 20 2D 20                 defm    'L - Load System'
FCD3    4C 6F 61 64
FCD7    20 53 79 73
FCDB    74 65 6D
FCDE    0D 0A                       defb    cr,lf

                                    if      options and o.term
FCE0    48 20 2D 20                 defm    'H - Host Terminal'
FCE4    48 6F 73 74
FCE8    20 54 65 72
FCEC    6D 69 6E 61
FCF0    6C
FCF1    0D 0A                       defb    cr,lf
                                    endif
                                    if      options and o.type
FCF3    54 20 2D 20                 defm    'T - Typewriter'
FCF7    54 79 70 65
FCFB    77 72 69 74
FCFF    65 72
FD01    0D 0A                       defb    cr,lf
                                    endif
FD03    07 04                       defb    7,eot

FD05    CD F006             eatkey: call    const
FD08    CA F003                     jp      z,warm          ;go enter monitor
FD0B    CD F009                     call    conin
FD0E    18 F5                       jr      eatkey

                                    subttl  I/O byte Drivers
                                    page
```

```

                                               overlay iobdvr
    00BB'                   +                  c&seg

                                               .dephase
                                               .phase  iobloc

                                       ;;      comins - Communications input status.
                                       ;
    F770    DB 06                      comins: in      a,(siocpa)
    F772    0F                                 rrca
    F773    9F                                 sbc     a,a
    F774    C9                                 ret

                                       ;;      cominp - Communications input data.
                                       ;
    F775    DB 06                      cominp: in      a,(siocpa)
    F777    0F                                 rrca
    F778    30 FB                              jr      nc,cominp
    F77A    DB 04                              in      a,(siodpa)
    F77C    C3 F0E2                            jp      kbmask

                                       ;;      comout - Communications output.
                                       ;
    F77F    CD F788                    comout: call    comots
    F782    28 FB                              jr      z,comout
    F784    79                                 ld      a,c
    F785    D3 04                              out     (siodpa),a
    F787    C9                                 ret

                                       ;;      comots - Communications output status.
                                       ;
    F788    DB 06                      comots: in      a,(siocpa)
    F78A    E6 04                              and     4
    F78C    C8                                 ret     z
    F78D    F6 FF                              or      -1
    F78F    C9                                 ret

                                       ;;      coniob - get console i/o byte.
                                       ;
    F790    3A 0003                    coniob: ld      a,(iobyte)
    F793    E6 03                              and     00000011b
    F795    C9                                 ret

                                       ;;      iocono - Console output through iobyte.
                                       ;
    F796    CD F790                    iocono: call    coniob
    F799    28 E4                              jr      z,comout
    F79B    3D                                 dec     a
    F79C    CA F2FE                            jp      z,fastcrt
    F79F    79                                 ld      a,c
    F7A0    C3 F0F8                            jp      sioout

                                       ;;      iocons - Console status through iobyte.
                                       ;
```

```
F7A3    CD F790         iocons: call    coniob
F7A6    28 C8                   jr      z,comins
F7A8    3D                      dec     a
F7A9    CA F0CD                 jp      z,kbdst
F7AC    C3 F0E5                 jp      siost

                        ;;      ioconi - Console input through iobyte.
                        ;
F7AF    CD F790         ioconi: call    coniob
F7B2    28 C1                   jr      z,cominp
F7B4    3D                      dec     a
F7B5    CA F0D8                 jp      z,kbdin
F7B8    C3 F0F0                 jp      sioin

                        ;;      lstout - List output through iobyte.
                        ;
F7BB    3A 0003         iolist: ld      a,(iobyte)
F7BE    E6 C0                   and     11000000b
F7C0    28 BD                   jr      z,comout
F7C2    EA F7DC                 jp      pe,pioout
F7C5    79                      ld      a,c
F7C6    FA F0F8                 jp      m,sioout
F7C9    C3 F2FE                 jp      fastcrt

                        ;;      List output through iobyte
                        ;
F7CC    3A 0003         iolsts: ld      a,(iobyte)
F7CF    E6 C0                   and     11000000b
F7D1    28 B5                   jr      z,comots
F7D3    EA F7F4                 jp      pe,piosto
F7D6    FA F105                 jp      m,siordy
F7D9    F6 FF                   or      -1
F7DB    C9                      ret

                        ;;      Parallel Output Driver.
                        ;
F7DC    CD F7F4         pioout: call    piosto
F7DF    28 FB                   jr      z,pioout        ;if printer not ready
F7E1    79                      ld      a,c
F7E2    D3 08                   out     (gpioda),a      ;load character data
F7E4    DB 0A                   in      a,(gpiodb)
F7E6    CB 97                   res     p.strb,a        ;assert strobe
F7E8    D3 0A                   out     (gpiodb),a
F7EA    CB D7                   set     p.strb,a        ;release stobe
F7EC    D3 0A                   out     (gpiodb),a
F7EE    3E 0A                   ld      a,10            ;delay for ACK
F7F0    3D              piol:   dec     a
F7F1    20 FD                   jr      nz,piol
F7F3    C9                      ret

                        ;;      Parallel Output Status.
                        ;
F7F4    DB 0A           piosto: in      a,(gpiodb)      ;read status
F7F6    2F                      cpl
F7F7    E6 10                   and     1 shl p.rdyo
F7F9    C8                      ret     z               ;if ready
```

```
        F7FA     F6 FF                         or      -1
        F7FC     C9                            ret

        008D                          iobdvs   equ     $-iobloc

                                               .dephase
                                               .phase  cloc+iobdvs

                                               subttl  Transient Command Processors
                                               page
```

```
 3782
 3783                                         if      options and o.ddvr
 3784                                 ;       -- disk boot loader command --
 3785                                 ;
 3786                                         overlay boot
 3787    0148'                +               c&seg
 3788
 3789    FC55    21 FF5D                      ld      hl,linbuf+1
 3790    FC58    7E                   boot1:  ld      a,(hl)            ;scan command line
 3791    FC59    2C                           inc     l
 3792    FC5A    D6 0D                        sub     cr
 3793    FC5C    28 0B                        jr      z,boot2           ;if no parameter, boot from A:
 3794    FC5E    FE 13                        cp      ' '-cr
 3795    FC60    28 F6                        jr      z,boot1           ;skip leading blanks
 3796    FC62    D6 34                        sub     'A'-cr
 3797    FC64    D8                           ret     c                 ;if invalid drive
 3798    FC65    FE 10                        cp      16
 3799    FC67    3F                           ccf
 3800    FC68    D8                           ret     c                 ;if bad drive
 3801    FC69    4F                   boot2:  ld      c,a               ;set boot drive selected
 3802    FC6A    C6 41                        add     a,'A'
 3803    FC6C    32 FCDD                      ld      (bootd),a         ;set up error message
 3804    FC6F    2E 00                        ld      l,0               ;set A:
 3805    FC71    C5                           push    bc
 3806    FC72    E5                           push    hl
 3807    FC73    CD FCEE                      call    swap              ;switch boot drive with A:
 3808    FC76    21 FCD9                      ld      hl,booter         ;set boot error return
 3809    FC79    E5                           push    hl
 3810    FC7A    0E 00                        ld      c,0               ;then boot from A:
 3811    FC7C    CD FA17                      call    select
 3812    FC7F    C0                           ret     nz                ;if drive not configured or density error
 3813    FC80    3E FF                        ld      a,-1
 3814    FC82    12                           ld      (de),a
 3815    FC83    11 000A                      ld      de,10             ;set dpb address offset within dph
 3816    FC86    19                           add     hl,de
 3817    FC87    5E                           ld      e,(hl)            ;set dpb address
 3818    FC88    23                           inc     hl
 3819    FC89    56                           ld      d,(hl)
 3820    FC8A    CD FA3C                      call    home
 3821    FC8D    0E 01                        ld      c,1               ;set sector 1
 3822    FC8F    1A                           ld      a,(de)            ;get low sectors per track
 3823    FC90    32 FCD4                      ld      (boots),a         ;inform boot loader
 3824    FC93    B7                           or      a
 3825    FC94    20 0D                        jr      nz,boot3          ;if not rigid
 3826    FC96    21 000D                      ld      hl,13             ;set reserved track offset within dpb
 3827    FC99    19                           add     hl,de
 3828    FC9A    4E                           ld      c,(hl)            ;get reserved tracks
 3829    FC9B    23                           inc     hl
 3830    FC9C    46                           ld      b,(hl)
 3831    FC9D    0B                           dec     bc                ;point behind directory
 3832    FC9E    ED 43 FA11                   ld      (phytrk),bc       ;do implied seek
 3833    FCA2    4F                           ld      c,a               ;set sector zero for rigid
 3834    FCA3    21 ED80              boot3:  ld      hl,bootbf         ;point to boot load buffer
 3835    FCA6    CD FA48                      call    read              ;read cold start loader
 3836    FCA9    C0                           ret     nz                ;if read error
```

```
FCAA    11 00FF                  ld      de,bootld+128-1 ;set boot loader address
FCAD    21 EDFF                  ld      hl,bootbf+128-1
FCB0    01 0080                  ld      bc,128
FCB3    ED B8                    lddr                    ;move front half of boot loader to 80h
FCB5    13                       inc     de
FCB6    1A                       ld      a,(de)          ;verify instructions read in
FCB7    FE E5                    cp      0e5h
FCB9    C8                       ret     z               ;if disk has no system
FCBA    21 F000                  ld      hl,Monitr
FCBD    22 F004                  ld      (warm+1),hl     ;set warm start to reload monitor
FCC0    CD FD05                  call    lcp             ;load configuration parameters
FCC3    21 112B                  ld      hl,iobdvr       ;load iobyte driver
FCC6    11 F770                  ld      de,iobloc
FCC9    01 008D                  ld      bc,iobdvs
FCCC    AF                       xor     a
FCCD    CD F2A3                  call    crtldir
FCD0    21 0080                  ld      hl,bootld       ;set start address
FCD3    3E 00                    ld      a,0
FCD4                    boots    equ     $-1             ;sectors per track
FCD5    11 FA0E                  ld      de,phycmd       ;tell boot loader from whence he came
FCD8    E9                       jp      (hl)            ;execute Boot Loader with return to booter

                        ;;       Booter - Boot Error Processor.
                        ;
FCD9    CD FC3D         booter:  call    pnext
FCDC    07                       defb    7
FCDD    64 3A 20 4C     bootd:   defm    'd: Load error.'
FCE1    6F 61 64 20
FCE5    65 72 72 6F
FCE9    72 2E
FCEB    04                       defb    eot
FCEC    C1                       pop     bc              ;switch drives back
FCED    E1                       pop     hl

                        ;;       swap - swap logical drives.
                        ;
                        ;        Entry:  C = first  drive index, 0-15
                        ;                L = second drive index, 0-15
                        ;
FCEE    06 00           swap:    ld      b,0             ;clear upper indices
FCF0    60                       ld      h,b
FCF1    11 F360                  ld      de,seltab       ;set select table address
FCF4    29                       add     hl,hl
FCF5    19                       add     hl,de
FCF6    EB                       ex      de,hl           ;set second address to DE, get seltab to HL
FCF7    09                       add     hl,bc
FCF8    09                       add     hl,bc           ;set first address to HL
FCF9    06 02                    ld      b,2
FCFB    4E              swapl:   ld      c,(hl)          ;swap two bytes
FCFC    1A                       ld      a,(de)
FCFD    77                       ld      (hl),a
FCFE    79                       ld      a,c
FCFF    12                       ld      (de),a
FD00    23                       inc     hl
FD01    13                       inc     de
FD02    10 F7                    djnz    swapl           ;if swap not complete
```

```
FD04   C9                       ret


                        ;;      lcp - load configuration parameters.
                        ;
FD05   3E 81            lcp:    ld      a,10000001b     ;default i/o byte to CRT: and LPT:
FD07   32 0003                  ld      (iobyte),a
FD0A   3A FCD4                  ld      a,(boots)       ;get boot diskette type
FD0D   B7                       or      a
FD0E   0E 20                    ld      c,32
FD10   21 ED80                  ld      hl,bootbf       ;use boot loader buffer
FD13   28 08                    jr      z,lcp1          ;if rigid, use system track, sector 32
FD15   FE 1B                    cp      26+1
FD17   D8                       ret     c               ;no parameters from single density boots
FD18   0E 03                    ld      c,3             ;dd configuration comes from track 0, sector 3
FD1A   21 EE00                  ld      hl,bootbf+128   ;use second half of boot loader buffer
FD1D   CD FA48          lcp1:   call    read
FD20   C0                       ret     nz              ;if can't read configuration
FD21   3A EE00                  ld      a,(bootbf+128)
FD24   D6 E5                    sub     0e5h
FD26   C8                       ret     z
FD27   3A EE7B                  ld      a,(z.xonp)      ;configure Xon-Xoff
FD2A   B7                       or      a
FD2B   28 03                    jr      z,lcp2
FD2D   FE C9                    cp      0c9h
FD2F   C0                       ret     nz
FD30   32 F115          lcp2:   ld      (Xonenb),a
FD33   3A EE60                  ld      a,(z.stpr)      ;configure step rate
FD36   32 FF54                  ld      (steprt),a
FD39   3A EE5F                  ld      a,(z.scra)      ;configure screen attribute
FD3C   32 FD49                  ld      (lcpa),a
FD3F   3A EE62                  ld      a,(z.keym)      ;configure keyboard mask
FD42   32 FD4B                  ld      (lcpb),a
FD45   CD FC3D                  call    pnext
FD48   1B                       defb    esc
FD49   00               lcpa:   defb    0
FD4A   1B                       defb    esc
FD4B   00               lcpb:   defb    0
FD4C   04                       defb    eot
FD4D   21 EE63                  ld      hl,z.sioA       ;configure Sio channels
FD50   3E 02                    ld      a,2
FD52   46               lcp3:   ld      b,(hl)          ;get number of bytes
FD53   23                       inc     hl
FD54   4E                       ld      c,(hl)          ;get port address
FD55   23                       inc     hl
FD56   ED B3                    otir
FD58   3D                       dec     a
FD59   20 F7                    jr      nz,lcp3
FD5B   3A EE7D                  ld      a,(z.baua)      ;configure channel A bit rate
FD5E   D3 00                    out     (bauda),a
FD60   3A EE7E                  ld      a,(z.baub)      ;configure channel B bit rate
FD63   D3 0C                    out     (baudb),a
FD65   3A EE77                  ld      a,(z.siom)      ;configure printer ready mask
FD68   32 F10C                  ld      (siomsk),a
FD6B   3A EE79                  ld      a,(z.siov)      ;configure printer ready value
FD6E   32 F10E                  ld      (sioval),a
FD71   3A EE7F                  ld      a,(z.iobt)      ;configure I/O byte
```

```
FD74    32 0003                       ld      (iobyte),a
FD77    C9                            ret
                                      else
                              boot    equ     what
                                      endif

                              ;;      -- goto to memory location command --
                              ;
                                      overlay goto
026B'                   +             c&seg

FC55    B7                            or      a
FC56    37                            scf
FC57    C8                            ret     z               ;if no parameters
FC58    E5                            push    hl              ;set goto address
FC59    DD E1                         pop     ix              ;ld     ix,hl
FC5B    EB                            ex      de,hl           ;set second arg to HL
FC5C    7D                            ld      a,l             ;and A
FC5D    50                            ld      d,b             ;set third arg to DE
FC5E    5D                            ld      e,l
FC5F    ED 4B FFBB                    ld      bc,(param4)     ;set fourth arg to BC
FC63    CD FAD6                       call    jpix
FC66    CD FC1B                       call    put2hs          ;print A reg
FC69    C3 FC16                       jp      put4hs

                              ;;      -- memory dump command --
                              ;
                                      overlay memdmp
0282'                   +             c&seg

FC55    3D                            dec     a               ;check parameter count
FC56    28 06                         jr      z,mdmp2
FC58    3D                            dec     a
FC59    28 08                         jr      z,mdmp3
FC5B    2A FFBD               mdmp1:  ld      hl,(last)
FC5E    11 0010               mdmp2:  ld      de,16
FC61    18 0E                         jr      mdmp3b

FC63    EB                    mdmp3:  ex      de,hl
FC64    ED 52                         sbc     hl,de           ;derive bytecount for dump range
FC66    D8                            ret     c               ;if addresses backwards
FC67    06 04                         ld      b,4
FC69    CB 3C                 mdmp3a: srl     h               ;divide bytecount by 16
FC6B    CB 1D                         rr      l
FC6D    10 FA                         djnz    mdmp3a
FC6F    23                            inc     hl
FC70    EB                            ex      de,hl
FC71    CD FB8F               mdmp3b: call    dump            ;dump de*16 bytes strting at hl
FC74    22 FFBD                       ld      (last),hl
FC77    C9                            ret

                              ;       -- memory examine command --
                              ;
                                      overlay view
02A5'                   +             c&seg

```

```
FC55    CD FB22        view0:  call    mdata
FC58    CD FC27                call    echo
FC5B    FE 0D                  cp      cr
FC5D    28 2F                  jr      z,view4
FC5F    FE 2D                  cp      '-'
FC61    28 2D                  jr      z,view5
FC63    FE 22                  cp      '"'
FC65    20 08                  jr      nz,view1
FC67    CD F009                call    conin
FC6A    CD F00C                call    conout
FC6D    18 1B                  jr      view3
FC6F    CD FBF3        view1:  call    hexbin
FC72    3F                     ccf
FC73    D0                     ret     nc
FC74    4F                     ld      c,a
FC75    87                     add     a,a
FC76    87                     add     a,a
FC77    87                     add     a,a
FC78    87                     add     a,a
FC79    47                     ld      b,a
FC7A    CD FC27                call    echo
FC7D    D6 0D                  sub     cr
FC7F    28 08                  jr      z,view2
FC81    C6 0D                  add     a,cr
FC83    CD FBF3                call    hexbin
FC86    3F                     ccf
FC87    D0                     ret     nc
FC88    48                     ld      c,b
FC89    81             view2:  add     a,c
FC8A    77             view3:  ld      (hl),a
FC8B    CD FB0E                call    check
FC8E    23             view4:  inc     hl
FC8F    23                     inc     hl
FC90    2B             view5:  dec     hl
FC91    18 C2                  jr      view0

                               if      options and o.baud
                       ;       -- Baud Rate Command --
                       ;
                       ;       * B<rate> [channel]        ;channel may be 0,1 or A/B
                       ;
                               overlay baud
02E3'                          c&seg

FC55    B7                     or      a
FC56    37                     scf
FC57    C8                     ret     z                  ;if no parameters
FC58    3D                     dec     a
FC59    20 02                  jr      nz,baud1           ;if channel specified
FC5B    1E 01                  ld      e,1                ;set channel 1 (B)
FC5D    CB 43          baud1:  bit     0,e                ;check port
FC5F    0E 00                  ld      c,bauda            ;set communications port
FC61    28 02                  jr      z,baud2
FC63    0E 0C                  ld      c,baudb            ;set printer port
FC65    ED 69          baud2:  out     (c),l              ;set baud rate
FC67    AF                     xor     a
```

```
FC68    C9                      ret
                                else
                        baud    equ     what
                                endif

                                if      options and o.disk
                        ;;      -- disk sector read/write command --
                        ;
                        ;       * R <unit> <track> <sector> <address>
                        ;       * W <unit> <track> <sector> <address>
                        ;
                                overlay dskcmd
02F7                            c&seg

FC55    47                      ld      b,a
FC56    3A FF5C                 ld      a,(linbuf)
FC59    D6 57                   sub     'W'
FC5B    20 1E                   jr      nz,dsk1
FC5D    B0                      or      b
FC5E    20 16                   jr      nz,dsk0
FC60    4F                      ld      c,a
FC61    CD F2FE                 call    Fastcrt
FC64    23                      inc     hl
FC65    11 0011                 ld      de,17
FC68    01 0015                 ld      bc,21
FC6B    EB                      ex      de,hl
FC6C    AF                      xor     a
FC6D    32 FC54                 ld      ($-25),a
FC70    CD F2A3                 call    crtldir
FC73    C3 FC36                 jp      crlf

FC76    3A FC54         dsk0:   ld      a,($-34)
FC79    B7                      or      a
FC7A    C0                      ret     nz
FC7B    78              dsk1:   ld      a,b
FC7C    FE 04                   cp      4               ;check parameter count
FC7E    37                      scf
FC7F    C0                      ret     nz
FC80    21 FFB5                 ld      hl,param1       ;move parameters to disk command
FC83    11 FA10                 ld      de,phydrv
FC86    01 0007                 ld      bc,3*2+1
FC89    ED A0                   ldi
FC8B    23                      inc     hl              ;skip upper unit
FC8C    ED B0                   ldir
FC8E    05                      dec     b               ;set select operation
FC8F    CD FA51                 call    xqphys          ;execute physical select
FC92    7D                      ld      a,l
FC93    B4                      or      h
FC94    28 16                   jr      z,dskerr        ;if select error
FC96    06 00                   ld      b,0             ;preset write command
FC98    3A FF5C                 ld      a,(linbuf)      ;get command
FC9B    FE 57                   cp      'W'
FC9D    28 01                   jr      z,dsk3          ;if write
FC9F    04                      inc     b
FCA0    CD FA51         dsk3:   call    xqphys          ;execute driver
FCA3    2A FFBB                 ld      hl,(param4)
```

```
FCA6    11 0010                         ld      de,16           ;assume 256-byte sector
FCA9    CA FB8F                         jp      z,dump          ;dump disk read buffer if no error

FCAC    CD FC3D                 dskerr: call    pnext
FCAF    44 73 6B 20                     defm    'Dsk Err'
FCB3    45 72 72
FCB6    04                              defb    eot
FCB7    C9                              ret
                                        else    ;(not disk options)
                                dskcmd  equ     what
                                        endif

                                        if      options and o.inpc
                                ;;      -- read input port command --
                                ;
                                ;       * I <16-bit port address>
                                ;
                                        overlay incmd
035A'                   +               c&seg

FC55    3D                              dec     a
FC56    37                              scf
FC57    C0                              ret     nz              ;if not one parameter
FC58    4D                              ld      c,l             ;set input port
FC59    44                              ld      b,h
FC5A    CD FC36                 in1:    call    crlf
FC5D    79                              ld      a,c             ;display port address
FC5E    CD FC1B                         call    put2hs
FC61    ED 78                   in2:    in      a,(c)
FC63    CD FC1B                         call    put2hs
FC66    CD F009                         call    conin           ;read character
FC69    FE 20                           cp      ' '
FC6B    28 F4                           jr      z,in2           ;read same port again
FC6D    FE 0D                           cp      cr
FC6F    28 06                           jr      z,in3           ;if read next
FC71    FE 2D                           cp      '-'
FC73    28 04                           jr      z,in4           ;if read previous
FC75    B7                              or      a               ;clear carry
FC76    C9                              ret
FC77    03                      in3:    inc     bc              ;advance to next port
FC78    03                              inc     bc
FC79    0B                      in4:    dec     bc
FC7A    18 DE                           jr      in1
                                        else
                                incmd   equ     what
                                        endif

                                        if      options and o.outc
                                ;;      -- write to output port command --
                                ;
                                ;       * O <16-bit port address> <8-bit value>
                                ;
                                        overlay outcmd
0381'                   +               c&seg

FC55    FE 02                           cp      2               ;require two parameters
```

```
FC57    37                              scf
FC58    C0                              ret     nz              ;if not 2 parameters
FC59    4D                              ld      c,l             ;set 16 bit output port address
FC5A    44                              ld      b,h
FC5B    ED 59                           out     (c),e           ;output to d0-d7 and address to a0-a17
FC5D    B7                              or      a
FC5E    C9                              ret
                                        else
                                outcmd  equ     what
                                        endif

                                        if      options and o.ramt
                                ;;      -- memory read/write diagnostic command --
                                ;
                                ;       * X <first addr> <last addr>
                                ;
                                        overlay test
038B'                   +               c&seg

FC55    FE 02                           cp      2               ;check parameter count
FC57    37                              scf
FC58    C0                              ret     nz
FC59    13                              inc     de
FC5A    5A                              ld      e,d             ;get ending page address into e
FC5B    54                              ld      d,h             ;get starting page address into d
FC5C    06 00                           ld      b,0             ;initialize pass counter
FC5E    62                      test1:  ld      h,d             ;point hl to start of block
FC5F    2E 00                           ld      l,0
FC61    7D                      test2:  ld      a,l
FC62    AC                              xor     h               ;generate test byte
FC63    A8                              xor     b
FC64    77                              ld      (hl),a          ;store byte in ram
FC65    23                              inc     hl
FC66    7C                              ld      a,h
FC67    BB                              cp      e               ;check for end of test block
FC68    20 F7                           jr      nz,test2
FC6A    62                              ld      h,d             ;now read back each byte & compare
FC6B    2E 00                           ld      l,0             ;point hl back to start
FC6D    7D                      test3:  ld      a,l
FC6E    AC                              xor     h               ;re-generate test byte data
FC6F    A8                              xor     b
FC70    CD FB0E                         call    check           ;verify memory data still good
FC73    C0                              ret     nz              ;exit if escape request is indicated
FC74    23                              inc     hl              ; else go on to next byte
FC75    7C                              ld      a,h
FC76    BB                              cp      e               ;check for end of block
FC77    20 F4                           jr      nz,test3
FC79    04                              inc     b               ;bump pass count
FC7A    3E 2B                           ld      a,'+'
FC7C    CD FC20                         call    output
FC7F    28 DD                           jr      z,test1         ;do another pass if user not unhappy
FC81    C9                              ret
                                        else
                                test    equ     what
                                        endif

```

```
                                      if      options and o.fill
                              ;;      -- fill memory with constant command --
                              ;
                                      overlay fill
03B8'                   +             c&seg

FC55    FE 03                         cp      3               ;check if parameter count=3
FC57    37                            scf
FC58    C0                            ret     nz
FC59    71                    fill1:  ld      (hl),c
FC5A    E5                            push    hl
FC5B    B7                            or      a
FC5C    ED 52                         sbc     hl,de           ;compare hl to end address in de
FC5E    E1                            pop     hl
FC5F    23                            inc     hl              ;advance pointer after comparison
FC60    38 F7                         jr      c,fill1
FC62    C9                            ret
                                      else
                              fill    equ     what
                                      endif

                                      if      options and o.move
                              ;;      -- memory block move command --
                              ;
                                      overlay block
03C6'                   +             c&seg

FC55    FE 03                         cp      3               ;check if parameter count=3
FC57    37                            scf
FC58    C0                            ret     nz
FC59    CD FC49                       call    blocad
FC5C    79                            ld      a,c
FC5D    B0                            or      b
FC5E    C8                            ret     z               ;exit now if bc=0
FC5F    ED B0                         ldir
FC61    C9                            ret
                                      else
                              block   equ     what
                                      endif

                                      if      options and o.verf
                              ;;      -- memory block compare command --
                              ;
                                      overlay vercmd
03D3'                   +             c&seg

FC55    FE 03                         cp      3               ;check if parameter count=3
FC57    37                            scf
FC58    C0                            ret     nz
FC59    CD FC49                       call    blocad
FC5C    18 08                         jr      verf2

FC5E    1A                    verf1:  ld      a,(de)
FC5F    CD FB0E                       call    check           ;compare data @ de and @ hl
FC62    C0                            ret     nz              ;exit if escape request is indicated
FC63    23                            inc     hl
```

```
FC64    13                      inc     de
FC65    0B                      dec     bc
FC66    78              verf2:  ld      a,b
FC67    B1                      or      c
FC68    20 F4                   jr      nz,verf1
FC6A    C9                      ret
                                else
                        vercmd  equ     what
                                endif

                                if      options and o.prot
                        ;;      Printer Protocol.
                        ;
                                overlay proto
03E9'               +           c&seg

FC55    3D                      dec     a
FC56    28 10                   jr      z,prot1         ;if one parameter
FC58    D6 02                   sub     2
FC5A    37                      scf
FC5B    C0                      ret     nz
FC5C    7B                      ld      a,e
FC5D    F6 04                   or      4
FC5F    32 F10C                 ld      (siomsk),a
FC62    79                      ld      a,c
FC63    F6 04                   or      4
FC65    32 F10E                 ld      (sioval),a
FC68    7D              prot1:  ld      a,l
FC69    B7                      or      a
FC6A    3E C9                   ld      a,0c9h
FC6C    28 01                   jr      z,prot2
FC6E    AF                      xor     a
FC6F    32 F115         prot2:  ld      (Xonenb),a
FC72    C9                      ret
                                else
                        proto   equ     what
                                endif

                                if      (options and o.type) ne 0
                        ;;      Type - Simple Typewriter.
                        ;
                                overlay type
0407'               +           c&seg

FC55    B7                      or      a
FC56    28 06                   jr      z,typ0          ;if no baud rate
FC58    3D                      dec     a
FC59    37                      scf
FC5A    C0                      ret     nz              ;if more than one parameter
FC5B    7D                      ld      a,l
FC5C    D3 0C                   out     (baudb),a       ;set printer baud rate
FC5E    CD FC3D         typ0:   call    pnext
FC61    1A                      defb    clrs
                                if      (options and o.esct) ne 0
FC62    1B 31                   defb    esc,'1'         ;set 8 bit keyboard mode
                                else
```

```
                                      defb    '0'-'@'         ;set 8 bit keyboard mode
                                      endif
FC64    54 79 70 65                   defm    'Typewriter mode.  Touch CTRL+ESC to exit.'
FC68    77 72 69 74
FC6C    65 72 20 6D
FC70    6F 64 65 2E
FC74    20 20 54 6F
FC78    75 63 68 20
FC7C    43 54 52 4C
FC80    2B 45 53 43
FC84    20 74 6F 20
FC88    65 78 69 74
FC8C    2E
FC8D    0D 0A 04                      defb    cr,lf,eot

FC90    CD F0E5               typl:   call    siost           ;status printer
FC93    28 0F                         jr      z,typ2          ;if char not ready
FC95    CD F0F0                       call    sioin           ;read character
FC98    E6 7F                         and     7fh             ;strip parity bit
FC9A    CD F00C                       call    conout
FC9D    FE 0D                         cp      cr
FC9F    3E 0A                         ld      a,lf
FCA1    CC F00C                       call    z,conout
FCA4    CD F006               typ2:   call    const           ;status console
FCA7    28 E7                         jr      z,typl          ;if user not active
FCA9    CD F009                       call    conin           ;read keyboard
FCAC    CD F0F8                       call    sioout          ;send character to printer
FCAF    CD F00C                       call    conout          ;and screen
FCB2    FE 0D                         cp      cr
FCB4    20 DA                         jr      nz,typl         ;if not CR
FCB6    3E 0A                         ld      a,lf            ;send line feed to screen and printer.
FCB8    CD F0F8                       call    sioout
FCBB    CD F00C                       call    conout
FCBE    18 D0                         jr      typl
                                      else
                              type    equ     what
                                      endif

                                      if      options and o.term
                              ;;      Terminal / Scroll Driver.
                              ;
                                      subttl  Terminal / Screen Manager
                                      page
```

```



                                   overlay term
  0472'                            c&seg

  000F                     pass8   equ     15
  0016                     inslin  equ     22
  0017                     dellin  equ     23
  001A                     clrchr  equ     26
  001E                     homscr  equ     30
  001F                     force   equ     31

  0081                     kuplin  equ     81h             ;Move top line off screen to buffer
  0082                     kdnlin  equ     82h             ;Move bottom line off screen to buffer
  00B1                     Rmttog  equ     80h+'1'         ;Toggle Remote Echo
  00B2                     Rmtalf  equ     80h+'2'         ;Toggle Remote Auto LF after CR
  008A                     Localf  equ     80h+lf          ;Toggle Local Auto LF after CR
  00FF                     Typtog  equ     80h+7fh         ;Toggle Local Echo
  00AE                     Brkkey  equ     80h+'.'         ;Hardware BREAK function

  0007                     s.lecho equ     7               ;local echo
  0006                     s.recho equ     6               ;remote echo
  0005                     s.autol equ     5               ;local auto lf after cr
  0004                     s.autor equ     4               ;remote auto lf after cr

  0100                     Trmbuf  equ     100h
  EE80                     Buftop  equ     Trmbuf+760*80
  EF00                     Siobuf  equ     Monitr-100h
  EF00                     Trmstk  equ     Siobuf

  FC55    FE 02                    cp      2               ;check number of arguments
  FC57    3F                       ccf
  FC58    D8                       ret     c               ;if more than 1
  FC59    B7                       or      a
  FC5A    20 02                    jr      nz,term1        ;if port specifed
  FC5C    2E 00                    ld      l,0
  FC5E    01 0406          term1:  ld      bc,siocpa+siodpa*256     ;preset A channel ports
  FC61    CB 45                    bit     0,l
  FC63    28 03                    jr      z,term2         ;if 0/1 or A/B
  FC65    01 0507                  ld      bc,siocpb+siodpb*256     ;set B channel ports
  FC68    ED 43 FE78       term2:  ld      (ports),bc
  FC6C    31 EF00                  ld      sp,trmstk
  FC6F    CD FC3D                  call    pnext
  FC72    1A                       db      clrs
                                   if      options and o.esct
  FC73    1B 31                    db      esc,'1'
                                   else
                                   db      pass8
                                   endif
  FC75    54 65 72 6D              db      'Terminal mode.  Touch CTRL+ESC to exit.'
  FC79    69 6E 61 6C
  FC7D    20 6D 6F 64
  FC81    65 2E 20 20
  FC85    54 6F 75 63
  FC89    68 20 43 54
```

```
FC8D    52 4C 2B 45
FC91    53 43 20 74
FC95    6F 20 65 78
FC99    69 74 2E
FC9C    0D 0A                         db      cr,lf
FC9E    04                            db      eot

FC9F    FD 21 FEE5                    ld      iy,status         ;set pointer to status byte

FCA3    CD F006             term3:    call    const             ;status keyboard
FCA6    C4 FCB1                       call    nz,pki            ;process keyboard input
FCA9    CD FEC8                       call    sioist            ;status sio
FCAC    C4 FD40                       call    nz,prc            ;process remote character
FCAF    18 F2                         jr      term3             ;until user escapes

                            ;;        pki - Process Keyboard Input.
                            ;
FCB1    3E 00               pki:      ld      a,0
FCB2                        brkflg    equ     $-1
FCB3    B7                            or      a
FCB4    C4 FD21                       call    nz,clrbrk         ;terminate pending break
FCB7    CD F009                       call    conin             ;read input
FCBA    CB 7F                         bit     7,a
FCBC    20 0B                         jr      nz,pki1           ;if function key
FCBE    CD FD5F                       call    sndrmt            ;send it to remote
FCC1    FD CB 00 7E                   bit     s.lecho,(iy)
FCC5    C4 FD4C                       call    nz,sndloc         ;if local echo enabled, display console input
FCC8    C9                            ret
FCC9    FE 81               pki1:     cp      kuplin
FCCB    20 12                         jr      nz,pki2           ;if not scroll up
FCCD    CD FE50                       call    gcp               ;get cursor position
FCD0    CD FC3D                       call    pnext             ;home screen, then delete top line
                                      if      options and o.esct
FCD3    1E 1B 52 04                   defb    homscr,esc,'R',eot
                                      else
                                      defb    homscr,dellin,eot
                                      endif
FCD7    CD FD89                       call    ltl               ;link top line
FCDA    CD FDEB                       call    dbl               ;display bottom line
FCDD    18 14                         jr      pki3
FCDF    FE 82               pki2:     cp      kdnlin
FCE1    20 13                         jr      nz,pki4           ;if not scroll down
FCE3    CD FE50                       call    gcp               ;get cursor position
FCE6    CD FC3D                       call    pnext             ;home screen, insert blank line
                                      if      options and o.esct
FCE9    1E 1B 45 04                   defb    homscr,esc,'E',eot
                                      else
                                      defb    homscr,dellin,eot
                                      endif
FCED    CD FE0B                       call    lbl               ;link bottom line
FCF0    CD FDB1                       call    dtl               ;display top line
FCF3    C3 FE6E             pki3:     jp      rcp               ;restore cursor position
FCF6    FE FF               pki4:     cp      Typtog
FCF8    20 04                         jr      nz,pki5
FCFA    3E 80                         ld      a,1 shl s.lecho
FCFC    18 16                         jr      pki8
```

```
FCFE    FE B1           pki5:   cp      Rmttog
FD00    20 04                   jr      nz,pki6
FD02    3E 40                   ld      a,1 shl s.recho
FD04    18 0E                   jr      pki8
FD06    FE 8A           pki6:   cp      Localf
FD08    20 04                   jr      nz,pki7
FD0A    3E 20                   ld      a,1 shl s.autol
FD0C    18 06                   jr      pki8
FD0E    FE B2           pki7:   cp      Rmtalf
FD10    20 09                   jr      nz,pki9
FD12    3E 10                   ld      a,1 shl s.autor
FD14    FD AE 00        pki8:   xor     (iy)
FD17    FD 77 00                ld      (iy),a
FD1A    C9                      ret
FD1B    FE AE           pki9:   cp      Brkkey
FD1D    C0                      ret     nz
FD1E    3A FCB2                 ld      a,(brkflg)
FD21    EE FF           clrbrk: xor     -1
FD23    32 FCB2                 ld      (brkflg),a
FD26    16 10                   ld      d,10h           ;set line SPACING
FD28    20 02                   jr      nz,setbrk
FD2A    16 00                   ld      d,0             ;set line MARKING
FD2C    ED 4B FE78      setbrk: ld      bc,(ports)
FD30    3E 05                   ld      a,5             ;set up WR5
FD32    F3                      di
FD33    ED 79                   out     (c),a
FD35    3E AA                   ld      a,10101010b     ;assert DTR, 7 bpc, RTS, Tx Enb
FD37    B2                      or      d
FD38    ED 79                   out     (c),a
FD3A    FB                      ei
FD3B    3E FF                   ld      a,0ffh
FD3D    C3 FE90                 jp      sioot           ;send RUBOUT to allow MARKING

                        ;;      prc - Process Remote Character.
                        ;
FD40    CD FED6         prc:    call    sioinc          ;read remote character
FD43    FD CB 00 76             bit     s.recho,(iy)
FD47    C4 FD5F                 call    nz,sndrmt       ;echo it back
FD4A    18 26                   jr      doc             ;display it locally

                        ;;      sndloc - send character to screen.
                        ;
FD4C    CD FD72         sndloc: call    doc
FD4F    FE 0D                   cp      cr
FD51    C0                      ret     nz
FD52    FD CB 00 6E             bit     s.autol,(iy)
FD56    C8                      ret     z
FD57    3E 0A                   ld      a,lf
FD59    CD FD72                 call    doc
FD5C    3E 0D                   ld      a,cr
FD5E    C9                      ret

                        ;;      sndrmt - send character to remote.
                        ;
FD5F    CD FE90         sndrmt: call    sioot
FD62    FE 0D                   cp      cr
```

```
FD64    C0                      ret     nz
FD65    FD CB 00 66             bit     s.autor,(iy)
FD69    C8                      ret     z
FD6A    3E 0A                   ld      a,lf
FD6C    CD FE90                 call    sioot
FD6F    3E 0D                   ld      a,cr
FD71    C9                      ret

                        ;;      doc - Display One Character.
                        ;
FD72    FE 7F           doc:    cp      7fh
FD74    C8                      ret     z               ;don't display RUBOUT
FD75    4F                      ld      c,a             ;send it to screen
FD76    C5                      push    bc
FD77    CD FE9B                 call    outcrt          ;display character
FD7A    C1                      pop     bc
FD7B    47                      ld      b,a
FD7C    79                      ld      a,c
FD7D    FE 0A                   cp      lf
FD7F    C0                      ret     nz
FD80    04                      inc     b
FD81    05                      dec     b
FD82    C0                      ret     nz              ;if line feed did not scroll
FD83    CD FD89                 call    ltl             ;link top line
FD86    3E 0A                   ld      a,lf
FD88    C9                      ret

                        ;;      ltl - link top line.
                        ;
FD89    21 FF5C         ltl:    ld      hl,linbuf
FD8C    ED 5B FEE8              ld      de,(topptr)     ;set address of line above screen
FD90    01 0050                 ld      bc,80
FD93    ED B0                   ldir                    ;move line
FD95    CD FE34                 call    wup             ;wrap upper pointer
FD98    ED 53 FEE8              ld      (topptr),de     ;set new top line address
FD9C    2A FEE6                 ld      hl,(botptr)
FD9F    EB                      ex      de,hl
FDA0    B7                      or      a
FDA1    ED 52                   sbc     hl,de
FDA3    C0                      ret     nz
FDA4    11 0050                 ld      de,80
FDA7    19                      add     hl,de           ;advance bottom pointer
FDA8    EB                      ex      de,hl
FDA9    CD FE34                 call    wup             ;wrap upper pointer
FDAC    ED 53 FEE6              ld      (botptr),de
FDB0    C9                      ret

                        ;;      dtl - Display Top Line.
                        ;
FDB1    ED 5B FEE8      dtl:    ld      de,(topptr)     ;get line above screen
FDB5    21 FFB0                 ld      hl,-80
FDB8    19                      add     hl,de
FDB9    CD FE41                 call    wlp             ;wrap lower pointer
FDBC    22 FEE8                 ld      (topptr),hl
FDBF    01 0050                 ld      bc,80

```

```
                                ;;      dln - display line.
                                ;
FDC2    E5                      dln:    push    hl
FDC3    09                              add     hl,bc
FDC4    2B                              dec     hl
FDC5    3E 20                           ld      a,' '
FDC7    ED A9                   dln1:   cpd
FDC9    20 03                           jr      nz,dln2         ;if not trailing blank
FDCB    EA FDC7                         jp      pe,dln1
FDCE    E1                      dln2:   pop     hl
FDCF    E0                              ret     po              ;if entire line blank
FDD0    41                              ld      b,c
FDD1    04                              inc     b
FDD2    C5                      dln3:   push    bc
FDD3    7E                              ld      a,(hl)
FDD4    4F                              ld      c,a
FDD5    FE 20                           cp      ' '
FDD7    30 08                           jr      nc,dln4
FDD9    E5                              push    hl
FDDA    0E 1F                           ld      c,force         ;force next character out
FDDC    CD FE9B                         call    outcrt
FDDF    E1                              pop     hl
FDE0    4E                              ld      c,(hl)
FDE1    23                      dln4:   inc     hl              ;advance address
FDE2    E5                              push    hl
FDE3    CD FE9B                         call    outcrt          ;display character
FDE6    E1                              pop     hl
FDE7    C1                              pop     bc
FDE8    10 E8                           djnz    dln3            ;if not entire line
FDEA    C9                              ret

                                ;;      dbl - Display bottom line.
                                ;
FDEB    CD FC3D                 dbl:    call    pnext           ;plant cursor on bottom line
FDEE    1B 3D 37 20                     db      esc,'=',' '+23,' ',eot
FDF2    04
FDF3    2A FEE6                         ld      hl,(botptr)
FDF6    E5                              push    hl
FDF7    01 004F                         ld      bc,80-1
FDFA    CD FDC2                         call    dln             ;display bottom line
FDFD    E1                              pop     hl
FDFE    01 0050                         ld      bc,80
FE01    09                              add     hl,bc
FE02    EB                              ex      de,hl
FE03    CD FE34                         call    wup
FE06    ED 53 FEE6                      ld      (botptr),de
FE0A    C9                              ret

                                ;;      lbl - link bottom line.
                                ;
FE0B    01 0050                 lbl:    ld      bc,80
FE0E    2A FEE6                         ld      hl,(botptr)
FE11    B7                              or      a
FE12    ED 42                           sbc     hl,bc
FE14    CD FE41                         call    wlp
FE17    22 FEE6                         ld      (botptr),hl
```

```
        FE1A    EB                              ex      de,hl
        FE1B    2A FEE8                         ld      hl,(topptr)
        FE1E    B7                              or      a
        FE1F    ED 52                           sbc     hl,de
        FE21    20 0B                           jr      nz,lbl1
        FE23    2A FEE8                         ld      hl,(topptr)
        FE26    ED 42                           sbc     hl,bc
        FE28    CD FE41                         call    wlp
        FE2B    22 FEE8                         ld      (topptr),hl
        FE2E    21 FF5C                 lbl1:   ld      hl,linbuf
        FE31    ED B0                           ldir                    ;move gold mine to buffer
        FE33    C9                              ret

   \                                    ;;      wup - Wrap upper pointer.
                                        ;
        FE34    E5                      wup:    push    hl
        FE35    21 EE80                         ld      hl,buftop       ;set end of buffer address
        FE38    37                              scf
        FE39    ED 52                           sbc     hl,de
        FE3B    E1                              pop     hl
        FE3C    D0                              ret     nc              ;if not past end of buffer
        FE3D    11 0100                         ld      de,Trmbuf       ;start over at beggining of buffer
        FE40    C9                              ret

                                        ;;      wlp - Wrap lower pointer.
                                        ;
        FE41    E5                      wlp:    push    hl
        FE42    D5                              push    de
        FE43    11 0100                         ld      de,Trmbuf       ;set start of buffer address
        FE46    B7                              or      a
        FE47    ED 52                           sbc     hl,de
        FE49    D1                              pop     de
        FE4A    E1                              pop     hl
        FE4B    D0                              ret     nc              ;if not below start of buffer
        FE4C    21 EE30                         ld      hl,buftop-80    ;start over at end of buffer
        FE4F    C9                              ret

                                        ;;      gcp - get cursor position.
                                        ;
        FE50    ED 4B FFB1              gcp:    ld      bc,(base)
        FE54    2A FFAC                         ld      hl,(cursor)
        FE57    45                              ld      b,l             ;get column to B
        FE58    CB B8                           res     7,b
        FE5A    29                              add     hl,hl           ;set screen row to H
        FE5B    7C                              ld      a,h
        FE5C    D6 60                           sub     crtbas*2
        FE5E    91                              sub     c               ;row = 23-(base-curh)
        FE5F    C6 17                           add     a,23
        FE61    D6 18                   gcpl:   sub     24
        FE63    30 FC                           jr      nc,gcpl
        FE65    4F                              ld      c,a             ;set row
        FE66    21 1F38                         ld      hl,'  '+24-100h ;offset for <esc>=
        FE69    09                              add     hl,bc
        FE6A    22 FE73                         ld      (rcpa),hl
        FE6D    C9                              ret
```

```
                                ;;      rcp - Restore cursor position.
                                ;
FE6E     CD FC3D                rcp:    call    pnext
FE71     1B 3D                          db      esc,'='
FE73     20 20                  rcpa:   db      '  '
FE75     04                             db      eot
FE76     C9                             ret

                                ;;      sio drivers.
                                ;
FE77     01 FE78                sioins: ld      bc,ports        ;set status port to c
FE78                            ports   equ     $-2
FE7A     ED 78                          in      a,(c)
FE7C     CB 47                          bit     0,a             ;test rca
FE7E     C9                             ret

FE7F     CD FE77                sioinp: call    sioins          ;get status
FE82     28 FB                          jr      z,sioinp        ;if not ready
FE84     48                             ld      c,b             ;set data port address
FE85     ED 78                          in      a,(c)
FE87     CB BF                          res     7,a             ;pitch parity bit
FE89     C9                             ret

FE8A     CD FE77                siordt: call    sioins          ;get sio status
FE8D     CB 57                          bit     2,a             ;test TX empty
FE8F     C9                             ret

FE90     08                     sioot:  ex      af,af'          ;save char to send
FE91     CD FE8A                sioot1: call    siordt          ;test transmit ready status
FE94     28 FB                          jr      z,sioot1        ;if not ready
FE96     48                             ld      c,b
FE97     08                             ex      af,af'
FE98     ED 79                          out     (c),a
FE9A     C9                             ret

FE9B     CD FEA7                outcrt: call    siopl           ;poll for input before & after
FE9E     CD F2FE                        call    fastcrt
FEA1     F5                             push    af              ;save balcones gold
FEA2     CD FEA7                        call    siopl
FEA5     F1                             pop     af
FEA6     C9                             ret

                                ;;      Siopl - Sio Poll Input Characters.
                                ;
FEA7     C5                     Siopl:  push    bc
FEA8     CD FE77                        call    sioins          ;input Sio status
FEAB     28 19                          jr      z,siopl3        ;if input not ready
FEAD     48                             ld      c,b             ;set data port address
FEAE     ED 78                          in      a,(c)
FEB0     CB BF                          res     7,a             ;pitch parity bit
FEB2     E5                             push    hl
FEB3     2A FEEA                        ld      hl,(ipoint)     ;set in pointer
FEB6     77                             ld      (hl),a          ;store character in fifo
FEB7     2C                             inc     l
FEB8     20 02                          jr      nz,siopl1
FEBA     2E 00                          ld      l,low siobuf
```

```
FEBC    3A FEEC               siopl1: ld      a,(opoint)
FEBF    95                            sub     l
FEC0    28 03                         jr      z,siopl2        ;if buffer full
FEC2    22 FEEA                       ld      (ipoint),hl
FEC5    E1                    siopl2: pop     hl
FEC6    C1                    siopl3: pop     bc
FEC7    C9                            ret

                              ;;      Sioist - Sio Input Status.
                              ;
FEC8    CD FEA7               Sioist: call    Siopl           ;poll for input
FECB    2A FEEC                       ld      hl,(opoint)     ;set out pointer
FECE    3A FEEA                       ld      a,(ipoint)
FED1    95                            sub     l
FED2    C8                            ret     z               ;if data not ready
FED3    F6 FF                         or      -1
FED5    C9                            ret

                              ;;      Sioin - Sio Input Character.
                              ;
FED6    CD FEC8               Sioinc: call    Sioist          ;set input ready status
FED9    28 FB                         jr      z,Sioinc
FEDB    7E                            ld      a,(hl)
FEDC    2C                            inc     l               ;advance out
FEDD    20 02                         jr      nz,Sioil
FEDF    2E 00                         ld      l,low siobuf
FEE1    22 FEEC               Sioil:  ld      (opoint),hl
FEE4    C9                            ret

FEE5    00                    status: db      0

FEE6    0100                  botptr: dw      Trmbuf
FEE8    0100                  topptr: dw      Trmbuf

FEEA    EF00                  ipoint: dw      siobuf
FEEC    EF00                  opoint: dw      siobuf
                                      else
                              term    equ     what
                                      endif

                                      if      options and o.help

                              ;;      Help Key Command.
                              ;
                                      overlay help
070B'                   +             c&seg

FC55    CD FC3D                       call    pnext
FC58    42 61 75 64                   defb    'Baud           <rate> [B/A]',cr,lf
FC5C    09 09 3C 72
FC60    61 74 65 3E
FC64    20 5B 42 2F
FC68    41 5D 0D 0A
FC6C    44 75 6D 70                   defb    'Dump           [start] [end]',cr,lf
FC70    09 09 5B 73
FC74    74 61 72 74
```

```
FC78    5D 20 5B 65
FC7C    6E 64 5D 0D
FC80    0A
FC81    47 6F 74 6F                   defb   'Goto            <addr>',cr,lf
FC85    09 09 3C 61
FC89    64 64 72 3E
FC8D    0D 0A
FC8F    4D 6F 64 69                   defb   'Modify          <addr>',cr,lf
FC93    66 79 09 09
FC97    3C 61 64 64
FC9B    72 3E 0D 0A
FC9F    50 72 6F 74                   defb   'Protocol        <xon> [msk val]',cr,lf
FCA3    6F 63 6F 6C
FCA7    09 3C 78 6F
FCAB    6E 3E 20 5B
FCAF    6D 73 6B 20
FCB3    76 61 6C 5D
FCB7    0D 0A
FCB9    04                            defb    eot
FCBA    C9                            ret
                                      else
                              help    equ     what
                                      endif

                                      subttl  Segment Size Information
                                      page

                              ;;      Top of Overlay Area.
                              ;
                                      overlay stop
0771'                   +             c&seg
0299                          tpamax  equ     tpal            ;set length of transient move

                              ;;      Top of Resident Monitor.
                              ;
                                      below
0000!                   +             defs    comres
041B                          rbase   equ     $

                              ;;      Top of Non Resident Monitor.
                              ;
                                      above
0518!                   +             d&seg
FC55                          restop  equ     $               ;resident top
0C55                          reslen  equ     $-monitr        ;length of resident monitor

                                      update                  ;clear active segment

                              ;;      Top of Burned Rom Set.
                              ;
17E1                          romtop  equ     bloc+dloc+tloc-monitr

                              ;;      Fill Out Unused Rom Space.
                              ;
0C55"                                 cseg

                                      if      (rom+romsiz-romtop) gt 0
0771'                                 defs    (rom+romsiz-romtop),-1
                                      endif

                                      subttl  Resident Monitor System Ram
                                      page
```

```

                                        .phase  ram

                                ;;      Start of Documented Storage Locations.
                                ;
        FF00                    vectab:                         ;interrupt vector table starts here
        FF00                    siovec: defs    16              ;space for 8 vectors for sio
        FF10                    ctcvec: defs    8               ;space for 4 vectors for ctc
        FF18                    sysvec: defs    4               ;space for 2 vectors for system pio
        FF1C                    genvec: defs    4               ;space for 2 vectors for general pio

                                ;;      keyboard data input fifo variables
                                ;
        FF20                    fifo:   defs    16              ;console input fifo
        FF30                    fifcnt: defs    1               ;fifo data counter
        FF31                    fifin:  defs    1               ;fifi input pointer
        FF32                    fifout: defs    1               ;fifo output pointer

        FF33                            defs    1               ;round address

                                ;;      More interrupt vectors
                                ;
        FF34                    expvec: defs    8               ;space for 4 vectors for expansion slot

                                ;;      Available memory pointers.
                                ;
        FF3C                    availb: defs    2               ;bottom of available memory
        FF3E                    availt: defs    2               ;top of available memory

                                ;
                                ;;      End of documented storage locations.

        FF40                            defs    16              ;local stack for interrupts
        FF50                    intstk:

                                ;;      clock-timer interrupt variables
                                ;
        FF50                    Milsec: defs    2               ;One   Millisecond timer, Enable int on ctc1
        FF52                    tikcnt: defs    2               ;16 bit seconds counter (18 hr, 12 min, 16 sec)
        FF54                    steprt: defs    1               ;WD 1797 step rate
        FF55                    timout: defs    1               ;time-out, decrements once per second
                                ;
                                ;       Getime entry returns the address of DAY
                                ;
        FF56                    day:    defs    1               ;calendar day           (01-31)
        FF57                    month:  defs    1               ;         month         (01-12)
        FF58                    year:   defs    1               ;         year-1970     (1970-2225)
        FF59                    hrs:    defs    1               ;clock hours            (00-23)
        FF5A                    mins:   defs    1               ;      minutes          (00-59)
        FF5B                    secs:   defs    1               ;      seconds          (00-59)

                                ;;      crt output driver variables
                                ;
        FF5C                    linbuf: defs    80              ;line buffer & Bcc gold mine
        FFAC                    cursor: defs    2               ;cursor pointer
```

```
FFAE              csrchr: defs    1               ;character used for a cursor
FFAF              dircur: defs    2               ;cursor pointer for direct crt display
FFB1              base:   defs    1               ;current contents of scroll register
FFB2              leadin: defs    1               ;state of lead-in sequence handler
FFB3              attrib: defs    1               ;attribute enable
FFB4              chrsav: defs    1               ;character under cusror

                  ;;      console monitor program variables
                  ;
FFB5              param1: defs    2               ;storage for numbers read
FFB7              param2: defs    2               ; from line input buffer
FFB9              param3: defs    2               ; by 'PARAMS' subroutine
FFBB              param4: defs    2               ; for command processors
FFBD              last:   defs    2               ;last address used by 'MEMDMP'

                  ;;      Configurable parameter address table
                  ;
FFBF              contbl: defs    2*numcon

FFCB              spare1: defs    1               ;spare configuration byte
FFCC              spare2: defs    1               ;another spare byte

FFCD              spare:  defs    (ram+100h-48)-$ ;spare ram space

FFD0              sparnd:                         ;end of spare ram

FFD0                      defs    16              ;crt stack
FFE0              crtstk:

FFE0              rstsp:  defs    2               ;sp register on reset
FFE2              rsthl:  defs    2               ;hl register on reset
FFE4              rstpc:  defs    2               ;possible pc from top of stack

FFE6                      defs    26              ;monitor stack
0000              stack:

                          .dephase

                          subttl  Console Messages
                          page
```

```

;;      Console Message Macros.
;
message macro   text,h1,h2
        if1
        .radix  16
        printx  <text>,%(h1),%(h2-1),%((h2)-(h1))
        .radix  10
        endif
        endm

printx  macro   text,h1,h2,h3
        .printx + text h1 - h2 = h3 +
        endm

        if      romtop ge (rom+romsiz)
        message <* The ROM set is Too big *>,rom+romsiz,romtop
        endif

        if      cloc+tpal gt ram
        message <* The TPA set is Too big *>,ram,cloc+tpal
        endif

        message <Non-resident executes >,rom,bloc
        message <Rom is burned up from >,rom,romtop
        message <Unused Rom Space from >,romtop,rom+romsiz-1
        message <Resident Monitor needs>,monitr,rqtop
        message <Space Wasted to Driver>,Wasted,Seltab
        message <Physical Disk Drivers >,Seltab,Dvrlmt
        message <Driver Offset for ZSID>,200h+bloc+Seltab-Monitr,0
        message <I/O Byte Drivers from >,iobloc,iobloc+iobdvs
        message <Command Processor Area>,rqtop,restop
        message <Transient Overlay ROM >,start,stop
        message <Transient Command Area>,cloc,cloc+tpal
        message <Spare Locations in Ram>,spare,sparnd

        subttl  The*End
        end     entry
```

```
Balcones Operating System for the XEROX 820-II  MACRO-80 3.44   09-Dec-81
The*End

Macros:
ABOVE           BELOW           BSEG            MESSAGE         OVERLAY
PHEX            PMSG            PRINTX          SEGMENT         SERVICE
UPDATE

Symbols:
0080    ..              F360    .A              F362    .B
F364    .C              F366    .D              F368    .E
F36A    .F              F36C    .G              F36E    .H
F370    .I              F372    .J              F374    .K
F376    .L              F378    .M              F37A    .N
F37C    .O              F37E    .P              009B    ABORT
F6F2    ADDRH           F6F3    ADDRL           FD80    ALLO0
FDA0    ALLO1           FDC0    ALLO2           FDE0    ALLO3
FE00    ALLO4           FE80    ALLO5           FEC0    ALLO6
FEE0    ALLO7           0068    ASYNC           FFB3    ATTRIB
FA78    AUTOBT          FF3C    AVAILB          FF3E    AVAILT
0000    B.BSY           0002    B.CD            0004    B.IO
0001    B.MSG           0006    B.PAR           0003    B.REQ
0007    B.RST           0005    B.SEL           02CE    BAKSPC
FFB1    BASE            1353    BAUD            FC5D    BAUD1
FC65    BAUD2           0000    BAUDA           000C    BAUDB
0018!   BBASE           040F    BBG             032F    BELL
0331    BELL1           0028    BELLOF          0029    BELLON
041B    BLOC            FC49    BLOCAD          1436    BLOCK
0061    BLOFC           0061    BLONC           0035    BLTIM
000F    BNDRY           11B8    BOOT            FC58    BOOT1
FC69    BOOT2           FCA3    BOOT3           ED80    BOOTBF
FCDD    BOOTD           FCD9    BOOTER          0080    BOOTLD
FCD4    BOOTS           FEE6    BOTPTR          FCB2    BRKFLG
00AE    BRKKEY          0000    BSPACE          EE80    BUFTOP
0004    C.8IN           0004    C.FIVE          0007    C.FLAW
00C0    C.FLPY          0004    C.FMAT          0006    C.FTRK
000C    C.INIT          0007    C.KEYM          0008    C.READ
0001    C.RECAL         0003    C.RQSN          0002    C.RSYN
0006    C.SASI          000B    C.SEEK          00E0    C.TRAM
0000    C.TRDY          0005    C.TWO           0005    C.VTRK
000A    C.WRIT          0009    C.WRPR          F31E    CCA
F323    CCA1            F324    CCA2            00AF    CCS
00B1    CCS1            F57A    CDD             F584    CDD0
F592    CDD1            F59B    CDD2            0108    CFINIT
F6A5    CFT             F6A9I   CFTA            FB0E    CHECK
FD00    CHK00           FD20    CHK01           FD40    CHK02
FD60    CHK03           0000    CHK04           0000    CHK05
0000    CHK06           0000    CHK07           03F5    CHRDEL
03EA    CHRIN1          03F0    CHRIN2          03DC    CHRINS
0034    CHROM1          0035    CHROM2          FFB4    CHRSAV
FC55    CLOC            0350    CLR1            FD21    CLRBRK
001A    CLRCHR          0344    CLREOL          0361    CLREOS
0341    CLRLIN          001A    CLRS            0365    CLRS1
037A    CLRS2           0357    CLRSCN          0036    CMDSIZ
FAD8    CMDTAB          F767    CNFDPB          F000    COLD
F775    COMINP          F770    COMINS          F788    COMOTS
F77F    COMOUT          0518    COMRES          0518C   COMROM
F091    CONFG           F08B    CONFIG          F009    CONIN
F790    CONIOB          F00C    CONOUT          F006    CONST
```

```
Balcones Operating System for the XEROX 820-II  MACRO-80 3.44   09-Dec-81
The+End

FFBF    CONTBL          023D    CONTRL          F723    CPB
F731    CPB1            F736    CPB2            F759    CPB3
000D    CR              FC36    CRLF            0030    CRTBAS
0182    CRTD1           0196    CRTD2           0199    CRTD3
01B2    CRTD4           0169    CRTDVR          F2A3    CRTLDIR
3C00    CRTMAX          3000    CRTMEM          F2E7    CRTMV
F2E9    CRTMVO          F296    CRTOF1          F293    CRTOFF
F29C    CRTON           F299    CRTON1          F2F1    CRTOUT
FFE0    CRTSTK          003C    CRTTOP          0000    CSPACE
FFAE    CSRCHR          0018    CTC             0018    CTC0
0019    CTC1            001A    CTC2            001B    CTC3
FF10    CTCVEC          0036    CTLSIZ          0254    CTLTAB
FFAC    CURSOR          F6D7    CWP             FF56    DAY
F039    DAYTI           F086    DAYTIM          FDEB    DBL
F6F5    DCTRL           0000    DEBUG           02C5    DEFCUR
F6EA    DEFLPY          F6EB    DEFLUN          0017    DELLIN
FC80    DIRBUF          FFAF    DIRCUR          01F3    DIS1
01F2    DISATR          FDC2    DLN             FDC7    DLN1
FDCE    DLN2            FDD2    DLN3            FDE1    DLN4
FC55    DLOC            FC23    DMPFMT          02E7    DNCSR
FD72    DOC             F490    DPB5D           F470    DPB5S
F450    DPB8D           F430    DPB8S           F390    DPBASE
000A    DPBOFS          F470    DPBRG4          F480    DPBRG5
F490    DPBRG6          F4A0    DPBRG7          F1F1    DPM
F380    DRVTAB          FC76    DSK0            FC7B    DSK1
FCA0    DSK3            1367    DSKCMD          F4B0    DSKDVR
FCAC    DSKERR          03EF    DSM4            01EF    DSM5
00EF    DSM6            00EF    DSM7            0000    DSPACE
F632    DSW             FDB1    DTL             F6D5    DTYPE
FB8F    DUMP            FB9B    DUMP2           FBB4    DUMP3
FBD1    DUMP4           FA08    DVRLMT          FD05    EATKEY
FC27    ECHO            F69B    ECR             F0A2    EIRET
01EF    ENATR           0000!   ENTRY           0004    EOT
00C4    ERR             00BC    ERR1            00C1    ERR2
00CC    ERR3            00D4    ERRM1           00DD    ERRM2
0009    ERRML           001B    ESC             029B    ESCADR
02BD    ESCAPE          028A    ESCTAB          0011    ESCTBL
FF34    EXPVEC          0000    FALSE           0000    FALUN
F2FE    FASTCRT         0001    FBLUN           0000    FCLUN
0002    FDLUN           FF30    FIFCNT          FF31    FIFIN
FF20    FIFO            FF32    FIFOUT          1428    FILL
FC59    FILL1           F6F6    FIRST           F708    FIRST1
F721    FIRST2          F4BD    FLOP1           F4DE    FLOP2
F4F2    FLOP3           F4FC    FLOP4           F506    FLOP5
F6EF    FLPFRM          0005    FM.DD           0007    FM.DDDS
00A0    FM.DDSS         0004    FM.DS           0006    FM.FV
0080    FM.HARD         0001    FM.SDDS         0000    FM.SDSS
0002    FM.SZ           0007    FM.UN           0003    FM.WR
0001    FMDD            0006    FMDDSS          0000    FMDS
001F    FORCE           02D4    FORSPC          F61A    GCA
F626    GCA0            F634    GCA1            F63F    GCA2
F627    GCAA            FE50    GCP             FE61    GCP1
FF1C    GENVEC          FBDA    GETHEX          FB2C    GETHLP
FB37    GETLIN          F097    GETSEL          FB38    GLIN1
FB50    GLIN4           FBDF    GNUM1           FBE4    GNUM3
F319    GOLD            12DB    GOTO            0009    GPIOCA
```

```
Balcones Operating System for the XEROX 820-II  MACRO-80 3.44   09-Dec-81
The*End

000B    GPIOCB          0008    GPIODA          000A    GPIODB
177B    HELP            001E    HELPKEY         FBF3    HEXBIN
FA3C    HOME            02C9    HOMEUP          001E    HOMSCR
FF59    HRS             F649    ICC             F643    ICCS
F64D    ICCS1           F066    IDLE            FC5A    IN1
FC61    IN2             FC77    IN3             FC79    IN4
13CA    INCMD           F137    INDEX           0016    INSLIN
00E6    INTAB           FF50    INTSTK          112B    IOBDVR
008D    IOBDVS          F770    IOBLOC          0003    IOBYTE
F7AF    IOCONI          F796    IOCONO          F7A3    IOCONS
F7BB    IOLIST          F7CC    IOLSTS          FEEA    IPOINT
F643    ISC             FAD6    JPIX            001F    KBDCTL
001E    KBDDAT          F0D8    KBDIN           F0D5    KBDIN1
F0CD    KBDST           F0E2    KBMASK          0082    KDNLIN
F162    KEY1            F167    KEY2            F17F    KEY3
F184    KEY4            F18F    KEY5            F140    KEYSRV
0081    KUPLIN          FFBD    LAST            F5F0    LASTFM
FE0B    LBL             FE2E    LBL1            FD05    LCP
FD1D    LCP1            FD30    LCP2            FD52    LCP3
FD49    LCPA            FD4B    LCPB            F2B3    LDIR1
F2B5    LDIR2           F2C4    LDIR3           0418    LDIRX
FFB2    LEADIN          000A    LF              02F7    LFEED
FF5C    LINBUF          0388    LIND1           039E    LIND2
039F    LIND3           037C    LINDEL          03B7    LINI1
03C0    LINI2           03CD    LINI3           03A4    LININS
008A    LOCALF          0036    LOWLITE         F333    LSTATT
FD89    LTL             F6F1    LUN             0800    LX1984
021C    M3TST           022B    M4TST           0232    M5TST
F0E3    MASK            FB22    MDATA           FC5B    MDMP1
FC5E    MDMP2           FC63    MDMP3           FC69    MDMP3A
FC71    MDMP3B          12F2    MEMDMP          F236    MILO
F246    MILO1           F250    MILO2           F258    MILL1
F265    MILL2           F278    MILL3           F27C    MILL4
F27E    MILL5           F281    MILL6           F1FD    MILLI
FF50    MILSEC          FF5A    MINS            F5AF    MLU
01DF    MODE            01E1    MODE1           F000    MONITR
FF57    MONTH           00E5    MOVLN           F5C2    MPA
F5D7    MPA1            F5DA    MPA2            F5E6    MPA21
F5E9    MPA22           F606    MPA3            F610    MPA4
F613    MPA5            F559    MTRADR          01B4    MULTI
F6F4    NBLK            0066    NMI             02C0    NONO
0040    NT4             0020    NT5             0010    NT6
0010    NT7             0028    NTRK5           004D    NTRK8
F13F    NULINT          0006    NUMCON          F502    NUMUNT
4000    O.AUTO          0400    O.BAUD          0800    O.DDVR
0020    O.DISK          0010    O.ESCT          0004    O.FILL
2000    O.HELP          0200    O.INPC          0002    O.MOVE
0100    O.OUTC          1000    O.PROT          0040    O.RAMT
8000    O.RESV          0001    O.TERM          0008    O.TYPE
0080    O.VERF          F6F0    OPCODE          FEEC    OPOINT
BFFF    OPTIONS         13F1    OUTCMD          FE9B    OUTCRT
F288    OUTCUR          FC20    OUTPUT          0007    P.ACKN
0000    P.AUTO          0006    P.ONLN          0005    P.RDYI
0004    P.RDYO          0002    P.STRB          F59F    P2L
FB5D    PARA0           FB6C    PARA1           FB71    PARA2
FB76    PARA4           FFB5    PARAM1          FFB7    PARAM2
```

```
Balcones Operating System for the XEROX 820-II  MACRO-80 3.44   09-Dec-81
The*End

FFB9     PARAM3          FFBB     PARAM4          FB5F     PARAMS
000F     PASS8           FA0E     PHYCMD          FA15     PHYDMA
FA10     PHYDRV          FA13     PHYSEC          FA11     PHYTRK
FA0F     PHYUNT          F7F0     PIO1            0010     PIOAD
0011     PIOAS           0012     PIOBD           0013     PIOBS
F7DC     PIOOUT          F7F4     PIOSTO          FCB1     PKI
FCC9     PKI1            FCDF     PKI2            FCF3     PKI3
FCF6     PKI4            FCFE     PKI5            FD06     PKI6
FD0E     PKI7            FD14     PKI8            FD1B     PKI9
FC3D     PNEXT           FE78     PORTS           FD40     PRC
FAAC     PRMT1           FA62     PROMPT          FC68     PROT1
FC6F     PROT2           1459     PROTO           0000     PRS
0002     PRS1            003B     PRS2            0061     PRS3
0070     PRS4            00AC     PRS5            F339     PRVATT
FC1B     PUT2HS          FC03     PUT2HX          FB29     PUT2J
FC16     PUT4HS          FC0C     PUTNIB          FF00     RAM
041B     RBASE           FE6E     RCP             FE73     RCPA
F647     RDC             F605     RDID            F61B     RDID1
F6DC     RDONLY          F4E7     RDOP            FA4A     RDWR
F4FE     RDWRA           F4F6     RDWRS           FA4B     READ
F641     RECAL           F6E9     RECLUN          F130     REMOVE
F6AD     RESET           0C55     RESLEN          F07C     RESTART
FC55     RESTOP          F1EF     RETINS          02F2     RETURN
F0A1     RETV1           F09A     RETVAL          F5F6     RETZR
0191     REV             F1E9     RFI             EE00     RGDBUF
0003     RGLUN           F6E8     RGRECAL         F708     RIGDPB
00B2     RMTALF          00B1     RMTTOG          0000     ROM
1800     ROMSIZ          17E1     ROMTOP          FA08     RQTOP
F5F8     RSE             F603     RSE1            F332     RSTATT
FFE2     RSTHL           FFE4     RSTPC           FFE0     RSTSP
0001     RTK4            0041     RTK5            0061     RTK6
0071     RTK7            1800     RX1984          0005     S.AUTOL
0004     S.AUTOR         0007     S.LECHO         0006     S.RECHO
F4B0     SA1403          F4C0     SASO            F4B2     SASOA
F4F3     SAS1            F4F6     SAS2            0012     SASIC
0010    \SASID           0300     SASIDL          0012     SASIS
F470     SASSTR          F1EC     SAVSTK          0014     SCROLL
009E     SCRPRT          01C3     SEARCH          F4E6     SECLEN
FF5B     SECS            FA3E     SEEK            F5DE     SEEK0
F5EB     SEEK1           F5ED     SEEK2           F5EF     SEEK3
F5A3     SEEKX           0518!    SEGA            F5B9     SEK0
F5C4     SEK1            FA39     SEL1            F578     SEL1W
F585     SEL2            F591     SEL3            F598     SELDEN
F596     SELDNS          F510     SELEC           FA17     SELECT
F50B     SELER1          F42A     SELERR          F360     SELTAB
FA5A     SELTBL          F544     SELUNT          01D4     SETBLI
FD2C     SETBRK          021F     SETCOL          F0A4     SETCON
F284     SETCUR          01DD     SETGRA          01D9     SETINV
01CF     SETLOW          01F7     SETMSK          F337     SETPRV
0210     SETROW          0205     SETXY           0209     SETXY1
FC73     SIGN1           FC81     SIGN2           FC88     SIGN3
FC9E     SIGN3A          FCA6     SIGN4           FC55     SIGNON
F6CE     SIM             EF00     SIOBUF          0006     SIOCPA
0007     SIOCPB          0004     SIODPA          0005     SIODPB
FEE1     SIOI1           F0F0     SIOIN           F0ED     SIOIN1
FED6     SIOINC          FE7F     SIOINP          FE77     SIOINS
```

```
Balcones Operating System for the XEROX 820-II  MACRO-80 3.44   09-Dec-81
The*End

FEC8    SIOIST          F10C    SIOMSK          FE90    SIOOT
FE91    SIOOT1          F0F8    SIOOUT          FEA7    SIOPL
FEBC    SIOPL1          FEC5    SIOPL2          FEC6    SIOPL3
F113    SIORD1          F129    SIORD2          F12C    SIORD3
FE8A    SIORDT          F105    SIORDY          F0E5    SIOST
F10E    SIOVAL          FF00    SIOVEC          F0F9    SIOX1
0031    SLDDEN          FA08    SLERR           0030    SLSDEN
F65A    SMF             F66D    SMF0            F675    SMF0A
F693    SMF1            F6A3    SMF1A           F6BC    SMF1B
F6BE    SMF2            F6D4    SMF4            F6D1    SMFA
F50E    SMFS            F530    SMFS1           F548    SMFS1A
F550    SMFS2           F559    SMFS3           F573    SMFS4
F53D    SMFSA           03D1    SMP             FD4C    SNDLOC
FD5F    SNDRMT          F0D2    SOFT            F069    SOFTV
F6D2    SOM             F6D4    SOM1            FC1E    SPACE
F20E    SPACT           F22D    SPADDR          FFCD    SPARE
FFCB    SPARE1          FFCC    SPARE2          FFD0    SPARND
F224    SPCNT           F500    SSELEC          F0BF    SSP
0000    STACK           1070    START           FEE5    STATUS
F61D    STC             F644    STEPR           FF54    STEPRT
17E1    STOP            F66E    STPADR          02C1    STUFF
FCEE    SWAP            FCFB    SWAP1           0069    SYNC
001D    SYSCTL          001C    SYSPIO          FF18    SYSVEC
031F    TAB             F65F    TDI             F656    TDO
14E2    TERM            FC5E    TERM1           FC68    TERM2
FCA3    TERM3           13FB    TEST            FC5E    TEST1
FC61    TEST2           FC6D    TEST3           FF52    TIKCNT
F192    TIMER           F1B1    TIMER1          F1B9    TIMER2
F1E8    TIMER3          0006    TIMOU           FF55    TIMOUT
0771    TLOC            FEE8    TOPPTR          0299    TPAL
0299    TPAMAX          F6FF    TRKTBL          0100    TRMBUF
EF00    TRMSTK          F6ED    TRN5            F410    TRN6
FFFF    TRUE            F639    TTC             F63A    TTCA
FC5E    TYP0            FC90    TYP1            FCA4    TYP2
1477    TYPE            00FF    TYPTOG          02DC    UPCSR
F048    USRSEC          F31B    USRSTK          FF00    VECTAB
1443    VERCMD          FC5E    VERF1           FC66    VERF2
1315    VIEW            FC55    VIEW0           FC6F    VIEW1
FC89    VIEW2           FC8A    VIEW3           FC8E    VIEW4
FC90    VIEW5           F003    WARM            F35F    WASTED
F669    WCC             0010    WD1797          0010    WDCR
0031    WDDD            0013    WDDT            0030    WDSD
001C    WDSL            0012    WDSN            0010    WDSR
0011    WDTR            F687    WFR             F69A    WFR1
F696    WFRA            FAC9    WHAT            FE41    WLP
F64B    WOC             F64D    WOC1            F650    WOC2
FA44    WRITE           FE34    WUP             0000!   XCKS
0008!   XCKS1           0013    XOFF            F12D    XOFFLG
0011    XON             F115    XONENB          F344    XQDVR
FA51    XQPHYS          F508    XSELERR         FF58    YEAR
EE7D    Z.BAUA          EE7E    Z.BAUB          EE7F    Z.IOBT
EE62    Z.KEYM          EE5F    Z.SCRA          EE63    Z.SIOA
EE6D    Z.SIOB          EE77    Z.SIOM          EE79    Z.SIOV
EE60    Z.STPR          EE7B    Z.XONP


No Fatal error(s)
```

```
..          2433#     2450#     2450      2450      2450#     2450      2460#     2460      2460      2460#     2460      2470#
            2470      2470      2470#     2470      2480#     2480      2480      2480#     2480
.A          1756#
.B          1757#
.C          1758#
.D          1759#
.E          1761#
.F          1762#
.G          1763#
.H          1764#
.I          1766#
.J          1767#
.K          1768#
.L          1769#
.M          1771#
.N          1772#
.O          1773#
.P          1774#
ABORT         96#      815
ABOVE        177#      562       681       1701      1737      2415      3126      3142      3237      4872
ADDRH       2852      3035#
ADDRL       3036#
ALL00       1803#     1820
ALL01       1804#     1825
ALL02       1805#     1830
ALL03       1806#     1835
ALL04       1807#     1840
ALL05       1808#     1845
ALL06       1803#     1850
ALL07       1810#     1855
ASYNC         73#      526
ATTRIB      1179      1266      4952#
AUTOBT      3251#
AVAILB       446      4919#
AVAILT      4920#
B.BSY       2514#
B.CD        2516#     2943
B.IO        2518#
B.MSG       2515#     2922
B.PAR       2520#     2940
B.REQ       2517#     2938
B.RST       2521#     2978
B.SEL       2519#     2871
BAKSPC      1345      1445#
BASE        1132      1496      1508      1564      1571      1592      1623      4702      4950#
BAUD        3303      4047#
BAUD1       4053      4055#
BAUD2       4057      4059#
```

```
BAUDA         45#     523    3941    4056
BAUDB         54#     507    3943    4058    4335
BBASE        243      263#    266
BBG         1503     1588    1616    1692#
BELL        1344     1529#
BELL1       1530#    1537
BELLOF        66#    1533
BELLON        67#    1530
BELOW        171#     269    1162    4866
BLOC         227#     271     563#   1164    1702#   3572    3663    3787    3958    3977    4003    4047
            4073     4135    4170    4190    4233    4254    4273    4299    4327    4387    4820    4861
            4868     4873#   4881
BLOCAD      3554#    4259    4278
BLOCK       3304     4254#
BLOFC        102#    1534
BLONC        101#    1531
BLTIM        100#    1529
BNDRY       1742#    1743    1744    1744
BOOT        3302     3313    3787#
BOOT1       3790#    3795
BOOT2       3793     3801#
BOOT3       3825     3834#
BOOTBF        35#     132    3150    3834    3838    3902    3907    3910
BOOTD       3803     3863#
BOOTER      3808     3861#
BOOTLD        34#    3837    3853
BOOTS       3823     3855#   3899
BOTPTR      4586     4595    4643    4652    4658    4662    4806#
BRKFLG      4457#    4511    4513
BRKKEY      4402#    4509
BSEG         191#     239     270    1163    4867
BSPACE       231#     270     270     270#    563     563     563#    682     682    1163    1163    1163#
            1702     1702    1702#   1738    1738    2416    2416    3127    3127    3143    3143    3238
            3238     3572    3572    3663    3663    3787    3787    3958    3958    3977    3977    4003
            4003     4047    4047    4073    4073    4135    4135    4170    4170    4190    4190    4233
            4233     4254    4254    4273    4273    4299    4299    4327    4327    4387    4387    4820
            4820     4861    4861    4867    4867    4867#   4873    4873    4873#   4878    4878
BUFTOP      4410#    4679    4697
C.8IN       2008#    2147    2187    2327
C.FIVE        80#    3593    3596
C.FLAW      2547#
C.FLPY      2556#    3028
C.FMAT      2544#    2887
C.FTRK      2546#
C.INIT      2552#
C.KEYM        78#
C.READ      2548#    2605    2747    3015
C.RECAL     2541#    2862    3025
C.RQSN      2543#
```

```
C.RSYN     2542#
C.SASI       79#    3601
C.SEEK     2551#
C.TRAM     2573#
C.TRDY     2540#
C.TWO      2009#
C.VTRK     2545#
C.WRIT     2550#    2603     2633
C.WRPR     2549#
CCA         957     1131#    1298     1615
CCA1       1134#    1646
CCA2       1135#    1136     1643
CCS         328      359      370#
CCS1        371#     378
CDD        2691     2740#
CDD0       2743     2745#
CDD1       2750#    2753
CDD2       2751     2754#
CFINIT      437#     443
CFT        2876     2935     2957#
CFTA       2959#    2960     3054
CHECK      3330#    4035     4214     4282
CHK00      1794#    1820
CHK01      1795#    1825
CHK02      1796#    1830
CHK03      1797#    1835
CHK04      1798#    1840
CHK05      1799#    1845
CHK06      1800#    1850
CHK07      1801#    1855
CHRDEL     1398     1672#
CHRIN1     1661#    1665
CHRIN2     1660     1666#
CHRINS     1400     1652#
CHROM1       70#    1249
CHROM2       71#    1242     1246
CHRSAV     1168     1194     4953#
CLOC        366     3268     3570#    3572     3572     3573     3663     3663     3663     3663     3664     3778
           3787     3787     3787     3788     3958     3958     3958     3958     3959     3977     3977     3977
           3978     4003     4003     4003     4004     4047     4047     4047     4048     4073     4073     4073
           4074     4135     4135     4135     4136     4170     4170     4170     4171     4190     4190     4190
           4191     4233     4233     4233     4234     4254     4254     4254     4255     4273     4273     4273
           4274     4299     4299     4299     4300     4327     4327     4327     4328     4387     4387     4387
           4388     4820     4820     4820     4820     4821     4861     4861     4861     4862     4867     5007
CLR1       1554#    1556
CLRBRK     4459     4512#
CLRCHR     4392#
CLREOL     1361     1397     1546#    1569
CLREOS     1354     1396     1569#
```

```
CLRLIN     1504    1542#    1580     1607
CLRS         90#   3618     4337     4427
CLRS1      1571#   1581
CLRS2      1578    1582#
CLRSCN     1363    1410     1562#
CMDSIZ     3328#
CMDTAB      364    3260     3301#    3328
CNFDPB     3057    3062     3075     3116#
COLD        564#
COMINP      595    3677#    3679     3725
COMINS      594    3670#    3717
COMOTS      597    3685     3693#    3744
COMOUT      596    3685#    3686     3708     3734
COMRES      234#    240      267#     270      563#    1163     1702#    4867     4873#
COMROM      240#    270#    1163#    4867#
CONFG       623#   3580
CONFIG      584     620#
CONIN       567#   3437     3440     3525     3656     4013     4147     4366     4460
CONIOB     3701#   3707     3716     3724
CONOUT      568#   3430     3433     3511     3528     3548     4014     4360     4363     4368     4373
CONST       566#   3435     3654     4364     4448
CONTBL      436     655     4965#
CONTRL     1191    1325#
CPB        3060    3074#
CPB1       3077    3081#
CPB2       3083#   3093
CPB3       3102#   3113
CR           86#    995     3244     3252     3353     3361     3386     3388     3438     3441     3537     3629
           3635    3643     3650     3792     3794     3796     4007     4026     4028     4150     4354     4361
           4369    4443     4538     4544     4550     4556     4827     4832     4836     4841     4847
CRLF       3282    3341     3443     3536#    4090     4142
CRTBAS       40#   1137     1465     1477     4708
CRTD1      1179#   1315
CRTD2      1173    1178     1191#
CRTD3      1186    1190     1192#
CRTD4      1203    1206#
CRTDVR     1117    1167#
CRTLDIR     581    1041#    3852     4089
CRTMAX       39#     41      308
CRTMEM       38#     39       40      305      307      308      385      426      428     1562
CRTMV      1045    1077#
CRTMVO     1071    1073     1078#
CRTOF1     1020#
CRTOFF      832    1018#    1078     1119     3278     3576
CRTON       940    1010     1027#    1044     1115     3275
CRTON1     1022#   1030
CRTOUT      568    1091#
CRTSTK     1042    1110     4975#
CRTTOP       41#   1467     1475
```

```
CSPACE     232#     270     563     563     682     682    1163    1163    1702    1702    1738
          1738     2416    2416    3127    3127    3143    3143    3238    3238    3572    3572    3572#
          3663     3663    3663#   3663#   3787    3787    3787#   3787#   3958    3958    3958#   3958#
          3977     3977    3977#   3977#   4003    4003    4003#   4003#   4047    4047    4047#   4047#
          4073     4073    4073#   4073#   4135    4135    4135#   4135#   4170    4170    4170#   4170#
          4190     4190    4190#   4190#   4233    4233    4233#   4233#   4254    4254    4254#   4254#
          4273     4273    4273#   4273#   4299    4299    4299#   4299#   4327    4327    4327#   4327#
          4387     4387    4387#   4387#   4820    4820    4820#   4820#   4861    4861    4861#   4861#
          4867     4867    4867#   4873    4873    4878    4878
CSRCHR    1195     1317    1320    4948#
CTC         57#
CTC0        58#     476
CTC1        59#     480     675     991
CTC2        60#     484
CTC3        61#     488
CTCVEC     409      478    4900#
CTLSIZ    1370#
CTLTAB    1330     1342#   1370
CURSOR     425     1167    1192    4703    4947#
CWP       2617     3004#
DAY        615     4937#
DAYTI      583#    2089    3052
DAYTIM     583      615#
DBL       4477     4640#
DCTRL     2683     2735    3038#
DEBUG       25#      29      30     123     128
DEFCUR    1342     1434#
DEFLPY    2837     3028#
DEFLUN    2785     2828    3029#
DELLIN    4391#
DIRBUF    1793#    1819    1824    1829    1834    1839    1844    1849    1854
DIRCUR    1005     1011    1014    4949#
DIS1      1266#
DISATR    1265#    1412
DLN       4609#    4646
DLN1      4613#    4615
DLN2      4614     4616#
DLN3      4620#    4635
DLN4      4624     4630#
DLOC       228#     564     682#    683    1163#   1703    1738#   1739    2416#   2417    3123#   3123
          3124     3127#   3128    3143#   3144    3238#   3239    3572#   4874    4878#   4881
DMPFMT    3417     3419    3421    3515#
DNCSR     1472#    1495    1579
DOC       4533     4537    4543    4561#
DPB5D     1943#
DPB5S     1923#    3603
DPB8D     1901#
DPB8S     1882#    2388    2727
DPBASE    1817#    2100    2677    3099
```

```
DPBOFS    2011#    2109
DPBRG4    1839     2450#    3095     3100
DPBRG5    1844     2460#
DPBRG6    1849     2470#
DPBRG7    1854     2480#
DPM        874      905#
DRVTAB    1720     1782#
DSK0      4080     4092#
DSK1      4078     4095#
DSK3      4113     4115#
DSKCMD    3319     3324     4073#
DSKDVR    1783     2018#    3048
DSKERR    4109     4120#
DSM4      2450#    2452     2453
DSM5      2460#    2462     2463
DSM6      2470#    2472     2473
DSM7      2480#    2482     2483
DSPACE     233#     270      563      563#     682      682#     682#    1163     1163#    1702     1702#    1738
          1738#    1738#    2416     2416#    2416#    3127     3127#    3127#    3143     3143#    3143#    3238
          3238#    3238#    3572     3572#    3663     3787     3958     3977     4003     4047     4073     4135
          4170     4190     4233     4254     4273     4299     4327     4387     4820     4861     4867     4873
          4873#    4878     4878#
DSW       2169     2270#
DTL       4489     4600#
DTYPE     2324     2384#
DUMP      3412#    3447     3996     4118
DUMP2     3416#    3425
DUMP3     3429#    3434
DUMP4     3436     3443#
DVRLMT    3129#
EATKEY    3654#    3657
ECHO      3357     3525#    4006     4025
ECR       2915     2920     2923     2925     2949#
EIRET      641#
ENATR     1263#    1411
ENTRY      241#     264     5025
EOT         84#    3246     3296     3337     3376     3537     3546     3652     3867     3930     4123     4354
          4444     4472     4484     4641     4724     4849
ERR        383      385#
ERR1       318      320      382#
ERR2       329      384#
ERR3       388#     391
ERRM1      382      394#     400
ERRM2      384      397#
ERRML      385      386      400#
ESC         89#    3619     3926     3928     4339     4429     4472     4484     4641     4722
ESCADR    1396#
ESCAPE    1364     1422#
ESCTAB    1222     1377#    1394
```

```
ESCTBL    1223    1394#
EXPVEC    4915#
FALSE       23#     25
FALUN     2525#   2762    2764
FASTCRT    569    1096    1109#   3710    3738    4082    4755
FBLUN     2526#   2763
FCLUN     2527#
FDLUN     2528#   2765
FIFCNT     417     689     769     814    4907#
FIFIN      823    4908#
FIFO       774    4906#
FIFOUT     771    4909#
FILL      3307    4233#
FILL1     4238#   4244
FIRST     2669    3045#   3050
FIRST1    3057#   3066
FIRST2    3061    3069#
FLOP1     2025#   2080
FLOP2     2042    2046    2048#
FLOP3     2060    2063#
FLOP4     2069#   2072
FLOP5     2029    2035    2075#
FLPFRM    2836    3031#
FM.DD     2001#   2003    2370    2391
FM.DDDS   2568#   2702    2765
FM.DDSS   2003#   2325
FM.DS     2000#   2379
FM.FV     2002#   2329    2394
FM.HARD   2569#   2766    2767    2768    2769    2805    3005
FM.SDDS   2566#   2763
FM.SDSS   2565#   2762
FM.SZ     2562#   2705
FM.UN     1999#   2003    2366    2367    2371
FM.WR     2563#
FMDD      2561#   2703    2709
FMDDSS    2567#   2764    2807
FMDS      2560#   2686    2817
FORCE     4394#   4626
FORSPC    1349    1453#
GCA       2860#   2889
GCA0      2864    2866#
GCA1      2873#   2877
GCA2      2875    2878#
GCAA      2866    2867#   3055
GCP       4469    4481    4702#
GCP1      4711#   4712
GENVEC    4902#
GETHEX    3395    3456#
GETHLP    3351#   3359
```

```
GETLIN    3249       3356#
GETSEL     582        630#
GLIN1     3357#      3369       3380
GLIN4     3364       3373#
GNUM1     3459#      3469
GNUM3     3464#
GOLD      1122#      1170       1276       1318       1498       1666       1682
GOTO      3308       3958#
GPIOCA      51#       531
GPIOCB      53#       536
GPIODA      50#      3755
GPIODB      52#       541       3756       3758       3760       3768
HELP      3301       4820#
HELPKEY     94#      3358       3526
HEXBIN    3467       3476#      4016       4029
HOME       574       3186#      3820
HOMEUP    1367       1440#
HOMSCR    4393#      4472       4484
HRS       4940#
ICC       2293       2298#
ICCS      2622       2748       2838       2886#      2986
ICCS1     2891#      2894
IDLE       598#       702        722        732       2305       2957
IN1       4142#      4159
IN2       4145#      4149
IN3       4151       4156#
IN4       4153       4158#
INCMD     3310       4135#
INDEX      772#       824
INSLIN    4390#
INTAB      330        404#
INTSTK     796        841        922       4926#
IOBDVR    3663#      3848
IOBDVS     447       3775#      3778       3850
IOBLOC     447       2413#      3666       3775       3849
IOBYTE      33#      3701       3732       3742       3898       3949
IOCONI     590       3724#
IOCONO     591       3707#
IOCONS     589       3716#
IOLIST     592       3732#
IOLSTS     593       3742#
IPOINT    4770       4778       4787       4809#
ISC       2218       2291#      2344       2363
JPIX      3289       3299#      3970
KBDCTL      65#       469
KBDDAT      64#       349        800
KBDIN      567        703#      3727
KBDIN1     702#       704
KBDST      566        689#       703       3719
```

```
KBMASK      708#    3681
KDNLIN     4397#    4479
KEY1        806      812#
KEY2        803      814#
KEY3        816      827#
KEY4        829#     831
KEY5        811      813      821      826      834#
KEYSRV      406      794#
KUPLIN     4396#    4467
LAST       3983     3997     4961#
LASTFM     2684     2831#    2832     2952
LBL        4488     4657#
LBL1       4667     4672#
LCP        3847     3897#
LCP1       3903     3908#
LCP2       3915     3918#
LCP3       3933#    3939
LCPA       3922     3927#
LCPB       3924     3929#
LDIR1      1047#    1075
LDIR2      1046     1048#
LDIR3      1053     1055#
LDIRX      1684     1695#
LEADIN     1171     1325     4951#
LF           85#     993     3244     3537     3629     3630     3635     3643     3650     4354     4362     4371
           4400     4443     4542     4554     4569     4575     4827     4832     4837     4841     4848
LFEED      1189     1347     1489#
LINBUF     1057     1065     1693     3247     3251     3283     3352     3354     3789     4076     4111     4580
           4672     4946#
LIND1      1593#    1603     1605
LIND2      1595     1606#
LIND3      1607#    1638
LINDEL     1399     1587#
LINI1      1624#    1635
LINI2      1627     1629#
LINI3      1625     1636#
LININS     1401     1613#
LOCALF     4400#    4499
LOWLITE      72#    1239
LSTATT     1147#    1154
LTL        4476     4574     4580#
LUN        2784     3034#
LX1984       32#     358      361
M3TST      1288     1300#
M4TST      1301     1312#
M5TST      1313     1317#
MASK        620      709#    1174     1274
MDATA      3333     3341#    4005
MDMP1      3983#
```

```
MDMP2      3980     3984#
MDMP3      3982     3987#
MDMP3A     3991#    3993
MDMP3B     3985     3996#
MEMDMP     3305     3977#
MESSAGE    4991#    5011     5012     5013     5014     5015     5016     5017     5018     5019     5020     5021
           5022
MIL0        944      953#
MIL01       964#     969
MIL02       968      970#
MILL1       952      975#
MILL2       937      982#
MILL3       989      993#
MILL4       984      995#
MILL5       994      996#
MILL6       932      935      981      998#
MILLI       410      920#
MILSEC      925      927     4930#
MINS       4941#
MLU        2609     2670     2778#
MODE       1247     1250#
MODE1      1244     1251#
MONITR       37#     228      310      354      355     3572     3663     3787     3845     3958     3977     4003
           4047     4073     4135     4170     4190     4233     4254     4273     4299     4327     4387     4411
           4820     4861     4875     4881
MONTH      4938#
MOVLN       243      266#
MPA        2620     2745     2801#
MPA1       2808     2814#
MPA2       2812     2816#
MPA21      2821     2823#
MPA22      2818     2826#
MPA3       2835     2840#
MPA4       2847#    2848
MPA5       2806     2849#
MTRADR     2091     2132     2133#    2152
MULTI      1211#    1326
NBLK       3037#
NMI        1983#    2261     2264     2280
NONO       1351     1352     1353     1355     1356     1357     1358     1359     1360     1362     1365     1366
           1424#
NT4        2428#    2450     2450
NT5        2429#    2460     2460
NT6        2430#    2470     2470
NT7        2431#    2480     2480
NTRK5      2006#    2190
NTRK8      2005#    2188
NULINT      588      598      778#
NUMCON      435      443#     648     4965
```

```
NUMUNT   2653#
O.AUTO    107#    128
O.BAUD    111#   4041
O.DDVR    110#    123    3783
O.DISK    116#    124    4066
O.ESCT    117#    123     128    1218    1341    4338    4428    4471    4483
O.FILL    119#    125    4229
O.HELP    108#   4815
O.INPC    112#   4129
O.MOVE    120#   3551    4250
O.OUTC    113#   4164
O.PROT    109#   4295
O.RAMT    115#    126    4184
O.RESV    106#    124
O.TERM    121#   3637    4379
O.TYPE    118#   3645    4323
O.VERF    114#    125    3551    4269
OPCODE   2606    2621    2632    2746    3014    3033#
OPOINT   4775    4786    4801    4810#
OPTIONS   123#    124#    124     125#    125     126#    126     128#   1218    1341    3551    3637
         3645    3783    4041    4066    4129    4164    4184    4229    4250    4269    4295    4323
         4338    4379    4428    4471    4483    4815
OUTCMD   3316    4170#
OUTCRT   4565    4627    4632    4754#
OUTCUR    580    1010#
OUTPUT   3500    3511#   4222
OVERLAY   183#   3571    3662    3786    3957    3976    4002    4046    4072    4134    4169    4189
         4232    4253    4272    4298    4326    4386    4819    4860
P.ACKN    146#
P.AUTO    151#    542
P.ONLN    147#
P.RDYI    148#
P.RDYO    149#   3770
P.STRB    150#    542    3757    3759
P2L      2762#   2778
PARA0    3383#   3389
PARA1    3390#   3403    3405
PARA2    3394#
PARA4    3397#
PARAM1   3286    3397    4099    4957#
PARAM2   3287    4958#
PARAM3   3288    4959#
PARAM4   3969    4116    4960#
PARAMS   3284    3384#
PASS8    4389#
PHEX     2583#   3046
PHYCMD   3145#   3223    3856
PHYDMA   3150#   3215
PHYDRV   3147#   3161    4100
```

```
PHYSEC    3149#    3214
PHYTRK    3148#    3193     3832
PHYUNT    3146#
PIO1      3762#    3763
PIOAD     2502#    2506
PIOAS     2501#    2502     2503     2504     2999
PIOBD     2504#    2507     2508
PIOBS     2503#    2975     2977
PIOOUT    3735     3752#    3753
PIOSTO    3745     3752     3768#
PKI       4449     4456#
PKI1      4462     4467#
PKI2      4468     4479#
PKI3      4476     4490#
PKI4      4480     4491#
PKI5      4492     4495#
PKI6      4496     4499#
PKI7      4500     4503#
PKI8      4494     4498     4502     4506#
PKI9      4504     4509#
PMSG      2577#    3048
PNEXT     3243     3292     3334     3374     3536     3542#    3549     3617     3861     3925     4120     4336
          4426     4470     4482     4640     4721     4822
PORTS     4424     4517     4729     4730#
PRC       4451     4530#
PRINTX    4999#
PRMT1     3267     3281#
PROMPT     565     3241#    3253     3290     3297
PROT1     4302     4312#
PROT2     4315     4317#
PROTO     3317     4299#
PRS        276#     326      392      611
PRS1       278#     279
PRS2       311#     324
PRS3       331#     340
PRS4       342#     348
PRS5       360      368#
PRVATT    1153#    1155
PUT2HS    3344     3424     3505#    3971     4144     4146
PUT2HX    3488#    3503     3505
PUT2J     3339     3344#
PUT4HS    3342     3413     3502#    3972
PUTNIB    3493     3495#
RAM         36#     355      448     4894     4970     5007
RBASE      353     4868#
RCP       4490     4721#
RCPA      4716     4723#
RDC       2018     2149     2225     2294#    2354
RDID      2234     2243#    2375
```

```
RDID1     2251     2255#
RDONLY    3008#    3068
RDOP      2021     2056#
RDWR      3200     3213#
RDWRA     2063     2071#
RDWRS     2065#    2199
READ       576     3204#    3835     3908
RECAL     2236     2286#    2334
RECLUN    3026#
REMOVE     706      769#
RESET     2860     2950     2972#    2983
RESLEN    4875#
RESTART    564      607#
RESTOP    4874#
RETINS     827      901#
RETURN    1350     1482#    1542     1692
RETV1      636      640#
RETVAL     616      626      634#
RETZR     2228#    2323     2337
REV         16#     625     3623     3623     3623
RFI        835      896#     998
RGDBUF    2497#    3074     3119
RGLUN     2529#    2766     2767     2768     2769
RGRECAL   2985     3025#
RIGDPB    2412#    3602
RMTALF    4399#    4503
RMTTOG    4398#    4495
ROM         29#     227      563     1702     4873     4887     4888     5003
ROMSIZ      30#     244      327     4887     4888     5003
ROMTOP    4881#    4887     4888     5003
RQTOP     3131#
RSE       2213     2233#
RSE1      2235     2238#
RSTATT    1146#    1343
RSTHL      281     4978#
RSTPC      283     4979#
RSTSP      280     4977#
RTK4      2450#    2458
RTK5      2460#    2468
RTK6      2470#    2478
RTK7      2480#    2488
RX1984      31#     357      361      367
S.AUTOL   4406#    4501     4540
S.AUTOR   4407#    4505     4552
S.LECHO   4404#    4464     4493
S.RECHO   4405#    4497     4531
SA1403    2595#    3058
SASO      2604     2606#
SASOA     2596#    2643
```

```
SAS1       2634      2637#
SAS2       2618      2636      2638#
SASIC      2507#     2872      2879      2979      2981
SASID      2506#     2870      2890
SASIDL     3121#     3123      3604
SASIS      2508#     2873      2921      2937
SASSTR     2420#     3121
SAVSTK      795       840       899#      921
SCROLL       56#      304      1509      1565
SCRPRT       95#      802
SEARCH     1224#
SECLEN     2631#     2801
SECS        857      4942#
SEEK        575      3192#
SEEK0      2215#     2227
SEEK1      2214      2222#
SEEK2      2221      2223#
SEEK3      2211      2225#
SEEKX      2033      2178#
SEGA        241#      271#     1164#     4868#
SEGMENT     199#      270       563       682      1163      1702      1738      2416      3127      3143      3238      3572
           3663      3787      3958      3977      4003      4047      4073      4135      4170      4190      4233      4254
           4273      4299      4327      4387      4820      4861      4867      4873
SEK0       2189      2191#
SEK1       2185      2194      2199#
SEL1       3160      3177      3181#
SEL1W      2151#     2159      2163
SEL2       2159#     2160      2162
SEL3       2144      2148      2164#
SELDEN     2130      2169#
SELDNS     2168#     2180
SELEC      2023      2085#
SELECT      573      3158#     3811
SELER1     2661#
SELERR     1782      1873#     2087      2105
SELTAB      365       630      1713      1754#     3608      3878
SELTBL     3162      3231#
SELUNT     2028/     2120#     2322
SERVICE     785#      794       839       920
SETBLI     1242#     1405      1407
SETBRK     4515      4517#
SETCOL     1302#
SETCON      586       646#
SETCUR      579      1005#
SETGRA     1249#     1406
SETINV     1246#     1404
SETLOW     1152      1239#     1403
SETMSK     1271#     1408      1409
SETPRV     1151#     1240      1251
```

```
SETROW      1292#     1441
SETXY       1283#     1402
SETXY1      1215      1287#
SIGN1       3591#     3591
SIGN2       3595      3598#
SIGN3       3582      3601#
SIGN3A      3610#     3615
SIGN4       3578      3600      3607      3617#
SIGNON       368      3575#
SIM         2749      2906      2913      2993#
SIOBUF      4411#     4412      4774      4800      4809      4810
SIOCPA        48#      513      3670      3677      3693      4420
SIOCPB        49#      495       714       741       742      4423
SIODPA        46#     3680      3688      4420
SIODPB        47#      725       735       949       996      4423
SIOI1       4799      4801#
SIOIN        571       723#      754      3728      4358
SIOIN1       722#      724
SIOINC      4530      4795#     4796
SIOINP      4735#     4736
SIOINS      4729#     4735      4742      4764
SIOIST      4450      4785#     4795
SIOMSK       437       744#     3945      4308
SIOOT       4526      4549      4555      4746#
SIOOT1      4747#     4748
SIOOUT       572       730#     3712      3737      4367      4372
SIOPL       4754      4757      4763#     4785
SIOPL1      4773      4775#
SIOPL2      4777      4779#
SIOPL3      4765      4780#
SIORD1       747       750#
SIORD2       757       761#
SIORD3       753       759       762#
SIORDT      4742#     4747
SIORDY       585       731       740#      934      3746
SIOST        570       714#      723       752      3720      4356
SIOVAL       438       746#     3947      4311
SIOVEC       499      4899#
SIOX1        731#      733
SLDDEN        69#
SLERR       3133#
SLSDEN        68#
SMF         2103      2322#
SMF0        2328      2330#
SMF0A       2334#     2368
SMF1        2348#     2353
SMF1A       2351      2356#
SMF1B       2365      2370#
SMF2        2360      2371#
```

```
SMF4     2376    2378    2383#
SMFA     2126    2380    2381#
SMFS     2655    2669#
SMFS1    2689#   2704    2706
SMFS1A   2701    2703#
SMFS2    2695    2707#
SMFS3    2710    2712#
SMFS4    2699    2733#
SMFSA    2689    2697#
SMP      1593    1629    1642#
SNDLOC   4465    4537#
SNDRMT   4463    4532    4549#
SOFT      599     695#
SOFTV     599#   2079    2642
SOM      2868    2998#
SOM1     2994    2999#
SPACE    3414    3426    3509#   3517
SPACT     671     804     808     929#    976     983
SPADDR    947#    975
SPARE    4970#
SPARE1    441    4967#
SPARE2    442    4968#
SPARND   4972#
SPCNT     673     810     942#    945     971
SSELEC   2599    2651#
SSP       587     670#    812
STACK     325    3242    4982#
START    3572#
STATUS   4446    4804#
STC      2068    2244    2260#
STEPR    2292#   2333
STEPRT    440    3599    3920    4932#
STOP     4861#
STPADR   2093    2330    2331#
STUFF    1368    1428#
SWAP     3807    3876#
SWAP1    3885#   3892
SYNC       74#
SYSCTL     63#    458     464    3585    3587
SYSPIO     62#    461     608     610     851     853     938     980    1019    1022    1028    1048
         1061    1063    1074    1112    1254    1258    2510#   3272    3588    3592
SYSVEC    405     471    4901#
TAB      1346    1515#
TDI      2635    2906#
TDO      2637    2899#
TERM     3309    4387#
TERM1    4418    4420#
TERM2    4422    4424#
TERM3    4448#   4452
```

```
TEST      3325    4190#
TEST1     4199#   4223
TEST2     4201#   4208
TEST3     4211#   4219
TIKCNT     844     846    4931#
TIMER      412     839#
TIMER1     850     854#
TIMER2     858#    863
TIMER3     860     867     882     888     892#
TIMOU     2010#   2131    2155
TIMOUT     848    4933#
TLOC       229#   3572#   3572    3572    3663#   3663    3663    3787#   3787    3787    3958#   3958
          3958    3977#   3977    3977    4003#   4003    4003    4047#   4047    4047    4073#   4073
          4073    4135#   4135    4135    4170#   4170    4170    4190#   4190    4190    4233#   4233
          4233    4254#   4254    4254    4273#   4273    4273    4299#   4299    4299    4327#   4327
          4327    4387#   4387    4387    4820#   4820    4820    4861#   4861    4861    4881
TOPPTR    4581    4585    4600    4604    4664    4668    4671    4807#
TPAL       230#   3663    3663#   3787    3958    3958#   3977    4003    4047    4073    4135    4170
          4190    4233    4254    4273    4299    4327    4387    4820    4820#   4861    4862    4867
          5007
TPAMAX    3270    4862#
TRKTBL    2122    2408#
TRMBUF    4409#   4410    4684    4691    4806    4807
TRMSTK    4412#   4425
TRN5      2393    2402#
TRN6      1865#   2396    2711
TRUE        22#     23
TTC       2073    2249    2278#
TTCA      2262    2279#
TYP0      4330    4336#
TYP1      4356#   4365    4370    4374
TYP2      4357    4364#
TYPE      3321    4327#
TYPTOG    4401#   4491
UPCSR     1348    1462#
UPDATE     208#    270     563     682    1163    1702    1738    2416    3127    3143    3238    3572
          3663    3787    3958    3977    4003    4047    4073    4135    4170    4190    4233    4254
          4273    4299    4327    4387    4820    4861    4867    4873    4877
USRSEC     588#    847
USRSTK    1041    1079    1109    1123    1124#   1501
VECTAB     351    4898#
VERCMD    3323    4273#
VERF1     4281#   4289
VERF2     4279    4287#
VIEW      3306    3314    4003#
VIEW0     4005#   4039
VIEW1     4012    4016#
VIEW2     4027    4033#
VIEW3     4015    4034#
```

```
VIEW4     4008      4036#
VIEW5     4010      4038#
WARM       565#      833      3655      3846
WASTED    1741#
WCC       2754      2839      2900      2902      2908      2913#     2987
WD1797      55#     3590      3598
WDCR      1988#     2267      2298      2346
WDDD      1994#     2171      2338
WDDT      1991#     2216      2266      2342
WDSD      1993#     2173      2361
WDSL      1992#     2136      2141      2186      2203      2207      2326      2372      2374
WDSN      1990#     2048
WDSR      1987#     2157      2164      2306      2349
WDTR      1989#     2209      2253
WFR       2750      2891      2899      2907      2914      2919      2935#     2939
WFR1      2936      2941      2945#
WFRA      2942#
WHAT      3250      3256      3292#     3311      3312      3315      3318      3320      3322      3326      3327
WLP       4603      4661      4670      4689#
WOC       2282      2302#
WOC1      2303#     2304
WOC2      2305#     2308
WRITE      577      3199#
WUP       4584      4594      4651      4678#
XCKS       243#
XCKS1      246#      253
XOFF        88#      756       758
XOFFLG     761       763#
XON         87#      758
XONENB     439       751#     3918      4317
XQDVR      578      1709#     3225
XQPHYS    3173      3223#     4106      4115
XSELERR   2660#
YEAR      4939#
Z.BAUA     140#      141      3940
Z.BAUB     141#      142      3942
Z.IOBT     142#     3948
Z.KEYM     134#      135      3923
Z.SCRA     132#      133      3921
Z.SIOA     135#      136      3931
Z.SIOB     136#      137
Z.SIOM     137#      138      3944
Z.SIOV     138#      139      3946
Z.STPR     133#      134      3919
Z.XONP     139#      140      3913
```

## Notes

```
                                Title   Quick, Fast Cold Start Loader

                        ;;;     Quick, Fast Cold Start Loader.
                        ;
                        ;       Copyright (C) 1982, Balcones Computer Corporation.
                        ;
                                .z80

F02A                    Xqdvr   equ     0f02ah          ;Physical Driver Executioner
0004                    cdisk   equ     00004h          ;current user/disk

0000'                           cseg
0000'                   bios    equ     $               ;origin of bios above ccp & bdos

                                .phase  80h

0080                    phycmd  equ     $
0081                    phyunt  equ     $+1
0082                    phydrv  equ     $+2
0083                    phytrk  equ     $+3
0085                    physec  equ     $+5
0087                    phydma  equ     $+7

                        ;;      quick, fast loader.
                        ;
                        ;       Entry:  A =  Sectors per Track
                        ;               DE = Address of Physical Command Block that loaded QFD
                        ;
0080    EB              qfs:    ex      de,hl           ;transfer command block
0081    01 0005                 ld      bc,physec-phycmd
0084    ED B0                   ldir                    ;woe be unto he who changes qfs
0086    21 00D5                 ld      hl,ldrtbl-5     ;set loader control table address
0089    0E 05                   ld      c,5             ;set table entry size
008B    09              qfsl:   add     hl,bc           ;advance table address
008C    BE                      cp      (hl)            ;match with loader control table entry
008D    38 FC                   jr      c,qfsl          ;if match not found yet
008F    C0                      ret     nz              ;if entry not in table
0090    23                      inc     hl
0091    4E                      ld      c,(hl)          ;set track offset+1
0092    23                      inc     hl
0093    ED A0                   ldi                     ;move starting sector, adjust track offset
0095    AF                      xor     a
0096    12                      ld      (de),a          ;clear upper sector
0097    7E                      ld      a,(hl)          ;set number of sectors
0098    23                      inc     hl
0099    6E                      ld      l,(hl)          ;set (sector size)/4-1
009A    23                      inc     hl              ;sector size / 4
009B    29                      add     hl,hl
009C    29                      add     hl,hl
009D    EB                      ex      de,hl           ;set sector size in DE
009E    2A 0083                 ld      hl,(phytrk)     ;add track offset
00A1    09                      add     hl,bc
00A2    22 0083                 ld      (phytrk),hl
00A5    47                      ld      b,a             ;set number of sectors
00A6    7A                      ld      a,d             ;check sector size
00A7    21 FF80'                ld      hl,bios-80h     ;set starting address
```

```
00AA    B7                        or      a
00AB    20 01                     jr      nz,qfs3           ;if big sectors
00AD    19               qfs2:    add     hl,de             ;advance transfer address
00AE    22 0087          qfs3:    ld      (phydma),hl
00B1    D9                        exx                       ;switch register sets
00B2    21 0080                   ld      hl,phycmd or qfs;set physical command address
00B5    CD F02A                   call    Xqdvr             ;execute driver read
00B8    21 0085                   ld      hl,physec         ;advance sector
00BB    34                        inc     (hl)
00BC    D9                        exx                       ;switch back
00BD    B7                        or      a
00BE    C0                        ret     nz                ;if boot error
00BF    10 EC                     djnz    qfs2              ;if cold start not complete
00C1    32 0004                   ld      (cdisk),a         ;start out in A: user 0
00C4    21 0003'                  ld      hl,bios+3         ;warm start after signon
00C7    E5                        push    hl
00C8    21 00F6                   ld      hl,sernum
00CB    11 00DA                   ld      de,ldrtbl
00CE    0E 0A                     ld      c,sernml
00D0    ED B0                     ldir
00D2    12                        ld      (de),a
00D3    13                        inc     de
00D4    3E C9                     ld      a,0c9h
00D6    12                        ld      (de),a
00D7    CD 0000'                  call    bios              ;execute cold start loader

                         ;;       Loader Control Table.
                         ;
                         ;        Entries Must be in sort order
                         ;
                         ;        db      sectors per track
                         ;                offset+1 from boot track
                         ;                starting bios sector
                         ;                number of bios sectors
                         ;                sector size/4-1
                         ;
00DA    34 02 16 04      ldrtbl: db       52,1+1,22,4,256/4-1      ;8" Double Density
00DE    3F
00DF    22 03 05 04               db      34,2+1,05,4,256/4-1      ;5" Double Density
00E3    3F
00E4    1A 02 14 07               db      26,1+1,20,7,128/4-1      ;8" Single Density
00E8    1F
00E9    12 03 0A 07               db      18,2+1,10,7,128/4-1      ;5" Single Density
00ED    1F
00EE    00 01 16 04               db      00,0+1,22,4,256/4-1      ;Any SASI Rigid Disk
00F2    3F
00F3    00                        db      00                       ;   End of table

                                  if      $ gt 100h-10
                                  .printx * Too Big *
                                  else
                                  if      $ eq 100h-10
                                  .printx + Perfect Fit +
                                  else
00F4                              ds      100h-10-$,-1
                                  endif
```

```
                                      endif

                              ;;      Serialization.
                              ;
00F6    20 44 43 2A           sernum: db      ' DC*******'            ;Manufacturing serial number here
00FA    2A 2A 2A 2A
00FE    2A 2A
000A                          sernml  equ     $-sernum

                                      if      $ ne 100h
                                      .printx * Serial Number Out of Place *
                                      endif
                                      .dephase

                                      end
```

```
Quick, Fast Cold Start Loader   MACRO-80 3.44   09-Dec-81

Macros:

Symbols:
0000'   BIOS            0004    CDISK           00DA    LDRTBL
0080    PHYCMD          0087    PHYDMA          0082    PHYDRV
0085    PHYSEC          0083    PHYTRK          0081    PHYUNT
0080    QFS             008B    QFS1            00AD    QFS2
00AE    QFS3            000A    SERNML          00F6    SERNUM
F02A    XQDVR


No Fatal error(s)
```

```
BIOS      13#     56      71      81
CDISK     10#     70
LDRTBL    32      74      93#
PHYCMD    17#     30      62
PHYDMA    22#     60
PHYDRV    19#
PHYSEC    21#     30      64
PHYTRK    20#     51      53
PHYUNT    18#
QFS       29#     62
QFS1      34#     36
QFS2      59#     69
QFS3      58      60#
SERNML    75     120#
SERNUM    73     117#    120
XQDVR      9#     63
```

## Notes

```
XEROX 820-II BIOS         MACRO-80 3.44   09-Dec-81
Bios Jump Table

                                      subttl  Bios Jump Table
                                      title   XEROX 820-II BIOS

                              ;;      XEROX 820+ Rom Resident Bios Jump Table.
                              ;
                              ;       Copyright 1981, Balcones Computer Corporation.
                              ;
                                      .z80

0000'   C3 00F1'              bios:   jp      cboot           ;cold start
0003'   C3 0069'              bwboot: jp      wboot           ;warm start

0006'   C3 F04B               bconst: jp      const           ;console status
0009'   C3 F04E               bconin: jp      conin           ;console character in
000C'   C3 F051               bconot: jp      conout          ;console character out
000F'   C3 F054               bprint: jp      list            ;list character on printer
0012'   C3 F060               bpunch: jp      punch           ;punch
0015'   C3 F05D               breadr: jp      reader          ;reader

0018'   C3 01B6'              bhome:  jp      home            ;move head to home position
001B'   C3 0154'              bseld:  jp      seldsk          ;select disk
001E'   C3 01B9'              bsett:  jp      settrk          ;set track number
0021'   C3 01BE'              bsets:  jp      setsec          ;set sector number
0024'   C3 01C3'              bsetd:  jp      setdma          ;set dma address
0027'   C3 01EB'              bread:  jp      read            ;read a record
002A'   C3 01F3'              bwrit:  jp      write           ;write a record

002D'   C3 F057               bprnts: jp      listst          ;printer ready status
0030'   C3 01C8'              bsctrn: jp      sectrn          ;sector translate

0033'   81                    initio: db      10000001b       ;Initial I/O Byte

                                      Subttl  Cold and Warm Start Module
                                      page
```

```


0E00                         bdosln  equ     0e00h           ;Length of CP/M v 2.2 BDOS
0800                         ccplen  equ     0800h           ;Length of CP/M v 2.2 CCP
0004                         cdisk   equ     4               ;Current user/disk
002C                         nsects  equ     (ccplen+bdosln)/128      ;number of sectors for ccp + bdos
0062                         rev     equ     'b'

                             ;;      Wboot - Warm Start CP/M.
                             ;
0034'   3E C3                wbt5:   ld      a,0c3h          ;plant jumps
0036'   21 F206'                     ld      hl,bios-bdosln+6
0039'   BE                           cp      (hl)
003A'   20 1C                        jr      nz,wbterr       ;if no jump to bdos
003C'   32 0000                      ld      (0),a
003F'   32 0005                      ld      (5),a
0042'   22 0006                      ld      (6),hl          ;set address of jump to bdos
0045'   21 0003'                     ld      hl,bwboot       ;set warm boot address
0048'   22 0001                      ld      (1),hl
004B'   ED 4B 0004                   ld      bc,(cdisk)      ;set current disk / user
004F'   21 EA00'                     ld      hl,bios-bdosln-ccplen ;Enter CCP
0050'                        wbtcom  equ     $-2             ;patch to "03" to disable warm boot command
0052'   3E 03                        ld      a,3
0054'   32 0050'                     ld      (wbtcom),a
0057'   E9                           jp      (hl)

0058'   CD 0115'             wbterr: call    pmsg            ;display error message
005B'   0D 0A 42 6F                  db      13,10,'Boot Err',0
005F'   6F 74 20 45
0063'   72 72 00
0066'   CD 0009'                     call    bconin  ;wait for key
0069'   31 0100              wboot:  ld      sp,100h         ;use external stack
006C'   CD 013F'                     call    dboot           ;inform deblocker
006F'   4F                           ld      c,a             ;(zero) select A:
0070'   3E 2C                        ld      a,nsects        ;set number of sectors to read
0072'   32 00D0'                     ld      (seccnt),a      ;set sector counter
0075'   21 E980'                     ld      hl,bios-bdosln-ccplen-128
0078'   22 013B'                     ld      (dmabas),hl     ;set base track dma address
007B'   CD 001B'                     call    bseld           ;select boot drive (A:)
007E'   7C                           ld      a,h
007F'   B5                           or      l
0080'   28 D6                        jr      z,wbterr
0082'   23                           inc     hl              ;point to high translate address
0083'   7E                           ld      a,(hl)
0084'   32 0122'                     ld      (xlate),a
0087'   E5                           push    hl
0088'   0E 00                        ld      c,0             ;translate sector zero
008A'   CD 0121'                     call    mls
008D'   79                           ld      a,c
008E'   32 0133'                     ld      (transz),a      ;set sector zero translate value
0091'   E1                           pop     hl
0092'   11 0009                      ld      de,10-1         ;offset to dpb
0095'   19                           add     hl,de
0096'   4E                           ld      c,(hl)          ;get dpb address
0097'   23                           inc     hl
```

```
0098'   46                      ld      b,(hl)
0099'   0A                      ld      a,(bc)          ;get low sectors per track
009A'   32 00DC'                ld      (spt),a
009D'   21 000D                 ld      hl,13
00A0'   09                      add     hl,bc
00A1'   4E                      ld      c,(hl)          ;get reserved tracks
00A2'   23                      inc     hl
00A3'   46                      ld      b,(hl)
00A4'   0B                      dec     bc
00A5'   1E 01                   ld      e,1             ;set sector 1
00A7'   B7                      or      a               ;test low sectors per track
00A8'   28 06                   jr      z,wbt1          ;if rigid disk
00AA'   4A                      ld      c,d             ;set track 0
00AB'   FE 1B                   cp      26+1
00AD'   38 01                   jr      c,wbt1          ;if single density 8" or 5"
00AF'   4B                      ld      c,e             ;double density starts on track 1, sector 1
00B0'   C5              wbt1:   push    bc              ;save track
00B1    D5                      push    de              ;save starting sector
00B2'   CD 001E'                call    bsett           ;position disk
00B5'   C1                      pop     bc
00B6'   C5              wbt2:   push    bc              ;save sector
00B7'   CD 0121'                call    mls             ;map logical sector
00BA'   E5                      push    hl              ;save address
00BB'   CD 0021'                call    bsets           ;set sector
00BE'   C1                      pop     bc
00BF'   21 FFFE'                ld      hl,bios-2
00C2'   ED 42                   sbc     hl,bc
00C4'   38 12                   jr      c,wbt3          ;if within bios
00C6'   CD 0024'                call    bsetd           ;set dma address
00C9'   CD 01EB'                call    read            ;read next sector
00CC'   B7                      or      a
00CD'   20 89                   jr      nz,wbterr       ;if load error
00CF'   3E 00                   ld      a,0             ;update sectors read counter
00D0'                   seccnt  equ     $-1
00D1'   3D                      dec     a
00D2'   32 00D0'                ld      (seccnt),a
00D5'   CA 0034'                jp      z,wbt5          ;if end of load
00D8'   C1              wbt3:   pop     bc              ;advance sector
00D9'   0C                      inc     c
00DA'   79                      ld      a,c
00DB'   FE FF                   cp      -1
00DC'                   spt     equ     $-1
00DD'   20 D7                   jr      nz,wbt2         ;if not end of track
00DF'   41                      ld      b,c
00E0'   2A 013B'                ld      hl,(dmabas)     ;advance base dma address
00E3'   11 0080                 ld      de,128
00E6'   19              wbt4:   add     hl,de           ;by spt*128
00E7'   10 FD                   djnz    wbt4
00E9'   22 013B'                ld      (dmabas),hl
00EC'   C1                      pop     bc              ;advance track
00ED'   0C                      inc     c
00EE'   58                      ld      e,b             ;and restart on sector 0
00EF'   18 BF                   jr      wbt1

                        ;;      Cold Start CP/M.
                        ;
```

```
00F1'   CD 0115'             cboot:  call    pmsg            ;Announce CP/M size and version
00F4'   1A 58 65 72                  db      26,'Xerox 60k CP/M vers 2.2',rev
00F8'   6F 78 20 36
00FC'   30 6B 20 43
0100'   50 2F 4D 20
0104'   76 65 72 73
0108'   20 32 2E 32
010C'   62
010D'   20 23 32 2D                  db      ' #2-294'
0111'   32 39 34
0114'   00                           db      0

                             ;;      pmsg - print message at return address.
                             ;
0115'   E1                   pmsg:   pop     hl              ;print message after call
0116'   7E                           ld      a,(hl)
0117'   23                           inc     hl
0118'   B7                           or      a
0119'   E5                           push    hl
011A'   C8                           ret     z               ;if end of message
011B'   4F                           ld      c,a
011C'   CD 000C'                     call    bconot          ;display message at current console
011F'   18 F4                        jr      pmsg

                             ;;      mls - map logical sector.
                             ;
0121'   3E 00                mls:    ld      a,0             ;set translate address
0122'                        xlate   equ     $-1
0123'   B7                           or      a
0124'   79                           ld      a,c
0125'   28 0B                        jr      z,mls2          ;if not single density
0127'   87                           add     a,a             ;read by half tracks
0128'   2A 00DC'                     ld      hl,(spt)        ;get sectors per track
012B'   BD                           cp      l
012C'   38 02                        jr      c,mls1          ;if not past end of track
012E'   95                           sub     l               ;offset back to beginning of track
012F'   3C                           inc     a
0130'   3C                   mls1:   inc     a               ;map sector 0->1
0131'   4F                           ld      c,a
0132'   D6 00                mls2:   sub     0               ;offset by translate of sector zero
0133'                        transz  equ     $-1
0134'   1F                           rra
0135'   67                           ld      h,a
0136'   2E 00                        ld      l,0
0138'   CB 1D                        rr      l
013A'   11 0000                      ld      de,0            ;set base dma for this track
013B'                        dmabas  equ     $-2
013D'   19                           add     hl,de           ;compute address for this sector
013E'   C9                           ret

                                     Subttl  CHARIO - Character I/O Module
                                     page
```

```


F000                          monitr  equ     0f000h          ;820+ Resident Monitor Address

F04B                          const   equ     monitr+4bh
F04E                          conin   equ     monitr+4eh
F051                          conout  equ     monitr+51h
F054                          list    equ     monitr+54h
F057                          listst  equ     monitr+57h
F05D                          reader  equ     monitr+5dh
F060                          punch   equ     monitr+60h

                                      Subttl  CP/M Deblocking Driver
                                      page
```

```


                                 ;;      CP/M Deblocking Driver.
                                 ;
013F'                                    cseg

                                 ;;      Ascii.
                                 ;
000A                             lf      equ     10
000B                             up      equ     11
000D                             cr      equ     13
001B                             esc     equ     27

451B                             inslin  equ     ('E' shl 8) + esc
521B                             dellin  equ     ('R' shl 8) + esc

                                 ;;      Absolute Machine Addresses.
                                 ;
F02A                             xqdvr   equ     0f02ah          ;Resident Monitor Driver Executioner
0004                             cdisk   equ     4               ;CCP active user/disk

                                 ;;      CP/M Write Types.
                                 ;
0000                             wrall   equ     0               ;normal write to allocated sector
0001                             wrdir   equ     1               ;write to directory sector
0002                             wrual   equ     2               ;first write to unallocated block

                                 ;;      skip - skip next instruction.
                                 ;
                                 ;       Uses HL to perform very short jumps
                                 ;
                                 skip    macro   n
                                         if      ((n)-$) eq 2
                                         db      26h             ;;;set PC = $+2  (ld h,...)
                                         endif
                                         if      ((n)-$) eq 3
                                         db      21h             ;;;set PC = $+3  (ld hl,...)
                                         endif
                                         endm

                                 ;;      Dboot - Deblocking Bootstrap.
                                 ;
                                 ;       Entry:  Called prior to Warm Start reload.
                                 ;
013F'   21 0000"                 dboot:  ld      hl,hstbuf       ;initialize host buffer address
0142'   22 021A"                         ld      (hstdma),hl
0145'   21 021C"                         ld      hl,dphtab       ;clear internal DPH table of addresses
0148'   01 2000                          ld      bc,16*2*256     ;set table length, zero
014B'   71                       dbt2:   ld      (hl),c          ;clear next byte
014C'   23                               inc     hl
014D'   10 FC                            djnz    dbt2            ;if table not clear

                                 ;;      clract - Clear host buffer active.
                                 ;
014F'   AF                       clract: xor     a
```

```
0150'   32 026E'                ld      (hstact),a        ;clear host buffer active
0153'   C9                      ret

                        ;;      select - select CP/M disk.
                        ;
                        ;       Entry:  C = CP/M Logical Drive, 0-15.
                        ;               E = 2*n+0 if media identification required
                        ;               E = 2*n+1 if media previously identified
                        ;
0154'   79              seldsk: ld      a,c               ;remember disk to seek
0155'   32 0205"                ld      (sekdsk),a
0158'   06 00                   ld      b,0
015A'   21 021C"        sel1:   ld      hl,dphtab         ;set table of remembered dph's
015D'   09                      add     hl,bc             ;index by words
015E'   09                      add     hl,bc
015F'   CB 43                   bit     0,e
0161'   28 0A                   jr      z,sel2            ;if drive not previously selected
0163'   7E                      ld      a,(hl)            ;set disk parameter header address in hl
0164'   23                      inc     hl
0165'   66                      ld      h,(hl)
0166'   6F                      ld      l,a
0167'   B4                      or      h
0168'   20 19                   jr      nz,sel3           ;if previous select succesful
016A'   5F                      ld      e,a               ;force media identification
016B'   18 ED                   jr      sel1
016D'   E5              sel2:   push    hl                ;save dph table address
016E'   21 0202"                ld      hl,selcmd+2
0171'   71                      ld      (hl),c            ;set CP/M Logical drive
0172'   2B                      dec     hl
0173'   2B                      dec     hl                ;point to select command
0174'   36 FF                   ld      (hl),-1           ;set driver select operation
0176'   CD 02DF'                call    xdr               ;execute driver request
0179'   EB                      ex      de,hl
017A'   E1                      pop     hl
017B'   73                      ld      (hl),e            ;remember disk parameter header address
017C'   23                      inc     hl
017D'   72                      ld      (hl),d
017E'   EB                      ex      de,hl
017F'   7D                      ld      a,l
0180'   B4                      or      h
0181'   28 22                   jr      z,sel4            ;if drive not succesfully selected
0183'   E5              sel3:   push    hl                ;save dph address
0184'   01 000A                 ld      bc,10             ;set dpb offset in dph
0187'   09                      add     hl,bc
0188'   5E                      ld      e,(hl)            ;set disk parameter block address
0189'   23                      inc     hl
018A'   56                      ld      d,(hl)
018B'   EB                      ex      de,hl
018C'   22 0241'                ld      (dpbadr),hl
018F'   0E 03                   ld      c,3
0191'   09                      add     hl,bc
0192'   7E                      ld      a,(hl)            ;set block shift factor
0193'   3C                      inc     a                 ;form 128 byte records per block
0194'   32 021B'                ld      (rpb),a
0197'   0E 0C                   ld      c,15-3            ;point to end of dpb
0199'   09                      add     hl,bc
```

```
019A'   7E                              ld      a,(hl)          ;set internal parameter
019B'   32 0208'                        ld      (trkzfl),a      ;set track zero single density flag
019E'   E6 07                           and     7
01A0'   32 029B'                        ld      (secmsk),a      ;set sector mask
01A3'   E1                              pop     hl
01A4'   C9                              ret
01A5'                           sel4:                           ;fall into clear active disk

                                ;;      cad - Clear Active Disk.
                                ;
01A5'   21 0004                 cad:    ld      hl,cdisk        ;get disk that CCP will log in
01A8'   3A 0205"                        ld      a,(sekdsk)      ;get disk that failed
01AB'   AE                              xor     (hl)
01AC'   E6 0F                           and     not 11110000b   ;clear active user
01AE'   20 04                           jr      nz,cadl         ;if selected disk is not default disk
01B0'   7E                              ld      a,(hl)          ;cause CCP to log in A:
01B1'   E6 F0                           and     not 1111b       ;retain active user area
01B3'   77                              ld      (hl),a
01B4'   6C                      cadl:   ld      l,h             ;indicate select failure
01B5'   C9                              ret

                                ;;      Home - Set Track Zero.
                                ;
01B6'   01 0000                 home:   ld      bc,0            ;seek track zero

                                ;;      Settrk - Set Track.
                                ;
                                ;       Entry:  BC = Track number
                                ;
01B9'   ED 43 0206"             settrk: ld      (sektrk),bc     ;set track to seek
01BD'   C9                              ret

                                ;;      Setsec - Set Sector.
                                ;
                                ;       Entry:  BC = Sector number
                                ;
01BE'   ED 43 020C"             setsec: ld      (seksec),bc     ;set sector to seek
01C2'   C9                              ret

                                ;;      Setdma - Set Direct Memory Address.
                                ;
                                ;       Entry:  BC = DMA address
                                ;
01C3'   ED 43 020A"             setdma: ld      (sekdma),bc
01C7'   C9                              ret

                                ;;      Sectran - Sector Translate.
                                ;
                                ;       Entry:  BC = Sector number, 0 <= BC <  Sectors per Track
                                ;               DE = Single byte skew table address
                                ;
                                ;       Exit:   HL = BC         if DE =  0
                                ;                L = (DE+BC)    if DE <> 0
                                ;                H = B          which better be zero
                                ;
01C8'   69                      sectrn: ld      l,c             ;set untranslated sector
```

```
01C9'   60                              ld      h,b
01CA'   7A                              ld      a,d
01CB'   B3                              or      e
01CC'   C8                              ret     z               ;if no translate table
01CD'   EB                              ex      de,hl
01CE'   09                              add     hl,bc
01CF'   6E                              ld      l,(hl)          ;single byte translate
01D0'   60                              ld      h,b
01D1'   C9                              ret

                                ;;      Rdwrs - Read or Write Single Density.
                                ;
01D2'   3A 02AE'                rdwrs:  ld      a,(readop)      ;set read/write operation
01D5'   21 0203"                        ld      hl,sekcmd       ;set seek request
01D8'   18 07                           jr      rdwrhs          ;enter read/write dispatcher

                                ;;      Readhs - Read Host Sector.
                                ;
01DA'   3E 01                   readhs: ld      a,1             ;set read operation
                                        skip    $+2             ;jump over write entry point
01DC'   26                              db      26h

                                ;;      Wriths - Write Host Sector.
                                ;
01DD'   AF                      wriths: xor     a               ;set write operation
01DE'   21 0213"                        ld      hl,hstcmd

                                ;;      Rdwrhs - Read or Write Host Sector.
                                ;
                                ;       Entry:  HL = Physical command request address
                                ;                A = 0 to write
                                ;                A = 1 to read
                                ;
                                ;       Exit:   A  =  0, if no errors
                                ;               A  = -1, if errors
                                ;               Z  = condition of A reg
                                ;
01E1'   77                      rdwrhs: ld      (hl),a          ;set driver operation
01E2'   CD 02DF'                        call    xdr             ;execute driver read or write
01E5'   21 02BE'                        ld      hl,erflag       ;merge error flag for directory protection
01E8'   B6                              or      (hl)
01E9'   77                              ld      (hl),a
01EA'   C9                              ret

                                ;;      Read - Read CP/M Sector.
                                ;
                                ;       Entry:  Seldsk, Settrk, Setsec, Setdma previously called
                                ;
                                ;       Exit:   A =  0 if no errors
                                ;               A = -1 if errors
                                ;
01EB'   AF                      read:   xor     a               ;clear unalloc processing
01EC'   32 0226'                        ld      (unacnt),a
01EF'   0E 00                           ld      c,wrall         ;inhibit buffer flush after read
01F1'   3C                              inc     a               ;set read operation
                                        skip    $+2
```

```
01F2'   26              +       db      26h

                                ;;      Write - Write CP/M Sector.
                                ;
                                ;       Entry:  Seldsk, Settrk, Setsec, Setdma previously called
                                ;
                                ;       Exit:   A =  0 if no errors
                                ;               A = -1 if errors
                                ;               C = Write type
                                ;
01F3'   AF                      write:  xor     a               ;set write operation

                                ;;      Rdwr - Read or Write.
                                ;
                                ;       Entry:   A = 0 to write
                                ;                A = 1 to read
                                ;
01F4'   32 02AE'                rdwr:   ld      (readop),a      ;set read/write switch
01F7'   AF                              xor     a               ;reset error flag
01F8'   32 02BE'                        ld      (erflag),a
01FB'   2A 020C"                        ld      hl,(seksec)     ;set seek host sector
01FE'   22 0208"                        ld      (sekhst),hl
0201'   3A 029B'                        ld      a,(secmsk)      ;set sector size
0204'   B7                              or      a
0205'   28 CB                           jr      z,rdwrs         ;if deblocking not required
0207'   F6 00                           or      0               ;check track zero single density flag
0208'                           trkzfl  equ     $-1
0209'   F2 0212'                        jp      p,rdwr1         ;if track zero not single density
020C'   3A 0206"                        ld      a,(sektrk)      ;set seek track
020F'   B7                              or      a
0210'   28 C0                           jr      z,rdwrs         ;if track 0, read or write without deblocking
0212'   79                      rdwr1:  ld      a,c             ;save write type
0213'   32 02BA'                        ld      (wrtype),a
0216'   FE 02                           cp      wrual
0218'   20 0B                           jr      nz,writ1        ;if not write to unallocated group
021A'   3E 00                           ld      a,0             ;set records per block
021B'                           rpb     equ     $-1
021C'   32 0226'                        ld      (unacnt),a      ;start counting unallocated writes
021F'   11 020E"                        ld      de,unadsk       ;set unallocated parameter block address
0222'   CD 02D6'                        call    cpb             ;copy parameter block
0225'   3E 00                   writ1:  ld      a,0             ;set remaining unallocated sectors
0226'                           unacnt  equ     $-1
0227'   B7                              or      a
0228'   28 2E                           jr      z,writ4         ;if not processing unallocated group
022A'   3D                              dec     a
022B'   32 0226'                        ld      (unacnt),a      ;update unallocated sectors remaining
022E'   21 0205"                        ld      hl,sekdsk       ;set seek parameters
0231'   11 020E"                        ld      de,unadsk       ;set unallocated parameters
0234'   CD 02CC'                        call    cmp             ;compare parameter blocks
0237'   20 1B                           jr      nz,writ3        ;if not seek to unallocated sector
0239'   2A 0211"                        ld      hl,(unasec)     ;advance unallocated sector
023C'   23                              inc     hl
023D'   22 0211"                        ld      (unasec),hl
0240'   11 0000                         ld      de,0            ;set sectors per track
0241'                           dpbadr  equ     $-2
0243'   ED 52                           sbc     hl,de
```

```
0245'   20 0A                  jr      nz,writ2          ;if not end of track
0247'   22 0211"               ld      (unasec),hl       ;reset to sector zero
024A'   2A 020F"               ld      hl,(unatrk)       ;advance unallocated track
024D'   23                     inc     hl
024E'   22 020F"               ld      (unatrk),hl
0251'   AF             writ2:  xor     a                 ;mark pre-read not required
0252'   18 05                  jr      rwoper
0254'   AF             writ3:  xor     a                 ;clear unallocated processing
0255'   32 0226'               ld      (unacnt),a
0258'   3C             writ4:  inc     a                 ;mark pre-read required

                       ;;      Rwoper - Read or Write Operation Proper.
                       ;
0259'   32 028B'       rwoper: ld      (rsflag),a        ;set pre-read block flag
025C'   3A 029B'               ld      a,(secmsk)        ;set shift counter
025F'   2A 020C"               ld      hl,(seksec)
0262'   CB 3C          rwop1:  srl     h                 ;compute host sector = cpmsec/(2**sekmsk)
0264'   CB 1D                  rr      l
0266'   CB 3F                  srl     a
0268'   20 F8                  jr      nz,rwop1          ;if shift incomplete
026A'   22 0208"               ld      (sekhst),hl       ;set seek host sector
026D'   F6 00                  or      0                 ;check host active flag
026E'                  hstact  equ     $-1
026F'   3E 01                  ld      a,1
0271'   32 026E'               ld      (hstact),a        ;host buffer always becoms active
0274'   28 0E                  jr      z,rwop2           ;if host buffer was not active
0276'   21 0215"               ld      hl,hstdsk         ;set active host buffer identification
0279'   11 0205"               ld      de,sekdsk         ;set seek identification
027C'   CD 02CC'               call    cmp               ;compare seek request with active host sector
027F'   28 16                  jr      z,rwop3           ;if host buffer contains seek sector
0281'   CD 02C2'               call    flush             ;flush buffer if previously written
0284'   11 0215"       rwop2:  ld      de,hstdsk         ;set host request block address
0287'   CD 02D6'               call    cpb               ;copy seek parameter block to host
028A'   3E 00                  ld      a,0               ;check pre-read required
028B'                  rsflag  equ     $-1
028C'   B7                     or      a
028D'   C4 01DA'               call    nz,readhs         ;read host sector if preread required
0290'   B7                     or      a
0291'   C4 014F'               call    nz,clract         ;clear host buffer active if read errors
0294'   32 02C3'               ld      (hstwrt),a        ;mark buffer not written into
0297'   3A 020C"       rwop3:  ld      a,(seksec)        ;set seek sector
029A'   E6 00                  and     0                 ;form host buffer index from sector mask
029B'                  secmsk  equ     $-1
029C'   1F                     rra
029D'   57                     ld      d,a               ;multiply index by 128 bytes/sector
029E'   3E 00                  ld      a,0
02A0'   1F                     rra
02A1'   5F                     ld      e,a
02A2'   2A 021A"               ld      hl,(hstdma)       ;set host buffer address
02A5'   19                     add     hl,de             ;form seek buffer address
02A6'   ED 5B 020A"            ld      de,(sekdma)       ;set user transfer address
02AA'   01 0080                ld      bc,128            ;set CP/M sector length
02AD'   3E 00                  ld      a,0               ;set transfer direction
02AE'                  readop  equ     $-1
02AF'   B7                     or      a
02B0'   20 05                  jr      nz,rwop4          ;if read operation
```

```
02B2'   EB                      ex      de,hl           ;switch directions
02B3'   3C                      inc     a
02B4'   32 02C3'                ld      (hstwrt),a      ;mark buffer written into
02B7'   ED B0           rwop4:  ldir                    ;move sector to/from user buffer
02B9'   3E 00                   ld      a,0             ;set write type
02BA'                   wrtype  equ     $-1
02BB'   FE 01                   cp      wrdir
02BD'   3E 00                   ld      a,0             ;set error flag
02BE'                   erflag  equ     $-1
02BF'   C0                      ret     nz
02C0'   B7                      or      a
02C1'   C0                      ret     nz              ;if errors, do not clobber directory

                        ;;      Flush - Flush buffer to disk.
                        ;
02C2'   3E 00           flush:  ld      a,0             ;check host written flag
02C3'                   hstwrt  equ     $-1
02C4'   B7                      or      a
02C5'   C4 01DD'                call    nz,wriths       ;if buffer written into, write host sector
02C8'   32 02C3'                ld      (hstwrt),a      ;clear host written flag if no errors
02CB'   C9                      ret

                        ;;      Cmp - Compare Paramater Blocks.
                        ;
                        ;       Entry:  HL = Parameter block
                        ;               DL = Parameter block
                        ;
                        ;       Exit:   Z  = Set   if parameters identical
                        ;               Z  = Clear if parameters different
                        ;
02CC'   06 05           cmp:    ld      b,5             ;set length of parameter block
02CE'   1A              cmpl:   ld      a,(de)          ;compare next byte
02CF'   AE                      xor     (hl)
02D0'   C0                      ret     nz              ;if parameters different
02D1'   13                      inc     de
02D2'   23                      inc     hl
02D3'   10 F9                   djnz    cmpl            ;if more bytes
02D5'   C9                      ret

                        ;;      Cpb - Copy Parameter Block.
                        ;
                        ;       Entry:  DE = Address of Unallocated or Host parameter block
                        ;
                        ;       Exit:   Seek parameter block copied into block at DE
                        ;
02D6'   21 0205"        cpb:    ld      hl,sekdsk       ;set source parameters
02D9'   01 0005                 ld      bc,5            ;set block length
02DC'   ED B0                   ldir                    ;copy parameter block
02DE'   C9                      ret

                        ;;      Xdr - Execute Driver Request.
                        ;
                        ;       Entry:  HL = pointer to Physical Driver Request Block
                        ;
                        ;       Exit:   Physical Driver exit condition are maintained if
                        ;               no errors or user did not request warm start.
```

```
                                ;
02DF'    22 02EA'               xdr:    ld      (xdra),hl       ;save request for retrys
02E2'    2A 02EA'               xdr1:   ld      hl,(xdra)       ;restore request address
02E5'    CD F02A                        call    Xqdvr           ;execute physical driver
02E8'    47                             ld      b,a             ;save read/write error status
02E9'    3A 02EA'                       ld      a,(xdra)        ;get driver operation
02EA'                           xdra    equ     $-2
02EC'    4F                             ld      c,a             ;set message index
02ED'    3C                             inc     a
02EE'    20 05                          jr      nz,xdr2         ;if not select request
02F0'    B5                             or      l
02F1'    B4                             or      h
02F2'    C0                             ret     nz              ;if dph address returned by driver
02F3'    18 03                          jr      xdr3
02F5'    78                     xdr2:   ld      a,b             ;set read/write error status
02F6'    B7                             or      a
C2F7'    C8                             ret     z               ;if no read/write errors
02F8'    2A 02EA'               xdr3:   ld      hl,(xdra)       ;put drive name in message
02FB'    23                             inc     hl
02FC'    23                             inc     hl
02FD'    7E                             ld      a,(hl)
02FE'    C6 41                          add     a,'A'
0300'    32 0330'                       ld      (xdrb),a
0303'    0C                             inc     c
0304'    20 0C                          jr      nz,xdr4         ;if not select request
0306'    CD 0375'                       call    pmsgi
0309'    53 65 6C 65                    db      'Select',0
030D'    63 74 00
0310'    18 16                          jr      xdr6
0312'    0D                     xdr4:   dec     c
0313'    20 0B                          jr      nz,xdr5         ;if not write request
0315'    CD 0375'                       call    pmsgi
0318'    57 72 69 74                    db      'Write',0
031C'    65 00
031E'    18 08                          jr      xdr6
0320'    CD 0375'               xdr5:   call    pmsgi           ;must be read request
0323'    52 65 61 64                    db      'Read',0
0327'    00
0328'    CD 0115'               xdr6:   call    pmsg
032B'    20 45 72 72                    db      ' Err '
032F'    20
0330'    64 3A 20               xdrb:   db      'd: '
0333'    41 28 63 63                    db      'A(ccept), '
0337'    65 70 74 29
033B'    2C 20
033D'    49 28 67 6E                    db      'I(gnore), '
0341'    6F 72 65 29
0345'    2C 20
0347'    52 28 65 74                    db      'R(etry) '
034B'    72 79 29 20
034F'    00                             db      0
0350'    CD 0009'                       call    bconin          ;read character from console
0353'    F5                             push    af
0354'    CD 0115'                       call    pmsg
0357'    0D                             db      cr
0358'    521B                           dw      dellin
```

```
 035A'   0B 00                    db      up,0
 035C'   67                       ld      h,a              ;zero dph for accepted or ignored select errors
 035D'   6F                       ld      l,a
 035E'   F1                       pop     af
 035F'   E6 5F                    and     5fh              ;ignore parity, case
 0361'   FE 03                    cp      3
 0363'   28 0A                    jr      z,xdr7           ;if warm start requested
 0365'   D6 49                    sub     'I'
 0367'   C8                       ret     z                ;if user ignored error, don't tell BDOS
 0368'   D6 F8                    sub     'A'-'I'
 036A'   C2 02E2'                 jp      nz,xdr1          ;retry request
 036D'   2F                       cpl
 036E'   C9                       ret

 036F'   CD 01A5'         xdr7:   call    cad              ;clear active disk
 0372'   C3 0003'                 jp      bwboot

 0375'   CD 0115'         pmsgi:  call    pmsg
 0378'   0D 0A                    db      cr,lf
 037A'   451B                     dw      inslin
 037C    00                       db      0
 037D'   C3 0115'                 jp      pmsg

                                  subttl  Deblocker Storage Area
                                  page
```

```

                        reserve macro   s,n
                        s       equ     $+.
                        .       aset    .+n
                                endm
        0000            .       aset    0
        0380'                   dseg

                        ;;      Host Sector Deblocking Buffer.
                        ;
                        reserve hstbuf,512

                        ;;      Physical Driver Select Command.
                        ;
                        reserve selcmd,3                ;select command, unit, drive

                        ;;      Seek Sector Parameter Block.
                        ;
                        reserve sekcmd,1                ;kindly
                        reserve sekunt,1                ; leave
                        reserve sekdsk,1                ;  these
                        reserve sektrk,2                ;   bytes
                        reserve sekhst,2                ;    alone
                        reserve sekdma,2
                        reserve seksec,2

                        ;;      Unallocated Sector Parameter Block.
                        ;
                        reserve unadsk,1                ;kindly
                        reserve unatrk,2                ; leave
                        reserve unasec,2                ;  these

                        ;;      Host Sector Parameter Block.
                        ;
                        reserve hstcmd,1                ;kindly
                        reserve hstunt,1                ; leave
                        reserve hstdsk,1                ;  these
                        reserve hsttrk,2                ;   bytes
                        reserve hstsec,2                ;    alone
                        reserve hstdma,2

                        ;;      Disk Parameter Header Addresses.
                        ;
                        reserve dphtab,('P'-'A'+1)*2

        0000"                   cseg

                                end
```

```
XEROX 820-II BIOS        MACRO-80 3.44   09-Dec-81
Deblocker Storage Area

Macros:
RESERVE          SKIP

Symbols:
023C     .               0009'   BCONIN          000C'   BCONOT
0006'    BCONST          0E00    BDOSLN          0018'   BHOME
0000'    BIOS            000F'   BPRINT          002D'   BPRNTS
0012'    BPUNCH          0027'   BREAD           0015'   BREADR
0030'    BSCTRN          001B'   BSELD           0024'   BSETD
0021'    BSETS           001E'   BSETT           0003'   BWBOOT
002A'    BWRIT           01A5'   CAD             01B4'   CAD1
00F1'    CBOOT           0800    CCPLEN          0004    CDISK
014F'    CLRACT          02CC'   CMP             02CE'   CMP1
F04E     CONIN           F051    CONOUT          F04B    CONST
02D6'    CPB             000D    CR              013F'   DBOOT
014B'    DBT2            521B    DELLIN          013B'   DMABAS
0241'    DPBADR          021C"   DPHTAB          02BE'   ERFLAG
001B     ESC             02C2'   FLUSH           01B6'   HOME
026E'    HSTACT          0000"   HSTBUF          0213"   HSTCMD
021A"    HSTDMA          0215"   HSTDSK          0218"   HSTSEC
0216"    HSTTRK          0214"   HSTUNT          02C3'   HSTWRT
0033'    INITIO          451B    INSLIN          000A    LF
F054     LIST            F057    LISTST          0121'   MLS
0130'    MLS1            0132'   MLS2            F000    MONITR
002C     NSECTS          0115'   PMSG            0375'   PMSGI
F060     PUNCH           01F4'   RDWR            0212'   RDWR1
01E1'    RDWRHS          01D2'   RDWRS           01EB'   READ
F05D     READER          01DA'   READHS          02AE'   READOP
0062     REV             021B'   RPB             028B'   RSFLAG
0262'    RWOP1           0284'   RWOP2           0297'   RWOP3
02B7'    RWOP4           0259'   RWOPER          00D0'   SECCNT
029B'    SECMSK          01C8'   SECTRN          0203"   SEKCMD
020A"    SEKDMA          0205"   SEKDSK          0208"   SEKHST
020C"    SEKSEC          0206"   SEKTRK          0204"   SEKUNT
015A'    SEL1            016D'   SEL2            0183'   SEL3
01A5'    SEL4            0200"   SELCMD          0154'   SELDSK
01C3'    SETDMA          01BE'   SETSEC          01B9'   SETTRK
00DC'    SPT             0133'   TRANSZ          0208'   TRKZFL
0226'    UNACNT          020E"   UNADSK          0211"   UNASEC
020F"    UNATRK          000B    UP              0069'   WBOOT
00B0'    WBT1            00B6'   WBT2            00D8'   WBT3
00E6'    WBT4            0034'   WBT5            0050'   WBTCOM
0058'    WBTERR          0000    WRALL           0001    WRDIR
0225'    WRIT1           0251'   WRIT2           0254'   WRIT3
0258'    WRIT4           01F3'   WRITE           01DD'   WRITHS
02BA'    WRTYPE          0002    WRUAL           02DF'   XDR
02E2'    XDR1            02F5'   XDR2            02F8'   XDR3
0312'    XDR4            0320'   XDR5            0328'   XDR6
036F'    XDR7            02EA'   XDRA            0330'   XDRB
0122'    XLATE           F02A    XQDVR


No Fatal error(s)
```

```
          689#    695     695#    695     699     699#    699     703     703#    703     704     704#
          704     705     705#    705     706     706#    706     707     707#    707     708     708#
          708     709     709#    709     713     713#    713     714     714#    714     715     715#
          715     719     719#    719     720     720#    720     721     721#    721     722     722#
          722     723     723#    723     724     724#    724     728     728#    728
BCONIN     14#     65     654
BCONOT     15#    167
BCONST     13#
BDOSLN     37#     40      46      55      71
BHOME      20#
BIOS       10#     46      55      71     115
BPRINT     16#
BPRNTS     28#
BPUNCH     17#
BREAD      25#
BREADR     18#
BSCTRN     29#
BSELD      21#     73
BSETD      24#    118
BSETS      23#    113
BSETT      22#    108
BWBOOT     11#     52     674
BWRIT      26#
CAD       333#    673
CAD1      337     341#
CBOOT      10     146#
CCPLEN     38#     40      55      71
CDISK      39#     54     231#    333
CLRACT    266#    529
CMP       483     519     577#
CMP1      578#    583
CONIN      14     203#
CONOUT     15     204#
CONST      13     202#
CPB       474     523     592#
CR        222#    657     677
DBOOT      67     256#
DBT2      260#    262
DELLIN    226#    658
DMABAS     72     134     138     192#
DPBADR    315     489#
DPHTAB    258     279     728#
ERFLAG    418     454     555#
ESC       223#    225     226
FLUSH     521     562#
HOME       20     346#
HSTACT    267     513#    515
HSTBUF    256     695#
```

```
HSTCMD     404     719#
HSTDMA     257     539     724#
HSTDSK     517     522     721#
HSTSEC     723#
HSTTRK     722#
HSTUNT     720#
HSTWRT     530     549     563#    566
INITIO      31#
INSLIN     225#    678
LF         220#    677
LIST        16     205#
LISTST      28     206#
MLS         82     111     172#
MLS1       180     183#
MLS2       176     185#
MONITR     200#    202     203     204     205     206     207     208
NSECTS      40#     69
PMSG        61     146     160#    168     641     656     676     680
PMSGI      628     634     638     676#
PUNCH       17     208#
RDWR       452#
RDWR1      462     466#
RDWRHS     393     416#
RDWRS      391#    459     465
READ        25     119     430#
READER      18     207#
READHS     397#    527
READOP     391     452     544#
RESERVE    685#    694     698     702     703     704     705     706     707     708     712     713
           714     718     719     720     721     722     723     727
REV         41#    152
RPB        320     471#
RSFLAG     504     525#
RWOP1      507#    510
RWOP2      516     522#
RWOP3      520     531#
RWOP4      546     550#
RWOPER     497     504#
SECCNT      70     123#    125
SECMSK     326     457     505     533#
SECTRN      29     378#
SEKCMD     392     703#
SEKDMA     366     541     708#
SEKDSK     277     334     481     518     592     705#
SEKHST     456     511     707#
SEKSEC     359     455     506     531     709#
SEKTRK     352     463     706#
SEKUNT     704#
SEL1       279#    291
```

```
SEL2        283      292#
SEL3        289      308#
SEL4        307      329#
SELCMD      293      699#
SELDSK       21      276#
SETDMA       24      366#
SETSEC       23      359#
SETTRK       22      352#
SKIP        243#     398      434
SPT          92      131#     178
TRANSZ       84      186#
TRKZFL      324      461#
UNACNT      431      472      476#     480      499
UNADSK      473      482      713#
UNASEC      485      487      492      715#
UNATRK      493      495      714#
UP          221#     659
WBOOT        11       66#
WBT1        101      104      106#     142
WBT2        110#     132
WBT3        117      127#
WBT4        136#     137
WBT5         45#     126
WBTCOM       56#      58
WBTERR       48       61#      76      121
WRALL       235#     432
WRDIR       236#     553
WRIT1       469      475#
WRIT2       491      496#
WRIT3       484      498#
WRIT4       478      500#
WRITE        26      445#
WRITHS      403#     565
WRTYPE      467      552#
WRUAL       237#     468
XDR         298      417      604#
XDR1        605#     669
XDR2        612      617#
XDR3        616      620#
XDR4        627      632#
XDR5        633      638#
XDR6        631      637      641#
XDR7        665      673#
XDRA        604      605      608      609#     620
XDRB        625      644#
XLATE        79      173#
XQDVR       230#     606
```

## Notes

```
        Title   Banked Physical Driver

;;      Banked Physical Driver
;
;       Copyright (C) 1982, Balcones Computer Corporation
;
;       Transferred to Public Domain - (PD) 1983
;
;;      After executing this program by entering BANK x:(where x is any valid
;       CP/M disk drive A-P).  The BANK program will load a physical disk
;       driver into memory.  This physical driver is executed when drive x: is
;       accessed by CP/M.  This particular disk driver will map normal CP/M
;       files onto the address space of the alternate memory bank
;       (bank 0) in the 820-II.
;
;       This utility demonstrates the flexibility of the logical to
;       physical disk mapping in the 820-II.  The BANK program
;       moves the physical disk driver up to high memory.
;       It then updates the entry for drive x: in the logical to physical
;       disk drive mapping table telling the system to use physical
;       disk driver #3 when CP/M requests service from drive x:.
;
;       The execution address of the BANK driver is then placed in
;       entry #3 of the physical disk driver address table.
;
;       If BANK is executed by entering:  A>BANK P:
;
;       Then doing a A>DIR P: would display the following directory:
;
;       BOOT     .ROM  :  OPTION  .ROM  :  SCREEN  .MEM  :  EXPAND  .RAM
;
;       Entering: A>STAT P:*.* will display the following:
;
;                         Recs  Bytes  Ext Acc
;                           64    12k    1 R/O P:BOOT.ROM
;                          256    32k    1 R/W P:EXPAND.RAM
;                           16     2k    1 R/W P:OPTION.ROM
;                           24     4k    1 R/W P:SCREEN.MEM
;                        Bytes Remaining On P: 0k
;
;       The files map to the following memory addresses in bank 0:
;
;                        BOOT.ROM        0000h-2fffh
;                        EXPAND.RAM      4000h-bfffh
;                        OPTION.ROM      17ffh-1fffh
;                        SCREEN.MEM      3000h-3bffh
;
;       The BANK program can also be a very useful tool in that after
;       it has been executed a high level language program can access
;       items in the alternate memory bank as disk files on drive x:
;
;       Of particular interest is the file SCREEN.MEM, notice that it
;       is 24 records long.  Each record (128 bytes) corresponds to a
;       line on the CRT (only the first 80 bytes of each record are in
;       the display window).  The first record of the file corresponds
;       to the first line of the CRT only if the CRT has not been
;       permitted to scroll since the last clear screen command was sent
;       to it.
;
        Subttl  Constants & Program Mover
        page
```

```


 F000                        Monitr  equ     0f000h          ;Base address of resident monitor
 F033                        Xcrtmv  equ     monitr+33h      ;Crt <-> Ram Move LDIR Simulator
 F036                        Xgetsl  equ     monitr+36h      ;Get driver select table address to hl

 FF3C                        Bavail  equ     0ff3ch          ;Pointer to beginning of available memory
 FF3E                        Eavail  equ     0ff3eh          ;Pointer to end of available memory

 0005                        bdos    equ     5
 005C                        dfcb    equ     5ch

 FA80                        drvadr  equ     0fa80h          ;address for Bank driver
 0000                        stack   equ     0

                                     .z80

 0000'                               Aseg
                                     Org     100h
 0100     18 5A                      jr      loadit

 0102     43 6F 70 79                db      'Copyright (C) 1982 Balcones Computer Corporation'
 0106     72 69 67 68
 010A     74 20 28 43
 010E     29 20 31 39
 0112     38 32 20 42
 0116     61 6C 63 6F
 011A     6E 65 73 20
 011E     43 6F 6D 70
 0122     75 74 65 72
 0126     20 43 6F 72
 012A     70 6F 72 61
 012E     74 69 6F 6E
 0132     20 54 72 61                db      ' Transferred to Public Domain - (PD) 1983',26
 0136     6E 73 66 65
 013A     72 72 65 64
 013E     20 74 6F 20
 0142     50 75 62 6C
 0146     69 63 20 44
 014A     6F 6D 61 69
 014E     6E 20 2D 20
 0152     28 50 44 29
 0156     20 31 39 38
 015A     33 1A


 015C     CD 03D8            loadit: call    req822          ;see if machine is 820-II
 015F     3A 005C                    ld      a,(dfcb)
 0162     B7                         or      a
 0163     28 30                      jr      z,bnkusg
 0165     F5                         push    af
 0166     CD 03F8                    call    ckspac          ;see if room for driver
 0169     F1                         pop     af
 016A     3D                         dec     a
 016B     4F                         ld      c,a
```

```
016C    21 0259                 ld      hl,driver
016F    11 FA80                 ld      de,banked
0172    D5                      push    de
0173    C5                      push    bc
0174    01 017F                 ld      bc,drvlen
0177    ED B0                   ldir
0179    26 00                   ld      h,0             ;indicate register return
017B    CD F036                 call    XGetsl          ;get select table address
017E    C1                      pop     bc
017F    E5                      push    hl
0180    09                      add     hl,bc
0181    09                      add     hl,bc
0182    36 03                   ld      (hl),3
0184    23                      inc     hl
0185    36 00                   ld      (hl),0
0187    E1                      pop     hl
0188    11 0026                 ld      de,2*16+3*2
018B    19                      add     hl,de
018C    D1                      pop     de
018D    73                      ld      (hl),e
018E    23                      inc     hl
018F    72                      ld      (hl),d
0190    0E 0D                   ld      c,13
0192    C3 0005                 jp      bdos

0195    11 019D         bnkusg: ld      de,bnkmsg
0198    0E 09                   ld      c,9
019A    C3 0005                 jp      bdos

019D    55 73 61 67     bnkmsg: db      'Usage: BANK x:$'
01A1    65 3A 20 42
01A5    41 4E 4B 20
01A9    78 3A 24

01AC                            ds      200h-103h-($-loadit),-1
0259                    driver:
                                .phase  Drvadr

                                Subttl  Bank Driver
                                page
```

```


FA80    7E                     banked: ld      a,(hl)          ;get driver op
FA81    4F                             ld      c,a
FA82    23                             inc     hl
FA83    3C                             inc     a
FA84    28 51                          jr      z,selbnk        ;if select op
FA86    23                             inc     hl
FA87    23                             inc     hl
FA88    56                             ld      d,(hl)          ;set track
FA89    23                             inc     hl
FA8A    23                             inc     hl
FA8B    7E                             ld      a,(hl)          ;set sector
FA8C    0F                             rrca
FA8D    5F                             ld      e,a
FA8E    23                             inc     hl
FA8F    23                             inc     hl
FA90    7E                             ld      a,(hl)          ;set transfer address
FA91    23                             inc     hl
FA92    66                             ld      h,(hl)
FA93    6F                             ld      l,a
FA94    06 00                          ld      b,0             ;preset crtldir op
FA96    7C                             ld      a,h
FA97    FE C0                          cp      0c0h
FA99    30 01                          jr      nc,bank1        ;if transfer outside banked area
FA9B    05                             dec     b               ;set ram->crt
FA9C    79                     bank1:  ld      a,c             ;set read/write op
FA9D    B7                             or      a
FA9E    28 02                          jr      z,bank2         ;if write
FAA0    06 01                          ld      b,1             ;set crt->ram
FAA2    C5                     bank2:  push    bc              ;save direction op
FAA3    B2                             or      d               ;check directory track
FAA4    FA FAC8                        jp      m,bank6         ;if directory operation
FAA7    FE 30                          cp      030h
FAA9    79                             ld      a,c             ;set read/write switch
FAAA    01 0080                        ld      bc,128
FAAD    38 05                          jr      c,bank3         ;if not within screen memory
FAAF    B7                             or      a
FAB0    20 05                          jr      nz,bank4        ;if read
FAB2    0E 50                          ld      c,80            ;only write one line
FAB4    B7                     bank3:  or      a               ;test read/write
FAB5    28 01                          jr      z,bank5         ;if write
FAB7    EB                     bank4:  ex      de,hl           ;set read
FAB8    F1                     bank5:  pop     af              ;get mover op to A
FAB9    ED 73 FAC4                     ld      (stksav),sp     ;use high stack
FABD    31 0000                        ld      sp,stack
FAC0    CD F033                        call    Xcrtmv          ;move it to/from crt bank
FAC3    31 0000                        ld      sp,0
FAC4                           stksav  equ     $-2
FAC6    AF                             xor     a               ;always succeeds
FAC7    C9                             ret
FAC8    11 FADB                bank6:  ld      de,Direct       ;set directory address
FACB    0D                             dec     c
FACC    20 01                          jr      nz,bank7        ;if directory write
FACE    EB                             ex      de,hl
```

```
FACF    01 0080         bank7:  ld      bc,80h
FAD2    ED B0                   ldir                    ;read or re-write directory
FAD4    F1                      pop     af
FAD5    AF                      xor     a
FAD6    C9                      ret

FAD7    21 FB5B         selbnk: ld      hl,dph
FADA    C9                      ret

                                Subttl  Directory Sector, Dpb & Dph
                                page
```

```
Banked Physical Driver                          MACRO-80 3.44   09-Dec-81
Directory Sector, Dpb & Dph


        FADB    00                      Direct: db      0
        FADC    42 4F 4F 54                     dc      'BOOT    R'
        FAE0    20 20 20 20
        FAE4    D2
        FAE5    4F 4D                           db      'OM'
        FAE7    00 00 00 40                     db      00,00,00,64
        FAEB    01 02 03 04                     db      01,02,03,04     ;Bank 0 Memory locations        0000h-1fffh
        FAEF    05 06 00 00                     db      05,06,00,00     ;                               2000h-2fffh
        FAF3    00 00 00 00                     db      00,00,00,00
        FAF7    00 00 00 00                     db      00,00,00,00

        FAFB    00                              db      0
        FAFC    4F 50 54 49                     db      'OPTION  ROM'
        FB00    4F 4E 20 20
        FB04    52 4F 4D
        FB07    00 00 00 10                     db      00,00,00,16     ;Bank 0 Memory locations        17ffh-1fffh
        FB0B    04 00 00 00                     db      04,00,00,00
        FB0F    00 00 00 00                     db      00,00,00,00
        FB13    00 00 00 00                     db      00,00,00,00
        FB17    00 00 00 00                     db      00,00,00,00

        FB1B    00                              db      0
        FB1C    53 43 52 45                     db      'SCREEN  MEM'
        FB20    45 4E 20 20
        FB24    4D 45 4D
        FB27    00 00 00 18                     db      0,0,0,24
        FB2B    07 08 00 00                     db      07,08,00,00     ;Bank 0, Memory locations       3000h-3bffh
        FB2F    00 00 00 00                     db      00,00,00,00
        FB33    00 00 00 00                     db      00,00,00,00
        FB37    00 00 00 00                     db      00,00,00,00

        FB3B    00                              db      0
        FB3C    45 58 50 41                     db      'EXPAND  RAM'
        FB40    4E 44 20 20
        FB44    52 41 4D
        FB47    01 00 00 80                     db      01,00,00,80h
        FB4B    09 0A 0B 0C                     db      09,10,11,12     ;Bank 0, Memory locations       4000h-5fffh
        FB4F    0D 0E 0F 10                     db      13,14,15,16     ;                               6000h-7fffh
        FB53    11 12 13 14                     db      17,18,19,20     ;                               8000h-9fffh
        FB57    15 16 17 18                     db      21,22,23,24     ;                               a000h-bfffh

        FB5B    0000 0000               dph:    dw      0,0,0,0
        FB5F    0000 0000
        FB63    FB7F FB6B                       dw      dirbuf,dpb
        FB67    0000 FB7B                       dw      0,alloc

        FB6B    0002                    dpb:    dw      2               ;spt
        FB6D    04 0F 01                        db      4,15,1          ;blkshf, blkmsk, nullmsk
        FB70    0018 0003                       dw      24,3,128,0,-8   ;dsw,dirm,alloc01,chksiz,trk off
        FB74    0080 0000
        FB78    FFF8
        FB7A    00                              db      0               ;128 byte sectors

```

```
FB7B                alloc:  ds      4               ;allocation vector
FB7F                dirbuf: ds      128             ;directory buffer

                            .dephase
017F                drvlen  equ     $-driver

                            Subttl  System Identification
                            page
```

```
                                ;;      Verify The machine this program is being run by Murphy or
                                ;       a Xerox 820-II
                                ;
03D8    3A F000                 Req822: ld      a,(monitr)      ;make certain system is an 820-II
03DB    FE C3                           cp      0c3h            ;should be a jump instruction if 820
03DD    20 0D                           jr      nz,notii        ;if not give error message
03DF    2A F001                         ld      hl,(monitr+1)   ;follow reload monitor jump
03E2    7E                              ld      a,(hl)
03E3    FE F3                           cp      0f3h
03E5    20 05                           jr      nz,notii        ;if interrupts not disabled
03E7    23                              inc     hl
03E8    7E                              ld      a,(hl)
03E9    FE DB                           cp      0dbh
03EB    C8                              ret     z
03EC    E1                      Notii:  pop     hl              ;pitch return address
03ED    11 0434                         ld      de,msg
03F0    0E 09                   pmsg:   ld      c,9
03F2    CD 0005                         call    bdos
03F5    C3 0000                         jp      0

                                ;;      The pointer at Bavail points to the start of free memory, Eavail
                                ;       points to the end of free memory.  This test verifies that there
                                ;       is enough space for this program to fit in this un-allocated memory
                                ;       space.  If so the Eavail pointer is updated to the start of the driver -1.
                                ;       If not an error message is sent to the console.
                                ;
03F8    ED 5B FF3C              Ckspac: ld      de,(bavail)     ;get pointer to start of free address space
03FC    21 FA80                         ld      hl,drvadr       ;start of driver
03FF    B7                              or      a
0400    ED 52                           sbc     hl,de
0402    38 11                           jr      c,nroom         ;if drvadr < bavail then no space
0404    2A FF3E                         ld      hl,(eavail)     ;get pointer to end of available space
0407    11 FBFF                         ld      de,drvadr+drvlen
040A    ED 52                           sbc     hl,de
040C    38 07                           jr      c,nroom         ;if driver end > end of eavail then no space
040E    21 FA80                         ld      hl,drvadr       ;else update end pointer
0411    22 FF3E                         ld      (eavail),hl
0414    C9                              ret
0415    11 041A                 nroom:  ld      de,nspace
0418    18 D6                           jr      pmsg

041A    46 72 65 65             Nspace: db      'Free memory space in use.$'
041E    20 6D 65 6D
0422    6F 72 79 20
0426    73 70 61 63
042A    65 20 69 6E
042E    20 75 73 65
0432    2E 24

0434    54 68 69 73             Msg:    db      'This program requires a Xerox 820-II Information Processor.$'
0438    20 70 72 6F
043C    67 72 61 6D
0440    20 72 65 71
```

```
Banked Physical Driver                                   MACRO-80 3.44   09-Dec-81
System Identification

  341     0444     75 69 72 65
  342     0448     73 20 61 20
  343     044C     58 65 72 6F
  344     0450     78 20 38 32
  345     0454     30 2D 49 49
  346     0458     20 49 6E 66
  347     045C     6F 72 6D 61
  348     0460     74 69 6F 6E
  349     0464     20 50 72 6F
  350     0468     63 65 73 73
  351     046C     6F 72 2E 24
  352
  353                                                    Subttl  Symbol Table
  354                                                    end
```

```
Banked Physical Driver                        MACRO-80 3.44   09-Dec-81
Symbol Table

Macros:

Symbols:
FB7B    ALLOC           FA9C    BANK1           FAA2    BANK2
FAB4    BANK3           FAB7    BANK4           FABB    BANK5
FAC8    BANK6           FACF    BANK7           FA80    BANKED
FF3C    BAVAIL          0005    BDOS            019D    BNKMSG
0195    BNKUSG          03F8    CKSPAC          005C    DFCB
FB7F    DIRBUF          FADB    DIRECT          FB6B    DPB
FB5B    DPH             0259    DRIVER          FA80    DRVADR
017F    DRVLEN          FF3E    EAVAIL          015C    LOADIT
F000    MONITR          0434    MSG             03EC    NOTII
0415    NROOM           041A    NSPACE          03F0    PMSG
03D8    REQ822          FAD7    SELBNK          0000    STACK
FAC4    STKSAV          F033    XCRTMV          F036    XGETSL


No Fatal error(s)
```

```
ALLOC     269      278#
BANK1     181      183#
BANK2     185      187#
BANK3     193      197#
BANK4     195      199#
BANK5     198      200#
BANK6     189      208#
BANK7     210      212#
BANKED    118      159#
BAVAIL     68#     314
BDOS       71#     140      144      305
BNKMSG    142      146#
BNKUSG    111      142#
CKSPAC    113      314#
DFCB       72#     109
DIRBUF    268      279#
DIRECT    208      225#
DPB       268      271#
DPH       218      266#
DRIVER    117      152#     282
DRVADR     74#     153      315      320      323
DRVLEN    121      282#     320
EAVAIL     69#     319      324
LOADIT     81      108#     151
MONITR     64#      65       66      291      294
MSG       303      337#
NOTII     293      297      302#
NROOM     318      322      326#
NSPACE    326      329#
PMSG      304#     327
REQ822    108      291#
SELBNK    163      218#
STACK      75#     202
STKSAV    201      205#
XCRTMV     65#     203
XGETSL     66#     124
```

```
                        Title   Position encoded keyboard handler

                ;;      Position encoded keyboard handler for the 820-II & 16/8
                ;       professional computer.
                ;
                ;       Copyright 1983 (C) XEROX Corporation
                ;

                ;;              This is the stand alone rom addition to the Xerox
                ;               820-II monitor. It is called once during monitor restart
                ;               and at that time patches the monitor in ram to
                ;               call the modified k/b,crt,Screenprint and printer
                ;               routines.  It then moves in its own SIGNON overlay
                ;               and jumps into it.
                ;
                ;               This SIGNON in addition to selecting the disk driver also
                ;               moves into ram (in the spare driver area) translation
                ;               tables and code for k/b and printer routines (crt is run
                ;               out of rom).
                ;
                ;               There is also a RX BOOT overlay which is selected instead
                ;               of the Xerox one. This loads the national translation
                ;               tables from disk and then calls the Xerox BOOT.


                        .z80

 000D           ver     defl    013

                        subttl  Xerox ROM dependant equates
                        page
```

```



                            ;;      The following equates are dependant on the revision of the Xerox ROM
                            ;       These are compatible with Ver. 4.02
                            ;
 1800                       rx1984  equ     1800h           ;start of rx1984
 0800                       romsiz  equ     800h            ;size of eprom
 F000                       monitr  equ     0f000h          ;start of monitor ad jump table
 F1EC                       savstk  equ     x'f1ec'         ;stack save address
 FF10                       ctcvec  equ     x'ff10'         ;counter timer interrupt vector
 FF18                       sysvec  equ     0ff18h          ;vector page
 FF1A                       kbvec   equ     sysvec+2        ;keyboard vector
 FC5D                       tca     equ     0fc5dh          ;start of 4.02 transient command area
 0002                       boff1   equ     ('A'-'@')*2     ;A command vector in command table
 0018                       boff2   equ     ('L'-'@')*2     ;l command vector in command table
 0019                       sioff   equ     19h             ;sioout vector in monitor table
 000A                       kboff   equ     0ah             ;offset in k/b int service for patch
 0010                       fcrtof  equ     10h             ;fast crt out vector in monitor table
 0012                       crtcall equ     12h             ;offset in crt driver for patch
 F006                       const   equ     monitr+6
 F009                       conin   equ     monitr+9
 F003                       warm    equ     monitr+3
 F01B                       select  equ     monitr+1bh
 F01E                       home    equ     monitr+1eh
 F024                       read    equ     monitr+24h
 F03C                       config  equ     monitr+x'3c'    ;monitor configure routine
 F03F                       siordy  equ     monitr+x'3f'    ;sio channel b output ready status
 F066                       idle    equ     monitr+x'66'    ;idle while i/o pending
 F06C                       mntrex  equ     monitr+x'6c'    ;monitor jump table expansion area
 F06C                       kybdlp  equ     monitr+x'6c'    ;low profile keyboard entry address
 F06F                       key2    equ     monitr+x'6f'    ;keyboard xlat char entry address
 F072                       key5    equ     monitr+x'72'    ;keyboard without xlat char entry address
 F075                       pnext   equ     monitr+x'75'    ;print message after call
 F078                       prboff  equ     monitr+x'78'    ;promt boot entry
 0182                       crtd1   equ     0182h
 0196                       crtd2   equ     0196h
 01DD                       grpad   equ     1ddh            ;address of set graphics attribute
 1078                       xrsign  equ     1078h           ;adress of xr signon overlay
 0060                       sigoff  equ     60h             ;offset of ver value in signon
 11C0                       xrboot  equ     11c0h           ;boot o/l address
 F167                       mkey2   equ     x'f167'         ;keyboard handler entry address
 F18F                       mkey5   equ     x'f18f'         ;return from keyboard and timer interrupt add
 F22F                       sprnt1  equ     0f22fh          ;patch address for screen print
 F232                       sprnt2  equ     0f232h          ;return address from RX screenprint code
 F293                       crtoff  equ     x'f293'         ;switch to ram side
 F339                       prvatt  equ     0f339h          ;contains address of current set attribute
 FA62                       prompt  equ     0fa62h          ;4.02 PROMPT
 FA95                       mprmt0  equ     x'fa95'         ;4.01 PRMT0
 FC3D                       mpnext  equ     x'fc3d'         ;4.01 PNEXT

                            ;       Data Addreses

 ED80                       bootbf  equ     0ed80h
 F0E3                       mask    equ     0f0e3h
 F091                       confg   equ     0f091h
```

```
F20E                    spact   equ     x'f20e'
F319                    gold    equ     0f319h
F360                    seltab  equ     0f360h
F470                    fivdpb  equ     0f470h
F708                    rigdpb  equ     0f708h
F800                    tabled  equ     0f800h          ;space for rx code
FA11                    phytrk  equ     0fa11h
FF3C                    availb  equ     x'ff3c'         ;bottom available ram memory
FF50                    intstk  equ     x'ff50'         ;tempory stack address
FF54                    steprt  equ     0ff54h
FF5C                    linbuf  equ     0ff5ch
FFAC                    cursor  equ     0ffach
FFB2                    leadin  equ     0ffb2h
FFB3                    attrib  equ     0ffb3h          ;address of attributes enabled flag
FFB4                    chrsav  equ     0ffb4h

                        ;       Port addressess
                        ;
001D                    sysctl  equ     1dh
001C                    syspio  equ     1ch
0005                    siodpb  equ     05h
0010                    wd1797  equ     10h
001E                    kbdat   equ     1eh
0019                    ctc1    equ     x'19'           ;ctc1 port address

                        ;       Other Equates
                        ;
0081                    encntr  equ     x'81'           ;enable ctc command
0001                    stcntr  equ     x'01'           ;stop ctc command
0000                    rev0    equ     x'00'           ;4.00 Revision Level
0001                    rev1    equ     x'01'           ;4.01 Revision Level
0064                    rev50   equ     5*100-400       ;5.00 Revision level
003C                    cnfgoff equ     x'3c'           ;monitor configuration offset
0006                    cnfbyte equ     x'06'           ;configuration subroutine byte offset
0008                    kblp    equ     x'08'           ;configuration bit id for LPKYBD
0008                    romofs  equ     x'08'           ;PROMPT offset between 4.02 & 4.01 monitor
0001                    lpkofs  equ     x'01'           ;additonal sector required for table storage
007B                    upper   equ     'z'+1           ;upper limit for alpha test
0061                    lower   equ     'a'             ;lower limit for alpha test
0020                    upascii equ     'a'-'A'         ;set to upper case ASCII mask
0000                    zero    equ     0               ;zero
00FF                    setflg  equ     x'ff'           ;set flag

                        ;       Equates
                        ;
0004                    c.five  equ     04
0006                    c.sasi  equ     06
0001                    o.term  equ     0001h
0300                    sasidl  equ     300h

                        ;       Internal equates
                        ;
001D                    rtab1   equ     29              ;rigid disk tables sector 1
001E                    rtab2   equ     30              ;  "     "     "     "   2
0004                    ftab1   equ     04              ;floppy "      "     "   1
0005                    ftab2   equ     05              ;  "     "     "     "   2
```

```
0006                     ftab3   equu    06              ;  "    "     "    "   3
0000                     lang    equ     00              ;offset of language no. in index table
0001                     kbrd    equ     01              ;offset of k/b flag in index table
0002                     font    equ     02              ;offset of font flag in index table
0003                     prnt    equ     03              ;offset of printer flag in index table
0004                     kbrdtb  equ     04              ;offset of k/b tables in first sector
001A                     clrs    equ     1ah             ;clear screen
001B                     esc     equ     1bh             ;escape key
0004                     eot     equ     04h             ;end of text
000D                     cr      equ     0dh             ;carriage return
000A                     lf      equ     0ah             ;line feed

                                 subttl  RX1984 Restart
                                 page
```

```


0000'                             start:
                                          .phase  rx1984

                                  ;;      RX1984
                                  ;       Entry here from Xerox monitor bfore entering SIGNON.
                                  ;
                                  ;       Input:-
                                  ;               hl - cmdtab
                                  ;               de - seltab
                                  ;               bc - cloc
                                  ;
                                  ;
1800    C5                                push    bc
1801    D5                                push    de
1802    E5                                push    hl
1803    21 0000                           ld      hl,0
1806    CD F03C                           call    config          ;get monitor configuration
1809    7C                                ld      a,h
180A    FE 00                             cp      rev0
180C    CA 187E                           jp      z,noload        ;skip if below 4.01
180F    FE 64                             cp      rev50
1811    D2 187E                           jp      nc,noload       ;skip if 5.00 or above
1814    21 1B1A                           ld      hl,rv1tbl       ;4.01 spring board table
1817    FE 01                             cp      rev1
1819    28 03                             jr      z,tbxfer        ;skip if 4.01
181B    21 1B29                           ld      hl,rv2tbl       ;4.02+ spring board table
181E    11 F06C                   tbxfer: ld      de,mntrex
1821    01 000F                           ld      bc,jtblsz
1824    F5                                push    af              ;save monitor level
1825    ED B0                             ldir                    ;append monitor table with lpkybd jmp vectors
1827    DD 2A F03D                        ld      ix,(monitr+cnfgoff+1)   ;set address at monitor config:
182B    DD 7E 06                          ld      a,(ix+cnfbyte)
182E    F6 08                             or      kblp            ;set low profile bit flag
1830    DD 77 06                          ld      (ix+cnfbyte),a
1833    F1                                pop     af              ;recover monitor level

                                  ;;      Alter BOOT commnd vectors
                                  ;
1834    DD E1                             pop     ix              ;cmdtab address
1836    DD E5                             push    ix
1838    DD 36 02 3D'                      ld      (ix+boff1),low rxboot           ;assume 4.01 monitor
183C    DD 36 03 06'                      ld      (ix+boff1+1),high rxboot
1840    DD 36 18 3D'                      ld      (ix+boff2),low rxboot
1844    DD 36 19 06'                      ld      (ix+boff2+1),high rxboot
1848    FE 01                             cp      rev1            ;monitor check
184A    28 10                             jr      z,soout.        ;skip if 4.01 monitor
184C    DD 36 02 45'                      ld      (ix+boff1),low (rxboot+romofs)  ;4.02+ monitor boot over addr
1850    DD 36 03 06'                      ld      (ix+boff1+1),high (rxboot+romofs)
1854    DD 36 18 45'                      ld      (ix+boff2),low (rxboot+romofs)
1858    DD 36 19 06'                      ld      (ix+boff2+1),high (rxboot+romofs)

                                  ;;      Alter keyboard interrupt service
                                  ;
```

```
 185C     DD 2A FF1A              Soout:  ld      ix,(kbvec)       ;k/b int vector
 1860     DD 36 0A CD                     ld      (ix+kboff),0cdh ;CALL operation
 1864     DD 36 0B 6C                     ld      (ix+kboff+1),low kybdlp
 1868     DD 36 0C F0                     ld      (ix+kboff+2),high kybdlp

                                  ;;      Move in RX SIGNON to o/l area and execute it
                                  ;
 186C     E1                              pop     hl
 186D     D1                              pop     de
 186E     C1                              pop     bc
 186F     C1                              pop     bc               ;throw away  return address
 1870     21 0552'                        ld      hl,rxsign        ;rom address
 1873     11 FC5D                         ld      de,tca           ;o/l area
 1876     01 00EB                         ld      bc,rxsigl        ;length
 1879     ED B0                           ldir
 187B     C3 FC5D                         jp      tca              ;GO SIGN ON
 187E     E1                      noload: pop     hl
 187F     D1                              pop     de
 1880     C1                              pop     bc
 1881     3E FF                           ld      a,x'ff'          ;wrong monitor
 1883     A7                              and     a                ;load signon from monitor
 1884     C9                              ret

                                          subttl  ROM resident CRT Driver
                                          page
```

```


                           ;;      Crtdvr - Crt Driver RX Addition.
                           ;
1885    2A FFAC            Rxcrt:  ld      hl,(cursor)     ;set cursor address
1888    3A FFB4                    ld      a,(chrsav)      ;retrieve character under cursor
188B    77                         ld      (hl),a          ;replace character under cursor
188C    32 F319                    ld      (gold),a        ;bury balcones gold
188F    3A FFB2                    ld      a,(leadin)      ;set leadin state
1892    B7                         or      a
1893    C2 0196                    jp      nz,crtd2        ;if processing escape sequence
1896    3A F0E3                    ld      a,(mask)        ;get keyboard mask
1899    A1                         and     c
189A    4F                         ld      c,a
189B    FE 20                      cp      ' '
189D    DA 0196                    jp      c,crtd2         ;if control code
18A0    CD 18A6                    call    fonchk          ;do font translation
18A3    C3 0182                    jp      crtd1           ;go to XR code

                           ;;      Subroutine fonchk does the font translation for national
                           ;       character sets.
                           ;       entry:  C contains the character
                           ;       exit:   C contains the translation
                           ;
18A6    E5                 Fonchk: push    hl              ;save cursor posn.
18A7    79                         ld      a,c             ;get char in a
18A8    E6 80                      and     10000000b       ;preserve attribute bit
18AA    F5                         push    af
18AB    21 FFB3                    ld      hl,attrib       ;point to attribute enabled flag
18AE    B6                         or      (hl)            ;test if set
18AF    28 0A                      jr      z,fon1          ;no attribute bit - go do translation
18B1    11 01DD                    ld      de,grpad        ;check if graphics mode
18B4    2A F339                    ld      hl,(prvatt)     ;current attribute mode
18B7    ED 52                      sbc     hl,de
18B9    28 0F                      jr      z,fon2          ;grahics mode - no translate
18BB    79                 fon1:   ld      a,c             ;here to do translate
18BC    CB BF                      res     7,a             ;clear attribute bit
18BE    21 F960                    ld      hl,fontbl       ;address of exceptions table
18C1    01 000D                    ld      bc,fontsz       ;size of exceptions table
18C4    ED B1                      cpir                    ;search for char. in exceptions
18C6    4F                         ld      c,a             ;restore char to c
18C7    CC 18CF                    call    z,fntran        ;if found do translation
18CA    F1                 fon2:   pop     af              ;retrieve attribute bit
18CB    B1                         or      c               ;or it in
18CC    4F                         ld      c,a
18CD    E1                         pop     hl              ;retrieve cursor
18CE    C9                         ret

                           ;;      s/r fntran translates font characters
                           ;       entry: (HL) - address+1 of char to be translated in fontbl
                           ;       exit:  (c)  - translated character
                           ;
18CF    2B                 Fntran: dec     hl              ;back to byte to be translated
18D0    01 000D                    ld      bc,fontsz       ;size of table
18D3    09                         add     hl,bc           ;add to address of char. to be translated
```

```
18D4    4E                          ld      c,(hl)          ;get translated value
18D5    C9                          ret

                          ;;        This routine is called from the Xerox screenprint handler. It
                          ;         picks up the character to be printed from the crt ram, does a
                          ;         reverse font translate,replaces any control codes with a space,
                          ;         does a printer translate and outputs the character to the printer.
                          ;         entry:- HL - address of byte to be printed
                          ;
18D6    E5                scrprt:   push    hl
18D7    C5                          push    bc
18D8    7E                          ld      a,(hl)          ;byte for printing
18D9    CB BF                       res     7,a             ;ignore attribute bit
                                                            ;do reverse font translate
18DB    21 F96D                     ld      hl,fontbl+fontsz        ;point to translates
18DE    01 000D                     ld      bc,fontsz
18E1    ED B1                       cpir                    ;search for char.
18E3    20 07                       jr      nz,scr01        ;not in table
                                                            ;in table convert to media code
18E5    01 000D                     ld      bc,fontsz       ;offset back to media code
18E8    37                          scf
18E9    ED 42                       sbc     hl,bc           ;points to media code
18EB    7E                          ld      a,(hl)
18EC                      scr01:                            ;here with media code
18EC    FE 20                       cp      20h             ;is it a control code
18EE    30 02                       jr      nc,scr02        ;no
18F0    3E 20                       ld      a,20h           ;yes. substitute a space
18F2    CD 1966           scr02:    call    potran          ;do printer translation
18F5    20 0D                       jr      nz,scr03        ;no translation done. go output char.
                                                            ;translation done.check escape bit
18F7    CB 7F                       bit     7,a             ;escape bit
18F9    28 09                       jr      z,scr03         ;not set go output char
18FB    4F                          ld      c,a             ;set. save char.
18FC    3E 1B                       ld      a,esc           ;output an escape
18FE    CD 1959                     call    posout          ;output routine
1901    79                          ld      a,c             ;restore char.
1902    CB BF                       res     7,a             ;clear escape bit
1904    CD 1959           scr03:    call    posout          ;print char
1907    C1                          pop     bc
1908    E1                          pop     hl
1909    C3 F232                     jp      sprnt2          ;return to Xerox code

                          ;;        Exception print driver - ROM entry point
                          ;
190C    C5                Rmposend:push     bc
190D    E5                          push    hl
190E    CD 1914                     call    posend
1911    E1                          pop     hl
1912    C1                          pop     bc
1913    C9                          ret

                          ;;        Posend - deals with character translation and escape
                          ;                 sequences for the diablo 630
                          ;                 input--- a contains char for output to channel b
1914    4F                Posend:   ld      c,a
1915    3A F9A6                     ld      a,(escsq)       ;in an escape sequence?
```

```
1918    B7                        or      a
1919    20 22                     jr      nz,pos04        ;yes
191B    79                        ld      a,c
191C    FE 1B                     cp      esc             ;escape char?
191E    20 07                     jr      nz,pos01        ;no
1920    CD 1959                   call    posout          ;output char
1923    32 F9A6                   ld      (escsq),a       ;set escape sequence flag
1926    C9                        ret
1927                      pos01:                          ;not escape char
1927    CD 1966                   call    potran          ;do translation if neccessary
192A    20 0D                     jr      nz,pos03        ;wasn't neccessary
192C    CB 7F                     bit     7,a             ;escape marker set?
192E    28 09                     jr      z,pos02         ;no
1930    4F                        ld      c,a
1931    3E 1B                     ld      a,esc
1933    CD 1959                   call    posout          ;output escape char
1936    79                        ld      a,c
1937    CB BF                     res     7,a             ;clear escape marker
1939                      pos02:                          ;escape marker not set
1939                      pos03:                          ;no translation
1939    CD 1959                   call posout             ;output char
193C    C9                        ret
193D                      pos04:                          ;escape sequence
193D    FE FF                     cp      0ffh            ;3rd byte?
193F    20 06                     jr      nz,pos05        ;no 2nd
1941    79                        ld      a,c
1942    CD 1959                   call    posout          ;output char
1945    18 0D                     jr      pos06
1947    79                pos05:  ld      a,c             ;2nd byte of escape sequence
1948    CD 1959                   call    posout          ;output byte
194B    CD 1986                   call    poesc           ;search escape table for char
194E    20 04                     jr      nz,pos06        ;not present---2 byte sequence
1950    3E FF                     ld      a,0ffh          ;set sequence for 3rd byte
1952    18 01                     jr      pos07
1954    AF                pos06:  xor     a               ;end of 2 byte sequence
1955    32 F9A6           pos07:  ld      (escsq),a       ;toggle escape sequence flag
1958    C9                        ret
1959    47                posout: ld      b,a
195A    CD F03F           siox1:  call    siordy
195D    CC F066                   call    z,idle
1960    28 F8                     jr      z,siox1
1962    78                        ld      a,b
1963    D3 05                     out     (siodpb),a
1965    C9                        ret

                          ;;      Potran - does printer translation if neccessary and returns
                          ;                a flag to indicate if translation has been done.
                          ;                input- a  char for translaation
                          ;
                          ;                output- a  (translated) char
                          ;                         z  set if char is translated (otherwise reset)
                          ;
1966    21 F97A           Potran: ld      hl,prntbl       ;print exceptions table
1969    01 0016                   ld      bc,prntsz       ;size of table
196C    ED B1                     cpir
196E    C0                        ret     nz              ;no match - don't translate
```

```
196F    2B                          dec     hl              ;translate
1970    01 0016                     ld      bc,prntsz
1973    09                          add     hl,bc           ;offset to translation
1974    7E                          ld      a,(hl)          ;translation byte
1975    B7                          or      a               ;if zero, requires overstriking sequence
1976    20 0B                       jr      nz,ptr01        ;non-zero - go output char
                                                            ;zero - use next 2 bytes in table as sequence
1978    23                          inc     hl
1979    7E                          ld      a,(hl)          ;first byte
197A    CD 1959                     call    posout
197D    3E 08                       ld      a,08h           ;backspace
197F    CD 1959                     call    posout
1982    23                          inc     hl              ;second byte
1983    AF                  ptr01:  xor     a               ;set z for return flag
1984    7E                          ld      a,(hl)          ;get translation
1985    C9                          ret

                            ;;      Poesc - searches the escape table for a match with the char
                            ;               passed in a. if found returns with z set otherwise
                            ;               z is clear
                            ;
1986    21 198F             Poesc:  ld      hl,pesctb       ;table of escape sequences
1989    01 0007                     ld      bc,esctsz       ;size of table
198C    ED B1                       cpir
198E    C9                          ret

198F    09 0B 0C 1E         pesctb: defb    09h,0bh,0ch,1eh,1fh,16h,11h     ;630 daisy printer
1993    1F 16 11
0007                        esctsz  equ     $-pesctb


                            ;;      Function:- to deal with characters form a position
                            ;                     encoded keyboard.
                            ;       input:-       A  character read from PIO
                            ;                     CMD/STATUS byte
                            ;                               bit 7 -CMD/STATUS byte if set
                            ;                               bit 6 -upstroke flag
                            ;                               bit 5 -y axis negative (mouse)
                            ;                               bit 4 -x axis negative (mouse)
                            ;                               bit 3 -mouse active
                            ;                               bit 2 -ctrl key station active
                            ;                               bit 1 -shift key station active
                            ;                               bit 0 -lock key station active
                            ;               First data byte
                            ;                               bit 7 -Always reset
                            ;                               bits(6-0) -key station or x mouse displacement
                            ;                                           Second mouse data byte
                            ;                               bit 7 -Always reset
                            ;                               bits(6-0) -y mouse displacement
                            ;
                            ;       output:-      1) Carry set -- command byte or sequence error
                            ;                     2) Carry clear -- translated character returned in A
                            ;
1996    2F                  Pekhdl: cpl                     ;complement keyboard byte
1997    D5                          push    de              ;save registers
1998    16 00                       ld      d,zero          ;get flags
```

```
199A    CB 7F                   bit     cmd,a           ;command byte?
199C    28 17                   jr      z,kypos         ;skip to position byte handler
199E    18 01                   jr      cmdb            ;skip to command byte handler
19A0                    nochar  equ     $
19A0    7A              peknoc2:ld      a,d             ;clear command byte (non-valid position byte)
19A1    32 F9A7         cmdb:   ld      (cmdstat),a     ;save command-status byte
19A4    CB 5F                   bit     mouse,a         ;mouse cmd?
19A6    28 05                   jr      z,peknoc        ;skip if not mouse
19A8    21 F95D                 ld      hl,mstbl
19AB    CB 8E                   res     xy,(hl)
19AD    CD 1A66         peknoc: call    stpctcl         ;reset repeat flag
19B0    37              peknoc1:scf                     ;this no the position byte
19B1    D1              pekex:  pop     de              ;recover registers
19B2    C3 F9B7                 jp      lpkext          ;jmp instead of ret - small interrupt stack
19B5    5F              kypos:  ld      e,a             ;save position code
19B6    21 F9A7                 ld      hl,cmdstat      ;fetch command byte
19B9    CB 7E                   bit     cmd,(hl)        ;out of sync check
19BB    28 F0                   jr      z,peknoc        ;quit if no command byte
19BD    CB 5E                   bit     mouse,(hl)      ;test for mouse movement
19BF    C2 1A7D                 jp      nz,mice         ;skip if mouse moved
19C2    CB 76                   bit     ustrk,(hl)      ;test key posistion
19C4    20 20                   jr      nz,upstrk       ;jump if special upstroke
19C6    CD 19DB                 call    ctrtst          ;test for control codes
19C9    28 D5                   jr      z,peknoc2       ;quit if non printable control character
19CB    CD 19FF                 call    tblsel          ;select translation table
19CE    CD 1A23                 call    alphtst         ;test for alpha lock char
19D1    CD 1A3D                 call    rptst           ;test for repeat keys
19D4    21 F9A7         charout:ld      hl,cmdstat      ;fetch command byte
19D7    72                      ld      (hl),d          ;clear command byte (valid position byte)
19D8    A7                      and     a               ;clear carry
19D9    18 D6                   jr      pekex

                        ;;      Character is tested for the lock, shift, and ctrl key station.
                        ;
                        ;       input   a - key station code
                        ;
                        ;       output z - set if lock,shift, or ctrl key station
                        ;
19DB    E5              Ctrtst: push    hl              ;save registers
19DC    21 F953                 ld      hl,ctrltb       ;non printable char table
19DF    01 0006                 ld      bc,cntctr       ;byte count of table
19E2    ED B1                   cpir                    ;search table
19E4    E1                      pop     hl
19E5    C9                      ret

                        ;;      The up-stroke is tested for special up-stroke key-stations.
                        ;
                        ;       input   a - key station code
                        ;               strkup - user enable flag
                        ;
                        ;       output  a - translated up-stroke key-station code
                        ;
19E6    21 F95D         Upstrk: ld.     hl,mstbl        ;user enable up-stroke flag
19E9    CB 5E                   bit     strkup,(hl)
19EB    28 B3                   jr      z,nochar        ;quit if user inhibited
19ED    21 F959                 ld      hl,ups          ;exception key-station table
```

```
19F0   01 0002                 ld      bc,upssz         ;byte count of table
19F3   ED B1                   cpir                     ;search table
19F5   20 A9                   jr      nz,nochar        ;quit if no match
19F7   2B                      dec     hl               ;get exception
19F8   01 0002                 ld      bc,upssz
19FB   09                      add     hl,bc
19FC   7E                      ld      a,(hl)
19FD   18 D5                   jr      charout          ;return translated character

                       ;;      The appropriate keyboard translation table is selected
                       ;
                       ;       input   hl - command-status address
                       ;               de - key station code
                       ;
                       ;       output  a  - translated key station code
                       ;
19FF   7E              Tblsel: ld      a,(hl)           ;move cmd-status byte
1A00   E5                      push    hl               ;save command-status ptr
1A01   21 F867                 ld      hl,shtab         ;preset to shift table
1A04   CB 4F                   bit     shift,a          ;shift bit set?
1A06   20 17                   jr      nz,cmdbl         ;skip if set
1A08   21 F8CE                 ld      hl,cdtab         ;preset to control table
1A0B   CB 57                   bit     ctrl,a           ;control bit set?
1A0D   20 10                   jr      nz,cmdbl         ;skip if set
1A0F   21 F800                 ld      hl,tabl          ;preset to un shifted table
1A12   CB 47                   bit     lock,a           ;lock key set
1A14   28 09                   jr      z,cmdbl          ;skip if reset
1A16   3A F93B                 ld      a,(shftlck)      ;lock key set
1A19   A7                      and     a                ;test for shift lock (not alpha lock)
1A1A   28 03                   jr      z,cmdbl          ;skip if reset
1A1C   21 F867                 ld      hl,shtab         ;preset to shift table
1A1F                   cmdbl:                           ;here with translation table address in hl
1A1F   19                      add     hl,de            ;index into table
1A20   7E                      ld      a,(hl)           ;get translated char
1A21   E1                      pop     hl               ;recover command-status ptr
1A22   C9                      ret

                       ;;      If the lock key is depressed, the translated character is
                       ;       tested to see if it is an alphabet.  If it is lower case,
                       ;       then it is forced upper case.
                       ;
                       ;       input   hl - command-status address
                       ;               a  - translated character
                       ;
                       ;       output a  - translated character(upper chase if alpha+lock)
                       ;
1A23   CB 46           Alphtst:bit     lock,(hl)        ;test alpha lock flag
1A25   C8                      ret     z                ;quit if not alpha lock
1A26   FE 7B                   cp      upper            ;test for upper alpha range
1A28   30 06                   jr      nc,alphexc       ;skip if non alpha range
1A2A   FE 61                   cp      lower            ;test for lower case alpha range
1A2C   38 02                   jr      c,alphexc        ;skip if not lower alpha case
1A2E   D6 20                   sub     upascii          ;set upper case ASCII alpha character

                       ;;      Three additional caracters are allowed for the alpha lock key
                       ;
```

```
                                ;       input   hl - command-status address
                                ;               a  - translated character
                                ;
                                ;       output  a  - upper case exception
                                ;
        1A30    21 F935         Alphexc:ld      hl,captab               ;lock exception table
        1A33    01 0003                 ld      bc,cptbsz               ;table size
        1A36    ED B1                   cpir                            ;search
        1A38    C0                      ret     nz                      ;quit if not found
        1A39    23                      inc     hl                      ;get exception
        1A3A    23                      inc     hl
        1A3B    7E                      ld      a,(hl)
        1A3C    C9                      ret

                                ;;      Checks for repeat character.  If repeat character, the millisec
                                ;       timer is vector address is modified and the timer is set up
                                ;       for 0.5 second.  The timer is kicked off.
                                ;
                                ;       input   a - translated character
                                ;
        1A3D    21 F940         Rptst:  ld      hl,rptbl        ;repeat char table
        1A40    01 0013                 ld      bc,cntrp        ;number of repeat chars
        1A43    ED B1                   cpir                    ;test for repeat chars
        1A45    C0                      ret     nz              ;quit if not repeat char
        1A46    2A F93C                 ld      hl,(tick)       ;millisec count
        1A49    22 F9A8                 ld      (millcnt),hl    ;save it in table
        1A4C    21 F9AA                 ld      hl,rptchar      ;repeat char save address
        1A4F    77                      ld      (hl),a          ;save repeat char
        1A50    F5                      push    af
        1A51    23                      inc     hl              ;repeat flag address
        1A52    36 FF                   ld      (hl),setflg     ;set repeat flag
        1A54    2A FF12                 ld      hl,(ctcvec+2)   ;get 1 millisec interrupt vector
        1A57    22 F9AC                 ld      (save),hl       ;save it
        1A5A    21 F9D0                 ld      hl,rptclk       ;kybd repeat key timer
        1A5D    22 FF12                 ld      (ctcvec+2),hl   ;substitute it
        1A60    3E 81                   ld      a,encntr        ;enable millisec timmer
        1A62    D3 19                   out     (ctc1),a        ;do it
        1A64    F1                      pop     af              ;recover character
        1A65    C9                      ret

                                ;;      This routine stops the millisecond timer and restores the
                                ;       original timer vector
                                ;
        1A66    21 F9AB         Stpctc1:ld      hl,rptflg       ;fetch repeat char flag
        1A69    7E                      ld      a,(hl)
        1A6A    A7                      and     a               ;set flags
        1A6B    C8                      ret     z               ;quit if no repeat keys
        1A6C    72                      ld      (hl),d          ;clear repeat char flag
        1A6D    2A F9AC                 ld      hl,(save)       ;original 1 millisec interrupt address
        1A70    22 FF12                 ld      (ctcvec+2),hl   ;restore it
        1A73    3A F20E                 ld      a,(spact)       ;fetch screen print flag
        1A76    A7                      and     a
        1A77    C0                      ret     nz              ;don't kill timer, if screen printing
        1A78    3E 01                   ld      a,stcntr        ;stop timer
        1A7A    D3 19                   out     (ctc1),a
        1A7C    C9                      ret
```

```

                                     ;;      This is the optical mouse handler.  The delta x and y mouse
                                     ;       movement is accumulate and stored in memory locations.
                                     ;
                                     ;       input   a=      mouse delta either x or y
                                     ;               xy=     zero for x mouse delta
                                     ;                       x'ff' for y mouse delta
                                     ;               hl=     cmdstat address
                                     ;               cmdstat=bit 3   mouse moved
                                     ;                       bit 4   x delta negative
                                     ;                       bit 5   y delta negative
                                     ;               mstbl  =bit 7   mouse enabled user flag
                                     ;                       bit 6   intrp/npol
                                     ;                       bit 1   y/nx byte
                                     ;                       bit 0   mouse table is updated
                                     ;               mbyte  =interrupt return byte
                                     ;               xmax   =maximum horizontal display units
                                     ;               ymax   =maximum vertical display units
                                     ;
                                     ;       output mstbl=   bit 0, mouse table updated
                                     ;               xloc=   x position of mouse
                                     ;               yloc=   y position of mouse
                                     ;               dxmv=   prior x signed displacement
                                     ;               dymv=   prior y signed displacement
                                     ;
                                     ;       special requirements
                                     ;               The majority of the mouse-pointer table is require memory
                                     ;               resident in the in the user address space above X'BFFF'
                                     ;               since this handle is ROM resident.  Variables MSTBL AND MSPTR
                                     ;               reside in keyboard RAM space.  Variable MSPTR pointers to
                                     ;               where the user mouse table resides.  These variable are
                                     ;               update by both the handler and the user.  The following
                                     ;               data structure resides in the user's RAM space only if
                                     ;               the two-button mouse pointer is required for the applicaton:
                                     ;               (MSPTR+0)       =MBYTE
                                     ;               (MSPTR+1)       =XMAX-LSB
                                     ;               (MSPTR+2)       =    -MSB
                                     ;               (MSPTR+3)       =YMAX-LSB
                                     ;               (MSPTR+4)       =    -MSB
                                     ;               (MSPTR+5)       =XLOC-LSB
                                     ;               (MSPTR+6)       =    -MSB
                                     ;               (MSPTR+7)       =YLOC-LSB
                                     ;               (MSPTR+8)       =    -MSB
                                     ;               (MSPTR+9)       =DXMV-LSB
                                     ;               (MSPTR+A)       =    -MSB
                                     ;               (MSPTR+B)       =DYMV-LSB
                                     ;               (MSPTR+C)       =    -MSB
                                     ;
        1A7D    5F                   Mice:   ld      e,a             ;save mouse delta
        1A7E    7E                           ld      a,(hl)
        1A7F    47                           ld      b,a             ;save cmd/status byte
        1A80    21 F95D                      ld      hl,mstbl        ;mouse table
        1A83    CB 7E                        bit     msflg,(hl)      ;test for user enabled
        1A85    CA 19A0                      jp      z,nochar        ;quit if mouse handler is not enabled
        1A88    DD E5                        push    ix              ;save register
        1A8A    DD 2A F95E                   ld      ix,(msptr)      ;fetch user's table
```

```
1A8E    CB 4E                        bit     xy,(hl)         ;test y/nx mouse byte flag
1A90    20 26                        jr      nz,micey        ;skip if y axis delta
1A92    DD 6E 05                     ld      l,(ix+5)        ;fetch current x position
1A95    DD 66 06                     ld      h,(ix+6)
1A98    7B                           ld      a,e             ;save unsigned mouse delta byte
1A99    CB 60                        bit     xneg,b          ;test polarity of x delta
1A9B    CD 1AEB                      call    micel           ;add delta & do min value check
1A9E    DD 73 09                     ld      (ix+x'9'),e     ;save signed mouse delta word
1AA1    DD 72 0A                     ld      (ix+x'a'),d
1AA4    DD 5E 01                     ld      e,(ix+1)        ;fetch max position value
1AA7    DD 56 02                     ld      d,(ix+2)
1AAA    CD 1B00                      call    mice2           ;do max value check
1AAD    DD 75 05                     ld      (ix+5),l        ;save position
1AB0    DD 74 06                     ld      (ix+6),h
1AB3    DD E1                micex1: pop     ix              ;restore regiser
1AB5    C3 19B0                      jp      peknocl         ;return to wait for y mouse byte
1AB8    DD 6E 07             micey:  ld      l,(ix+7)        ;fetch current y position
1ABB    DD 66 08                     ld      h,(ix+8)
1ABE    7B                           ld      a,e             ;save unsigned mouse delta byte
1ABF    CB 68                        bit     yneg,b          ;test polarity of y delta
1AC1    CD 1AEB                      call    micel           ;add delta & do min value check
1AC4    DD 73 0B                     ld      (ix+x'b'),e     ;save signed mouse delta word
1AC7    DD 72 0C                     ld      (ix+x'c'),d
1ACA    DD 5E 03                     ld      e,(ix+3)        ;fetch max position value
1ACD    DD 56 04                     ld      d,(ix+4)
1AD0    CD 1B00                      call    mice2           ;do max value check
1AD3    DD 75 07                     ld      (ix+7),l        ;save position
1AD6    DD 74 08                     ld      (ix+8),h
1AD9    21 F95D                      ld      hl,mstbl        ;update mouse status
1ADC    CB C6                        set     msmov,(hl)      ;set the mouse update flag
1ADE    CB 76                        bit     mintrp,(hl)     ;test for interrupt mode
1AE0    CA 1AB3                      jp      z,micex1        ;bye bye if polling mode
1AE3    DD 7E 00                     ld      a,(ix)          ;user interrupt byte
1AE6    DD E1                        pop     ix              ;restore regiser
1AE8    C3 19D4                      jp      charout         ;bye bye

                             ;;      This routine adds the delta to either the x or y position and
                             ;       does minimum position check
                             ;       input   e=      mouse delta (absolute)
                             ;               zero    set if positive mouse delta
                             ;                       reset if negative mouse delta
                             ;
                             ;       output  hl=     update position
                             ;
1AEB    20 04                Micel:  jr      nz,micel1       ;skip if delta negative
1AED    16 00                        ld      d,zero          ;set msb positive
1AEF    18 07                        jr      micel2
1AF1    16 FF                micel1: ld      d,-1            ;set msb negative
1AF3    7B                           ld      a,e             ;recover delta
1AF4    2F                           cpl                     ;2's complement
1AF5    C6 01                        add     a,1
1AF7    5F                           ld      e,a             ;put negative value back
1AF8    19                   micel2: add     hl,de           ;add delta to mouse position
1AF9    7C                           ld      a,h             ;get msb
1AFA    A7                           and     a
1AFB    F0                           ret     p               ;skip if msb is positive
```

```
1AFC    21 0000                         ld      hl,zero         ;set to minimum boundary
1AFF    C9                              ret

                                ;;      This routine does a maximum x or y position check
                                ;       input   hl=     x or y position
                                ;               de=     x or y max value
                                ;
                                ;       output  a =     mstbl
                                ;
1B00    7A                      Mice2:  ld      a,d             ;msb position test
1B01    BC                              cp      h
1B02    38 04                           jr      c,mice21        ;skip if msb too big
1B04    7B                              ld      a,e             ;lsb position test
1B05    BD                              cp      l
1B06    30 01                           jr      nc,mice22       ;skip if lsb is not too big
1B08    EB                      mice21: ex      de,hl           ;force maximum limit
1B09    3A F95D                 mice22: ld      a,(mstbl)       ;mouse table
1B0C    CB 4F                           bit     xy,a            ;complement xy flag
1B0E    28 04                           jr      z,mice23
1B10    CB 8F                           res     xy,a
1B12    18 02                           jr      mice24
1B14    CB CF                   mice23: set     xy,a
1B16    32 F95D                 mice24: ld      (mstbl),a       ;update table
1B19    C9                              ret

                                ;;      Jump table for keyboard translator and interrupt handler.
                                ;       Exit points and monitor adjustment points for the SIGNON
                                ;       overlay and boot overlay
                                ;
1B1A    C3 F9AF                 Rvltbl: jp      lpkybd          ;4.01   monitor lpkybd jump table
1B1D    C3 F167                         jp      mkey2
1B20    C3 F18F                         jp      mkey5
1B23    C3 FC3D                         jp      mpnext
1B26    C3 FA95                         jp      mprmt0
000F                            jtblsz  equ     $-rvltbl

1B29    C3 F9AF                 rv2tbl: jp      lpkybd          ;4.02   monitor lpkybd jump table
1B2C    C3 F167                         jp      mkey2
1B2F    C3 F18F                         jp      mkey5
1B32    C3 FC45                         jp      mpnext+romofs
1B35    C3 FA9D                         jp      mprmt0+romofs

                                ;;      The keyboard tables are restored to the original default values
                                ;       that are stored in rom
                                ;
1B38    C5                      Movtbl: push    bc
1B39    D5                              push    de
1B3A    E5                              push    hl
1B3B    21 034A'                        ld      hl,tables
1B3E    11 F800                         ld      de,tabled
1B41    01 0159                         ld      bc,tablex
1B44    ED B0                           ldir
1B46    E1                              pop     hl
1B47    D1                              pop     de
1B48    C1                              pop     bc
1B49    C9                              ret
```

```

                                                  .dephase
                                                  subttl  RAM resident (Tables)
                                                  page
```

```
        034A'                   tables:                         ;rom address
                                        .phase  tabled          ;ram address

        0010                            .radix  16

                                ;;      k/b unshifted table
                                ;
        F800    00 1B 31 32     Tabl:   defb    00h,1bh,31h,32h,33h,34h,35h,36h         ;nul,esc,1,2,3,4,5,6
        F804    33 34 35 36
        F808    37 38 39 30             defb    37h,38h,39h,30h,2dh,3dh,08h,09h         ;7,8,9,0,-,=,bs,tab
        F80C    2D 3D 08 09
        F810'   71 77 65 72             defb    71h,77h,65h,72h,74h,79h,75h,69h         ;q,w,e,r,t,y,u,i
        F814    74 79 75 69
        F818    6F 70 5B 5D             defb    6fh,70h,5bh,5dh,0dh,0ee,61h,73h         ;o,p,[,],cr,lctrl,a,s
        F81C    0D EE 61 73
        F820    64 66 67 68             defb    64h,66h,67h,68h,6ah,6bh,6ch,3bh         ;d,f,g,h,j,k,l,;
        F824    6A 6B 6C 3B
        F828    27 0A EC 2E             defb    27h,0ah,0ec,2eh,7ah,78h,63h,76h         ;',lf,lshift,.,z,x,c,v
        F82C    7A 78 63 76
        F830    62 6E 6D 2C             defb    62h,6eh,6dh,2ch,2eh,2fh,0ed,1eh         ;b,n,m,,,.,/,rshift,help
        F834    2E 2F ED 1E
        F838    EF 20 EB F1             defb    0ef,20h,0eb,0f1,0f2,0f3,0f4,0f5         ;rctrl,sp,f1,f2,f3,f4,f5
        F83C    F2 F3 F4 F5
        F840    F6 F7 F8 F9             defb    0f6,0f7,0f8,0f9,0fa,0fb,0fc,37h         ;f6,f7,f8,f9,f10,f11,f12,7
        F844    FA FB FC 37
        F848    38 39 2C 34             defb    38h,39h,2ch,34h,35h,36h,0bd,31h         ;8,9,,,4,5,6,=enter,1
        F84C    35 36 BD 31
        F850    32 33 30 E7             defb    32h,33h,30h,0e7,82h,84h,83h,80h         ;2,3,0,next,darr,larr,rarr,h
        F854    82 84 83 80
        F858    81 E6 FD 7F             defb    81h,0e6,0fd,7fh,2bh,2dh,2ah,2fh         ;uarr,prev,acc,del,+,-,mul,d
        F85C    2B 2D 2A 2F
        F860    F0 18 8E 8F             defb    0f0,18h,8eh,8fh,0a0,0a2,0a4             ;ins,can,msw1,msw2,rx1,rx2,r
        F864    A0 A2 A4

                                ;;      k/b shifted
                                ;
        F867    00 1B 21 40     Shtab:  defb    00h,1bh,21h,40h,23h,24h,25h,5eh         ;nul,esc,!,@,#,$,%,^
        F86B    23 24 25 5E
        F86F    26 2A 28 29             defb    26h,2ah,28h,29h,5fh,2bh,08h,09h         ;&,*,(,),_,+,bs,tab
        F873    5F 2B 08 09
        F877    51 57 45 52             defb    51h,57h,45h,52h,54h,59h,55h,49h         ;Q,W,E,R,T,Y,U,I
        F87B    54 59 55 49
        F87F    4F 50 7B 7D             defb    4fh,50h,7bh,7dh,0dh,0ee,41h,53h         ;O,P,{,},cr,lcrtl,A,S
        F883    0D EE 41 53
        F887    44 46 47 48             defb    44h,46h,47h,48h,4ah,4bh,4ch,3ah         ;D,F,G,H,J,K,L,:
        F88B    4A 4B 4C 3A
        F88F    22 0A EC 2E             defb    22h,0ah,0ec,2eh,5ah,58h,43h,56h         ;",lf,lshift,.,Z,X,C,V
        F893    5A 58 43 56
        F897    42 4E 4D 3C             defb    42h,4eh,4dh,3ch,3eh,3fh,0ed,1eh         ;B,N,M,<,>,?,rshift,help
        F89B    3E 3F ED 1E
        F89F    EF 20 EB F1             defb    0ef,20h,0eb,0f1,0f2,0f3,0f4,0f5         ;rctrl,sp,lock,f1,f2,f3,f4,f
        F8A3    F2 F3 F4 F5
        F8A7    F6 F7 F8 F9             defb    0f6,0f7,0f8,0f9,0fa,0fb,0fc,37h         ;f6,f7,f8,f9,f10,f11,f12,7
        F8AB    FA FB FC 37
```

```
F8AF    38 39 2C 34                  defb    38h,39h,2ch,34h,35h,36h,0bd,31h       ;8,9,,,4,5,6,=enter,1
F8B3    35 36 BD 31
F8B7    32 33 30 E7                  defb    32h,33h,30h,0e7,82h,84h,83h,80h       ;2,3,0,next,darr,larr,rarr,h
F8BB    82 84 83 80
F8BF    81 E6 FD 7F                  defb    81h,0e6,0fd,7fh,2bh,2dh,2ah,2fh       ;uarr,prev,acc,del,+,-,mul,d
F8C3    2B 2D 2A 2F
F8C7    F0 18 8E 8F                  defb    0f0,18h,8eh,8fh,0a1,0a3,0a5           ;ins,can,msw1,msw2,rx1,rx2,r
F8CB    A1 A3 A5

                             ;;      k/b coded
                             ;
F8CE    00 9B 91 92          Cdtab:  defb    00h,9bh,91h,92h,93h,94h,95h,96h       ;nul,esc,1,2,3,4,5,6
F8D2    93 94 95 96
F8D6    97 98 99 90                  defb    97h,98h,99h,90h,1fh,9ah,88h,89h       ;7,8,9,0,-,=,bs,tab
F8DA    1F 9A 88 89
F8DE    11 17 05 12                  defb    11h,17h,05h,12h,14h,19h,15h,09h       ;q,w,e,r,t,y,u,i
F8E2    14 19 15 09
F8E6    0F 10 1B 1D                  defb    0fh,10h,1bh,1dh,8dh,0ee,01h,13h       ;o,p,[,],cr,lctrl,a,s
F8EA    8D EE 01 13
F8EE    04 06 07 08                  defb    04h,06h,07h,08h,0ah,0bh,0ch,7eh       ;d,f,g,h,j,k,l,~
F8F2    0A 0B 0C 7E
F8F6    60 8A EC AE                  defb    60h,08a,0ec,0ae,1ah,18h,03h,16h       ;`,lf,lshift,.,z,s,c,v
F8FA    1A 18 03 16
F8FE    02 0E 0D 1C                  defb    02h,0eh,0dh,1ch,7ch,5ch,0ed,9eh       ;b,n,m,,,|,\,rshift,help
F902    7C 5C ED 9E
F906    EF 00 EB D1                  defb    0ef,00h,0eb,0d1,0d2,0d3,0d4,0d5       ;rctrl,sp,lock,f1,f2,f3,f4,f
F90A    D2 D3 D4 D5
F90E    D6 D7 D8 D9                  defb    0d6,0d7,0d8,0d9,0da,0db,0dc,0b7       ;f6,f7,f8,f9,f10,f11,f12,7
F912    DA DB DC B7
F916    B8 B9 AC B4                  defb    0b8,0b9,0ac,0b4,0b5,0b6,0fe,0b1       ;8,9,,,4,5,6,=enter,1
F91A    B5 B6 FE B1
F91E    B2 B3 B0 C7                  defb    0b2,0b3,0b0,0c7,02h,04h,03h,1eh       ;2,3,0,next,darr,larr,rarr,h
F922    02 04 03 1E
F926    01 C6 DD FF                  defb    01h,0c6,0dd,0ff,0ab,0ad,0aa,0af       ;uarr,prev,acc,del,+,-,mul,d
F92A    AB AD AA AF
F92E    D0 DE 8E 8F                  defb    0d0,0de,8eh,8fh,0c8,0c9,0ca           ;ins,can,msw1,msw2,rx1,rx2,r
F932    C8 C9 CA

000A                                 .radix  10

F935    00 00 00             captab: defb    0,0,0           ;table of exceptions requiring shifting for
F938    00 00 00             cptex:  defb    0,0,0           ;caps lock key.(3 excepts then 3 translates)
0003                         cptbsz  equ     ($-captab)/2    ;size of table
F93B    00                   shftlck: defb   0               ;if set, locks all keys to shift table if lock set
F93C    F4                   tick:   defb    low hlfsec      ;lsb - repeat char speed
F93D    01                           defb    high hlfsec     ;msb
F93E    3F                   tock:   defb    low tenths      ;lsb
F93F    00                           defb    high tenths     ;msb
01F4                         hlfsec  equ     500             ;0.5 second count
003F                         tenths  equ     63              ;16 chars/sec

F940    08 0A 0D 20          rptbl:  defb    x'08',x'0a',x'0d',x'20'        ;bs,lf,cr,sp
F944    2D 2E 2F                     defb    x'2d',x'2e',x'2f'              ;-,.,/
F947    3D 58 78 7F                  defb    x'3d',x'58',x'78',x'7f'        ;=,X,x,del
F94B    81 82 83 84                  defb    x'81',x'82',x'83',x'84'        ;ucur,dcur,rcur,lcur
F94F    E0 E0 E0 E0          rptex:  defb    x'e0',x'e0',x'e0',x'e0'        ;16 TBD repeat keys
```

```
0013                            cntrp   equ     $-nptbl

F953    1D 2A 36 38             ctrltb: db      x'1d',x'2a',x'36',x'38',x'3a'    ;lctr,lshft,rshft,rctr,lck
F957    3A
F958    E0                      ctrlex: db      x'e0'                            ;19 TBD additional key stations
0006                            cntctr  equ     $-ctrltb
0159                            tablex  equ     $-tabl

F959    E0 E0                   ups:    defb    x'e0',x'e0'     ;upstroke exception key stations
F95B    E0 E0                   upsx:   defb    x'e0',x'e0'     ;upstroke char or code translations
0002                            upssz   equ     ($-ups)/2       ;size
F95D    00                      mstbl:  defb    0               ;mouse table
0007                            msflg   equ     7               ;mouse translator enabled if set
0006                            mintrp  equ     6               ;user interrupt with mbyte else user polls
0003                            strkup  equ     3               ;upstroke user enable flag
0001                            xy      equ     1               ;set for x delta else y delta
0000                            msmov   equ     0               ;mouse table contains new data
F95E    0000                    msptr:  defw    0               ;user address containing the following table
0160                            ktabsz  equ     $-tabl          ;size of k/b tables

                                ;;      Font translation table.
                                ;       first the exception codes
                                ;
F960    23 3C 3E 40             Fontbl: defb    23h,3ch,3eh,40h,5bh,5ch,5dh,5eh         ;#,<,>,@,[,\,],^
F964    5B 5C 5D 5E
F968    60 7B 7C 7D                     defb    60h,7bh,7ch,7dh,7eh                     ;`,{,|,},~
F96C    7E

                                ;;      Now their translations
                                ;
F96D    23 3C 3E 40                     defb    23h,3ch,3eh,40h,5bh,5ch,5dh,5eh
F971    5B 5C 5D 5E
F975    60 7B 7C 7D                     defb    60h,7bh,7ch,7dh,7eh
F979    7E
000D                            fontsz  equ     ($-fontbl)/2    ;size of font tables

                                ;;      Printer translation table
                                ;       first the exception codes
                                ;
F97A    21 23 2A 2B             Prntbl: defb    21h,23h,2ah,2bh,2ch,2eh,3ch,3eh         ;!,#,*,+,,,.,<,>
F97E    2C 2E 3C 3E
F982    40 5B 5C 5D                     defb    40h,5bh,5ch,5dh,5eh,60h,7bh,7ch         ;@,[,\,],^,`,{,|
F986    5E 60 7B 7C
F98A    7D 7E FF FF                     defb    7dh,7eh,x'ff',x'ff',x'ff',x'ff'         ;},~,TBD,TBD,TBD,TBD
F98E    FF FF

                                ;;      Now the translations
                                ;
F990    21 23 2A 2B                     defb    21h,23h,2ah,2bh,2ch,2eh,3ch,3eh
F994    2C 2E 3C 3E
F998    40 5B 5C 5D                     defb    40h,5bh,5ch,5dh,5eh,60h,7bh,7ch
F99C    5E 60 7B 7C
F9A0    7D 7E FF FF                     defb    7dh,7eh,x'ff',x'ff',x'ff',x'ff'
F9A4    FF FF
0016                            prntsz  equ     ($-prntbl)/2    ;size of printer table

```

```
F9A6    00                escsq:  defb    0               ;escape sequence flag
                                                          ;0=> no sequence in progress
                                                          ;1b=> expecting 2nd byte
                                                          ;ff=> expecting 3rd byte
F9A7    00                cmdstat:defb    00              ;comand-status byte
0007                      cmd     equ     7               ;command-status flag
0006                      ustrk   equ     6               ;up stroke
0005                      yneg    equ     5               ;mouse y axis negative
0004                      xneg    equ     4               ;mouse x axis negative
0003                      mouse   equ     3               ;mouse active
0002                      ctrl    equ     2               ;control key active
0001                      shift   equ     1               ;shift key active
0000                      lock    equ     0               ;lock key active
F9A8    0000              millcnt:defw    0               ;current millisecond count
F9AA    00                rptchar:defb    0               ;repeat character
F9AB    00                rptflg: defb    0               ;repeat flag
F9AC    0000              save:   defw    0               ;save address of the interrupt vector
F9AE    00                romram: defb    0               ;rom/ram memory bank status
0007                      siderom equ     7               ;ram side
01AF                      olsiz   equ     $-tabled

                          ;;      k/b interrupt handler for the low profile position encoded k/b.
                          ;       The interrupt interrupt service routine inputs two or three
                          ;       bytes from the keyboard port.  The first byte is the cmd/status
                          ;       byte.  Appropriate information is saved in memory and the return
                          ;       from interrupt code is invoked.  The second and third byte(mouse)
                          ;       is position encoded data or mouse displacement is analyzed,
                          ;       translated, and return to the existing keyboard handler if the
                          ;       information is valid; otherwise it is truncated and a return
                          ;       from interrupt is invoked.  All registers saved except for the
                          ;       A register.
                          ;
                          ;       input-  keyboard input port (data complemented) kbdat
                          ;
                          ;       output- Carry flag set - Command byte or truncated character
                          ;               Carry flag reset - Translated character in A register
                          ;
F9AF    DB 1E             Lpkybd: in      a,(kbdat)       ;read k/b port
F9B1    CD F9BE                   call    romside         ;switch to romside
F9B4    C3 1996                   jp      pekhdl          ;decode posn. enc. k/b
                                                          ;jp instead of call - interrupt stack small
F9B7    CD F9C8           lpkext: call    ramside         ;restore original memory side
F9BA    D0                        ret     nc              ;return to xerox code with char.
                                                          ;here if command byte
F9BB    C1                        pop     bc              ;throw away return address
F9BC    18 3B                     jr      rptclk2         ;return from interrupt (via xerox)

                          ;;      Romside saves the status of the current side of memory
                          ;       and switches to romside.
                          ;
                          ;       output  romram= status of syspio
                          ;
F9BE    F5                Romside:push    af              ;save register
F9BF    DB 1C                     in      a,(syspio)      ;read ram/rom status
F9C1    32 F9AE                   ld      (romram),a      ;save it
F9C4    CB FF                     set     siderom,a       ;force rom side
```

```
F9C6    18 04                         jr      rmside2

                            ;;        Ramside restores the ram/rom memory back to where it was
                            ;
                            ;         input   romram= ;status of prior ram/rom
                            ;
F9C8    F5                  Ramside:push      af                ;save register
F9C9    3A F9AE                       ld      a,(romram)        ;recover prior ram/rom status
F9CC    D3 1C               rmside2:out       (syspio),a        ;switch it
F9CE    F1                            pop     af
F9CF    C9                            ret

                            ;;        This routine is the repeat key timer interrupt handler.  If the
                            ;         the repeat flag or the count is not zero, then the return from
                            ;         interrupt is invoked.  If the count is zero, then the repeat
                            ;         character is passed to the ASCII keyboard handler.
                            ;
                            ;         input   rptflg  -repeat flag
                            ;                 rptchar -repeat char
                            ;                 millcnt -timer table
                            ;
                            ;         output  a        -repeat char if count is zero
                            ;
F9D0    ED 73 F1EC          Rptclk: ld        (savstk),sp       ;save current stack ptr
F9D4    31 FF50                       ld      sp,intstk         ;temporary interrupt stack
F9D7    E5                            push    hl                ;save registers
F9D8    F5                            push    af
F9D9    C5                            push    bc
F9DA    3A F9AB                       ld      a,(rptflg)        ;repeat key flag
F9DD    A7                            and     a                 ;set flags
F9DE    28 19                         jr      z,rptclk2         ;quit if not in repeat key mode
F9E0    2A F9A8                       ld      hl,(millcnt)      ;current millisec count
F9E3    7C                            ld      a,h
F9E4    B5                            or      l                 ;test count
F9E5    28 06                         jr      z,rptclk1         ;skip if time elasped
F9E7    2B                            dec     hl                ;dcr count
F9E8    22 F9A8                       ld      (millcnt),hl      ;save  millisec count
F9EB    18 0C                         jr      rptclk2`          ;quit if not time
F9ED    2A F93E             rptclk1:ld        hl,(tock)         ;reset millisec count
F9F0    22 F9A8                       ld      (millcnt),hl
F9F3    3A F9AA                       ld      a,(rptchar)       ;fetch repeat char
F9F6    C3 F06F                       jp      key2              ;give char to keyboard key
F9F9    C3 F072             rptclk2:jp        key5

                            ;;        Siout - output to channel b after translation and
                            ;                 escape sequence handling
F9FC    F3                  Rxsioo: di                          ;char in a
F9FD    CD F9BE                       call    romside           ;switch to romside
FA00    CD 190C                       call    rmposend          ;does real work
FA03    CD F9C8                       call    ramside           ;restore original memory side
FA06    FB                            ei
FA07    C9                            ret
FA07                        kbramend equ      $-1               ;last location of code in ram
0208                        olsiz3  equ       $-tabled          ;size of relocatable code

                                      .dephase
```

```
                                                subttl  Overlay (signon)
                                                page
```

```



                              ;;      signon - Announce System Ready.
                              ;
  0552'                       rxsign:                         ;source address in rom
                                      .phase  tca             ;execution in transient command area
  FC5D    21 F091             Signon: ld      hl,confg        ;point to configuration byte
  FC60    DB 1C                       in      a,(syspio)      ;check configuration
  FC62    CB 47                       bit     0,a
  FC64    28 26                       jr      z,sign3         ;if SASI interface present
  FC66    F3                          di
  FC67    3E CF                       ld      a,11001111b     ;set Pio B in Bit Mode
  FC69    D3 1D                       out     (sysctl),a
  FC6B    3E 38                       ld      a,00111000b     ;turn around d0,1,2
  FC6D    D3 1D                       out     (sysctl),a
  FC6F    3E 80                       ld      a,10000000b     ;ensure rom switched on
  FC71    D3 1C                       out     (syspio),a      ;drop all drive selects
  FC73    3E D0                       ld      a,0d0h          ;reset wd-1797-02
  FC75    D3 10                       out     (wd1797),a
  FC77    10 FE               sign1:  djnz    sign1           ;wait 1797 not busy
  FC79    DB 1C                       in      a,(syspio)
  FC7B    CB 67                       bit     c.five,a
  FC7D    3E 02                       ld      a,2             ;preset 10 msec step rate
  FC7F    20 04                       jr      nz,sign2        ;if not 5"
  FC81    CB E6                       set     c.five,(hl)
  FC83    3E 03                       ld      a,3             ;set long step
  FC85    D3 10               sign2:  out     (wd1797),a      ;restore / unload heads
  FC87    32 FF54                     ld      (steprt),a
  FC8A    18 1E                       jr      sign4
  FC8C    CB F6               sign3:  set     c.sasi,(hl)     ;set Sasi card installed
  FC8E    21 F708                     ld      hl,Rigdpb       ;set address of rigid dpb
  FC91    11 F470                     ld      de,Fivdpb       ;set address of 5.25" floppy dpb
  FC94    01 0300                     ld      bc,Sasidl       ;set sasi driver length
  FC97    ED B0                       ldir                    ;Move driver down
  FC99    E6 02                       and     2
  FC9B    20 0D                       jr      nz,sign4        ;if not A/E swap
  FC9D    21 F361                     ld      hl,Seltab+1
  FCA0    06 08                       ld      b,8
  FCA2    7E                  sign3a: ld      a,(hl)
  FCA3    EE 04                       xor     4
  FCA5    77                          ld      (hl),a
  FCA6    23                          inc     hl
  FCA7    23                          inc     hl
  FCA8    10 F8                       djnz    sign3a
  FCAA    21 034A'            sign4:  ld      hl,tables       ;move rx resident code to ram
  FCAD    11 F800                     ld      de,tabled
  FCB0    01 0208                     ld      bc,olsiz3
  FCB3    ED B0                       ldir                    ;move on top of GETHLP
  FCB5    21 FA08                     ld      hl,kbramend+1   ;next available ram loc
  FCB8    22 FF3C                     ld      (availb),hl     ;tell the world
  FCBB    21 0000                     ld      hl,0
  FCBE    CD F03C                     call    config          ;get monitor configuration
  FCC1    7C                          ld      a,h             ;monitor level
  FCC2    21 10D0                     ld      hl,xrsign+sigoff-romofs ;assume 4.01 level location
  FCC5    FE 01                       cp      rev1
```

```
FCC7    28 03                         jr      z,sign7           ;skip if 4.01
FCC9    21 10D8                       ld      hl,xrsign+sigoff ;4.02+ level location
FCCC    11 FCE6               sign7:  ld      de,sign6          ;put it in our signon message
FCCF    01 0004                       ld      bc,4
FCD2    ED B0                         ldir
FCD4    CD F293                       call    crtoff            ;disable rom bank
FCD7    CD F075                       call    pnext
FCDA    1A                            defb    clrs              ;clear screen
FCDB    1B 38                         defb    esc,'8'           ;set low light as default mode
FCDD    38 32 30 2D                   defm    '820-II v '
FCE1    49 49 20 76
FCE5    20
FCE6    00 00 00 00           sign6:  defb    0,0,0,0           ;*********** space for the XR rev value
FCEA    20 1F 1C 20                   defm    ' ',31,28,' 1983 Xerox Corp'
FCEE    31 39 38 33
FCF2    20 58 65 72
FCF6    6F 78 20 43
FCFA    6F 72 70
FCFD    20 28 76                      defm    ' (v'
FD00    30 31 33                      defm    ver/100+'0',(ver mod 100)/10+'0',(ver mod 10)+'0'
FD03    29 0D 0A                      defb    ')',cr,lf
FD06    0A                            defb    lf
FD07    4C 20 2D 20                   defm    'L - Load System'
FD0B    4C 6F 61 64
FD0F    20 53 79 73
FD13    74 65 6D
FD16    0D 0A                         defb    cr,lf

                                      if      o.term
FD18    48 20 2D 20                   defm    'H - Host Terminal'
FD1C    48 6F 73 74
FD20    20 54 65 72
FD24    6D 69 6E 61
FD28    6C
FD29    0D 0A                         defb    cr,lf
                                      endif

                                      if      o.term
FD2B    54 20 2D 20                   defb    'T - Typewriter'
FD2F    54 79 70 65
FD33    77 72 69 74
FD37    65 72
FD39    0D 0A                         defb    cr,lf
                                      endif

FD3B    07 04                         defb    7,eot

FD3D    CD F006               devour: call    const
FD40    CA F003                       jp      z,warm            ;go enter monitor
FD43    CD F009                       call    conin
FD46    18 F5                         jr      devour
00EB                          rxsigl  equ     $-signon

                                      .dephase
                                      subttl  Overlay (boot)
                                      page
```

```


      063D'                     rxboot:                          ;rom source address
                                         .phase  tca-romofs       ;execution address o/l area
      FC55                               ds      romofs,0         ;4.01 overlay start address
      FC5D     21 FF5D                   ld      hl,linbuf+1      ;4.02 overlay start address
      FC60     7E               boot1:   ld      a,(hl)           ;scan command line
      FC61     2C                        inc     l
      FC62     D6 0D                     sub     cr
      FC64     28 0B                     jr      z,boot2          ;if no parameter, boot from A:
      FC66     FE 13                     cp      ' '-cr
      FC68     28 F6                     jr      z,boot1          ;skip leading blanks
      FC6A     D6 34                     sub     'A'-cr
      FC6C     D8                        ret     c                ;if invalid drive
      FC6D     FE 10                     cp      16
      FC6F     3F                        ccf
      FC70     D8                        ret     c                ;if bad drive
      FC71     4F               boot2:   ld      c,a              ;set boot drive selected
      FC72     C6 41                     add     a,'A'
      FC74     32 FD72                   ld      (bootd),a        ;set up error message
      FC77     2E 00                     ld      l,0              ;set A:
      FC79     C5                        push    bc
      FC7A     E5                        push    hl
      FC7B     CD FD89                   call    swap             ;switch boot drive with A:
      FC7E     21 FD6E                   ld      hl,booter        ;set boot error return
      FC81     E5                        push    hl
      FC82     0E 00                     ld      c,0              ;then boot from A:
      FC84     CD F01B                   call    select
      FC87     C0                        ret     nz               ;if drive not configured or density error
      FC88     3E FF                     ld      a,-1
      FC8A     12                        ld      (de),a
      FC8B     11 000A                   ld      de,10            ;set dpb address offset within dph
      FC8E     19                        add     hl,de
      FC8F     5E                        ld      e,(hl)           ;set dpb address
      FC90     23                        inc     hl
      FC91     56                        ld      d,(hl)
      FC92     CD F01E                   call    home
      FC95     1A                        ld      a,(de)           ;get low sectors per track
      FC96     32 FD6D                   ld      (boots),a        ;inform boot loader
      FC99     B7                        or      a
      FC9A     20 20                     jr      nz,boot3         ;if not rigid
      FC9C     21 000D                   ld      hl,13            ;set reserved track offset within dpb
      FC9F     19                        add     hl,de
      FCA0     4E                        ld      c,(hl)           ;get reserved tracks
      FCA1     23                        inc     hl
      FCA2     46                        ld      b,(hl)
      FCA3     0B                        dec     bc               ;point behind directory
      FCA4     ED 43 FA11                ld      (phytrk),bc      ;do implied seek
                                                                  ;here for rigid
      FCA8     0E 1D                     ld      c,rtabl          ;first rigid sector
      FCAA     21 ED80                   ld      hl,bootbf        ;buffer
      FCAD     CD F024                   call    read             ;layout and k/b tables
      FCB0     C0                        ret     nz
      FCB1     0E 1E                     ld      c,rtabl+lpkofs   ;2nd rigid sector
      FCB3     21 EE80                   ld      hl,bootbf+x'100' ;buffer
```

```
FCB6  CD F024                call    read               ;layout and k/b tables
FCB9  C0                     ret     nz
FCBA  18 20                  jr      rxb01
FCBC                boot3:                              ;here for floppy
FCBC  FE 1B                  cp      27                 ;double density?
FCBE  DA FD52                jp      c,boot4            ;no - exit
FCC1  0E 04                  ld      c,ftab1            ;first floppy sector
FCC3  21 ED80                ld      hl,bootbf          ;buffer
FCC6  CD F024                call    read               ;layout table and half of k/b
FCC9  C0                     ret     nz
FCCA  0E 05                  ld      c,ftab2            ;second floppy sector
FCCC  21 EE00                ld      hl,bootbf+128
FCCF  CD F024                call    read               ;midle third of k/b tables
FCD2  C0                     ret     nz
FCD3  0E 06                  ld      c,ftab2+lpkofs     ;third floppy sector
FCD5  21 EE80                ld      hl,bootbf+128+128
FCD8  CD F024                call    read               ;last third of k/b tables
FCDB  C0                     ret     nz
FCDC                rxb01:                              ;check tables are present
FCDC  3A ED80                ld      a,(bootbf+lang)    ;language no. set?
FCDF  FE E5                  cp      0e5h
FCE1  28 6F                  jr      z,boot4            ;no - exit
FCE3  3A ED81                ld      a,(bootbf+kbrd)    ;k/b tables present?
FCE6  FE 6B                  cp      'k'
FCE8  20 68                  jr      nz,boot4           ;no - exit
FCEA  3A ED82                ld      a,(bootbf+font)    ;font tables present?
FCED  FE 66                  cp      'f'
FCEF  20 61                  jr      nz,boot4           ;no - exit
FCF1  3A ED83                ld      a,(bootbf+prnt)    ;printer tables prsent?
FCF4  FE 70                  cp      'p'
FCF6  20 5A                  jr      nz,boot4           ;no - exit
FCF8  21 ED84                ld      hl,bootbf+kbrdtb   ;move in k/b tables
FCFB  11 F800                ld      de,tabled
FCFE  01 0160                ld      bc,ktabsz
FD01  ED B0                  ldir
FD03  0E 1F                  ld      c,rtab2+lpkofs     ;3rd rigid sector
FD05  3A FD6D                ld      a,(boots)          ;rigid or floppy?
FD08  B7                     or      a
FD09  28 02                  jr      z,boot5            ;rigid
FD0B  0E 07                  ld      c,ftab3+lpkofs     ;floppy - 4th sector
FD0D  21 ED80       boot5:   ld      hl,bootbf          ;buffer
FD10  CD F024                call    read               ;font and print tables
FD13  C0                     ret     nz
FD14  3A ED80                ld      a,(bootbf)         ;configured?
FD17  FE E5                  cp      0e5h
FD19  28 37                  jr      z,boot4            ;no -exit
FD1B  21 ED80                ld      hl,bootbf          ;move font & print tables in
FD1E  11 F960                ld      de,fontbl
FD21  01 0046                ld      bc,fontsz*2+prntsz*2
FD24  ED B0                  ldir

                    ;;       alter SIOOUT
                    ;
FD26  DD 2A F019             ld      ix,(monitr+sioff);sioout address
FD2A  DD 36 00 C3            ld      (ix),0c3h          ;jump instruction
FD2E  DD 36 01 FC            ld      (ix+1),low rxsioo
```

```
FD32    DD 36 02 F9                             ld      (ix+2),high rxsioo

                                        ;       alter crt driver
                                        ;
FD36    DD 2A F010                              ld      ix,(monitr+fcrtof)      ;address of fast crt handler
FD3A    DD 36 12 85                             ld      (ix+crtcall),low rxcrt
FD3E    DD 36 13 18                             ld      (ix+crtcall+1),high rxcrt
FD42    DD 21 F22F                              ld      ix,sprntl       ;address of screenprint patch
FD46    DD 36 00 C3                             ld      (ix),0c3h       ;jump instruction
FD4A    DD 36 01 D6                             ld      (ix+1),low scrprt
FD4E    DD 36 02 18                             ld      (ix+2),high scrprt
FD52                                    boot4:                          ;here to exit
FD52    C1                                      pop     bc              ;throw away booter return
FD53    C1                                      pop     bc              ;get disk swap parameters
FD54    E1                                      pop     hl
FD55    CD FD89                                 call    swap            ;swap them back for xerox boot
FD58    C1                                      pop     bc              ;throw away return address
FD59    21 0000                                 ld      hl,0
FD5C    CD F03C                                 call    config          ;get monitor configuration
FD5F    7C                                      ld      a,h
FD60    21 11B8                                 ld      hl,xrboot-romofs ;assumed 4.01 monitor boot overlay address
FD63    FE 01                                   cp      revl
FD65    28 03                                   jr      z,boot6         ;skip if 4.01
FD67    21 11C0                                 ld      hl,xrboot       ;address of 4.02+ monitor boot overlay
FD6A    C3 F078                         boot6:  jp      prboff          ;enter xerox code to execute boot
FD6D    00                              boots:  defb    0               ;workbyte to save disk type

                                        ;;      Booter - Boot Error Processor.
                                        ;
FD6E    CD F075                         Booter: call    pnext
FD71    07                                      defb    7
FD72    64 3A 54 61                     bootd:  defm    'd:Tables Load error.'
FD76    62 6C 65 73
FD7A    20 4C 6F 61
FD7E    64 20 65 72
FD82    72 6F 72 2E
FD86    04                                      defb    eot
FD87    C1                                      pop     bc              ;switch drives back
FD88    E1                                      pop     hl

                                        ;;      Swap - swap logical drives.
                                        ;
                                        ;       Entry:  C = first  drive index, 0-15
                                        ;               L = second drive index, 0-15
                                        ;
FD89    06 00                           Swap:   ld      b,0             ;clear upper indices
FD8B    60                                      ld      h,b
FD8C    11 F360                                 ld      de,seltab       ;set select table address
FD8F    29                                      add     hl,hl
FD90    19                                      add     hl,de
FD91    EB                                      ex      de,hl           ;set second address to DE, get seltab to HL
FD92    09                                      add     hl,bc
FD93    09                                      add     hl,bc           ;set first address to HL
FD94    06 02                                   ld      b,2
FD96    4E                              swapl:  ld      c,(hl)          ;swap two bytes
FD97    1A                                      ld      a,(de)
```

```
FD98     77                      ld      (hl),a
FD99     79                      ld      a,c
FD9A     12                      ld      (de),a
FD9B     23                      inc     hl
FD9C     13                      inc     de
FD9D     10 F7                   djnz    swapl             ;if swap not complete
FD9F     C9                      ret
                                 .dephase

0788'                  romtop:
0788'                            defs    (romsiz-x'24')-(romtop-start),-1

                       ;;        Drctry is a table containing the RAM addresses of the keyboard
                       ;         tables.  This table is located on ROM side of memory.  The
                       ;         ROM address must be offset by x'1800' since resides in
                       ;         the fourth 2kx8 ROM slot.  This directory is helpful if future
                       ;         release require the RAM tables to reside in a different RAM
                       ;         location
                       ;
07DC'    F97A          Drctry:   defw    prntbl            ;print exception table
07DE'    F960                    defw    fontbl            ;font exception table
07E0'    F95D                    defw    mstbl             ;mouse table
07E2'    F959                    defw    ups               ;upstroke table
07E4'    F958                    defw    ctrlex            ;function key inhibit expansion table
07E6'    F953                    defw    ctrltb            ;function key inhibit table
07E8'    F94F                    defw    rptex             ;repeat key expansion table
07EA'    F940                    defw    rptbl             ;repeat key table
07EC'    F93C                    defw    tick              ;repeat speed table
07EE'    F93B                    defw    shftlck           ;shift lock flag
07F0'    F938                    defw    cptex             ;alpha lock expansion table
07F2'    F935                    defw    captab            ;alpha lock table
07F4'    F8CE                    defw    cdtab             ;code + table
07F6'    F867                    defw    shtab             ;shift table
07F8'    F800                    defw    tabl              ;unshifted table

07FA'    0D                      defb    ver               ;revision level
07FB'    00 FF         lpid:     defb    x'00',x'ff'       ;low profile kybd id

                       ;;        define checkword to let xerox know
                       ;         that we are present
                       ;
07FD'    AA 55                   defb    0aah,55h          ;id
07FF'    00                      defb    0                 ;space for checksum

                                 Subttl  Symbol Table
                                 end
```

```
Position encoded keyboard handler        MACRO-80 3.44   09-Dec-81
Symbol Table

Macros:

Symbols:
1A30     ALPHEXC          1A23     ALPHTST          FFB3     ATTRIB
FF3C     AVAILB           0002     BOFF1            0018     BOFF2
FC60     BOOT1            FC71     BOOT2            FCBC     BOOT3
FD52     BOOT4            FD0D     BOOT5            FD6A     BOOT6
ED80     BOOTBF           FD72     BOOTD            FD6E     BOOTER
FD6D     BOOTS            0004     C.FIVE           0006     C.SASI
F935     CAPTAB           F8CE     CDTAB            19D4     CHAROUT
FFB4     CHRSAV           001A     CLRS             0007     CMD
19A1     CMDB             1A1F     CMDB1            F9A7     CMDSTAT
0006     CNFBYTE          003C     CNFGOFF          0006     CNTCTR
0013     CNTRP            F091     CONFG            F03C     CONFIG
F009     CONIN            F006     CONST            0003     CPTBSZ
F938     CPTEX            000D     CR               0012     CRTCALL
0182     CRTD1            0196     CRTD2            F293     CRTOFF
0019     CTC1             FF10     CTCVEC           0002     CTRL
F958     CTRLEX           F953     CTRLTB           19DB     CTRTST
FFAC     CURSOR           FD3D     DEVOUR           07DC'    DRCTRY
0081     ENCNTR           0004     EOT              001B     ESC
F9A6     ESCSQ            0007     ESCTSZ           0010     FCRTOF
F470     FIVDPB           18CF     FNTRAN           18BB     FON1
18CA     FON2             18A6     FONCHK           0002     FONT
F960     FONTBL           000D     FONTSZ           0004     FTAB1
0005     FTAB2            0006     FTAB3            F319     GOLD
01DD     GRPAD            01F4     HLFSEC           F01E     HOME
F066     IDLE             FF50     INTSTK           000F     JTBLSZ
001E     KBDAT            0008     KBLP             000A     KBOFF
FA07     KBRAMEND         0001     KBRD             0004     KBRDTB
FF1A     KBVEC            F06F     KEY2             F072     KEY5
0160     KTABSZ           F06C     KYBDLP           19B5     KYPOS
0000     LANG             FFB2     LEADIN           000A     LF
FF5C     LINBUF           0000     LOCK             0061     LOWER
07FB'    LPID             F9B7     LPKEXT           0001     LPKOFS
F9AF     LPKYBD           F0E3     MASK             1A7D     MICE
1AEB     MICE1            1AF1     MICE11           1AF8     MICE12
1B00     MICE2            1B08     MICE21           1B09     MICE22
1B14     MICE23           1B16     MICE24           1AB3     MICEX1
1AB8     MICEY            F9A8     MILLCNT          0006     MINTRP
F167     MKEY2            F18F     MKEY5            F06C     MNTREX
F000     MONITR           0003     MOUSE            1B38     MOVTBL
FC3D     MPNEXT           FA95     MPRMTO           0007     MSFLG
0000     MSMOV            F95E     MSPTR            F95D     MSTBL
19A0     NOCHAR           187E     NOLOAD           0001     O.TERM
01AF     OLSIZ            0208     OLSIZ3           19B1     PEKEX
1996     PEKHDL           19AD     PEKNOC           19B0     PEKNOC1
19A0     PEKNOC2          198F     PESCTB           FA11     PHYTRK
F075     PNEXT            1986     POESC            1927     POS01
1939     POS02            1939     POS03            193D     POS04
1947     POS05            1954     POS06            1955     POS07
1914     POSEND           1959     POSOUT           1966     POTRAN
F078     PRBOFF           0003     PRNT             F97A     PRNTBL
0016     PRNTSZ           FA62     PROMPT           F339     PRVATT
1983     PTR01            F9C8     RAMSIDE          F024     READ
```

```
Position encoded keyboard handler       MACRO-80 3.44   09-Dec-81
Symbol Table

0000    REV0            0001    REV1            0064    REV50
F708    RIGDPB          190C    RMPOSEND        F9CC    RMSIDE2
0008    ROMOFS          F9AE    ROMRAM          F9BE    ROMSIDE
0800    ROMSIZ          0788'   ROMTOP          F940    RPTBL
F9AA    RPTCHAR         F9DC    RPTCLK          F9ED    RPTCLK1
F9F9    RPTCLK2         F94F    RPTEX           F9AB    RPTFLG
1A3D    RPTST           001D    RTAB1           001E    RTAB2
1B1A    RV1TBL          1B29    RV2TBL          1800    RX1984
FCDC    RXB01           063D'   RXBOOT          1885    RXCRT
00EB    RXSIGL          0552'   RXSIGN          F9FC    RXSIOO
0300    SASIDL          F9AC    SAVE            F1EC    SAVSTK
18EC    SCR01           18F2    SCR02           1904    SCR03
18D6    SCRPRT          F01B    SELECT          F360    SELTAB
00FF    SETFLG          F93B    SHFTLCK         0001    SHIFT
F867    SHTAB           0007    SIDEROM         FC77    SIGN1
FC85    SIGN2           FC8C    SIGN3           FCA2    SIGN3A
FCAA    SIGN4           FCE6    SIGN6           FCCC    SIGN7
FC5D    SIGNON          0060    SIGOFF          0005    SIODPB
0019    SIOFF           F03F    SIORDY          195A    SIOX1
185C    SOOUT           F20E    SPACT           F22F    SPRNT1
F232    SPRNT2          0000'   START           0001    STCNTR
FF54    STEPRT          1A66    STPCTC1         0003    STRKUP
FD89    SWAP            FD96    SWAP1           001D    SYSCTL
001C    SYSPIO          FF18    SYSVEC          F800    TABL
F800    TABLED          034A'   TABLES          0159    TABLEX
19FF    TBLSEL          181E    TBXFER          FC5D    TCA
003F    TENTHS          F93C    TICK            F93E    TOCK
0020    UPASCII         007B    UPPER           F959    UPS
0002    UPSSZ           19E6    UPSTRK          F95B    UPSX
0006    USTRK           000D    VER             F003    WARM
0010    WD1797          0004    XNEG            11C0    XRBOOT
1078    XRSIGN          0001    XY              0005    YNEG
0000    ZERO


No Fatal error(s)
```

```
ALPHEXC    565      567      577#
ALPHTST    485      562#
ATTRIB     100#     265
AVAILB      94#    1130
BOFF1       45#     199      200      205      206
BOFF2       46#     201      202      207      208
BOOT1     1198#    1203
BOOT2     1201     1209#
BOOT3     1232     1250#
BOOT4     1252     1268     1271     1274     1277     1292     1314#
BOOT5     1285     1287#
BOOT6     1325     1327#
BOOTBF      84#    1242     1246     1254     1258     1262     1266     1269     1272     1275     1278     1287
          1290     1293
BOOTD     1211     1334#
BOOTER    1216     1332#
BOOTS     1230     1283     1328#
C.FIVE     132#    1102     1105
C.SASI     133#    1110
CAPTAB     577      895#     897     1389
CDTAB      537      866#    1390
CHAROUT    487#     523      718
CHRSAV     101#     242
CLRS       149#    1143
CMD        460      476      972#
CMDB       462      465#
CMDB1      536      539      542      545      547#
CMDSTAT    465      475      487      971#
CNFBYTE    120#     190      192
CNFGOFF    119#     189
CNTCTR     500      916#
CNTRP      593      911#
CONFG       86#    1087
CONFIG      57#     175     1132     1321
CONIN       52#    1185
CONST       51#    1183
CPTBSZ     578      897#
CPTEX      896#    1388
CR         152#    1156     1162     1170     1178     1200     1202     1204
CRTCALL     50#    1308     1309
CRTD1       66#     254
CRTD2       67#     247      252
CRTOFF      76#    1141
CTC1       110#     608      626
CTCVEC      41#     603      606      621
CTRL       538      977#
CTRLEX     915#    1382
CTRLTB     499      913#     916     1383
```

```
CTRTST           482      498#
CURSOR            98#     241
DEVOUR          1183#    1186
DRCTRY          1378#
ENCNTR           114#     607
EOT              151#    1181     1339
ESC              150#     325      351      362     1144
ESCSQ            347      354      383      967#
ESCTSZ           426      432#
FCRTOF            49#    1307
FIVDPB            90#    1112
FNTRAN           278      289#
FON1             267      272#
FON2             271      279#
FONCHK           253      261#
FONT             146#    1272
FONTBL           274      306      934#     945     1294     1379
FONTSZ           275      290      306      307      311      945#    1295
FTAB1            141#    1253
FTAB2            142#    1257     1261
FTAB3            143#    1286
GOLD              88#     244
GRPAD             68#     268
HLFSEC           899      900      903#
HOME              55#    1228
IDLE              59#     387
INTSTK            95#    1047
JTBLSZ           186      774#
KBDAT            109#    1004
KBLP             121#     191
KBOFF             48#     213      214      215
KBRAMEND                 1075#    1129
KBRD             145#    1269
KBRDTB           148#    1278
KBVEC             43#     212
KEY2              62#    1064
KEY5              63#    1065
KTABSZ           929#    1280
KYBDLP            61#     214      215
KYPOS            461      474#
LANG             144#    1266
LEADIN            99#     245
LF               153#    1156     1157     1162     1170     1178
LINBUF            97#    1197
LOCK             541      562      979#
LOWER            125#     566
LPID            1395#
LPKEXT           473     1008#
LPKOFS           123#    1245     1261     1282     1286
```

```
FLPKYBD     769       776      1004#
 MASK        85#      248
 MICE       479       676#
 MICE1      690       704       728#
 MICE11     728       731#
 MICE12     730       736#
 MICE2      695       709       749#
 MICE21     751       755#
 MICE22     754       756#
 MICE23     758       761#
 MICE24     760       762#
 MICEX1     698#      715
 MICEY      685       700#
 MILLCNT    597       980#     1054      1059      1062
 MINTRP     714       924#
 MKEY2       72#      770       777
 MKEY5       73#      771       778
 MNTREX      60#      185
 MONITR      39#       51        52        53        54        55        56        57        58        59        60        61
             62        63        64        65       189      1300      1307
 MOUSE      466       478       976#
 MOVTBL     785#
 MPNEXT      80#      772       779
 MPRMTO      79#      773       780
 MSFLG      680       923#
 MSMOV      713       927#
 MSPTR      683       928#
 MSTBL      468       512       679       712       756       762       922#     1380
 NOCHAR     463#      514       518       681
 NOLOAD     178       180       228#
 O.TERM     134#     1164      1173
 OLSIZ      986#
 OLSIZ3    1076#     1127
 PEKEX      472#      490
 PEKHDL     457#     1006
 PEKNOC     467       470#      477
 PEKNOC1    471#      699
 PEKNOC2    464#      483
 PESCTB     425       430#      432
 PHYTRK      93#     1239
 PNEXT       64#     1142      1332
 POESC      378       425#
 POS01      352       356#
 POS02      360       366#
 POS03      358       367#
 POS04      349       370#
 POS05      372       376#
 POS06      375       379       382#
 POS07      381       383#
```

```
POSEND     338     346#
POSOUT     326     329     353     363     368     374     377     385#    413     415
POTRAN     319     357     400#
PRBOFF      65#   1327
PRNT       147#   1275
PRNTBL     400     950#    965    1378
PRNTSZ     401     405     965#   1295
PROMPT      78#
PRVATT      77#    269
PTR01      409     417#
RAMSIDE   1008    1029#   1072
READ        56#   1243    1247    1255    1259    1263    1288
REV0       116#    177
REV1       117#    182     203    1135    1324
REV50      118#    179
RIGDPB      91#   1111
RMPOSEND           336#   1071
RMSIDE2   1023    1031#
ROMOFS     122#    205     206     207     208     779     780    1134    1195    1196    1323
ROMRAM     984#   1021    1030
ROMSIDE   1005    1019#   1070
ROMSIZ      38#   1369
ROMTOP    1368#   1369
RPTBL      592     906#    911    1385
RPTCHAR    598     981#   1063
RPTCLK     605    1046#
RPTCLK1   1057    1061#
RPTCLK2   1012    1053    1060    1065#
RPTEX      910#   1384
RPTFLG     615     982#   1051
RPTST      486     592#
RTAB1      139#   1241    1245
RTAB2      140#   1282
RV1TBL     181     769#    774
RV2TBL     184     776#
RX1984      37#    160
RXB01     1249    1265#
RXBOOT     199     200     201     202     205     206     207     208    1194#
RXCRT      241#   1308    1309
RXSIGL     225    1187#
RXSIGN     223    1085#
RXSI00    1069#   1302    1303
SASIDL     135#   1113
SAVE       604     620     983#
SAVSTK      40#   1046
SCR01      309     315#
SCR02      317     319#
SCR03      320     323     329#
SCRPRT     301#   1312    1313
```

```
SELECT       54#   1219
SELTAB       89#   1117    1350
SETFLG      128#    602
SHFTLCK     543     898#   1387
SHIFT       535     978#
SHTAB       534     546     837#   1391
SIDEROM     985#   1022
SIGN1      1100#   1100
SIGN2      1104    1107#
SIGN3      1090    1110#
SIGN3A     1119#   1124
SIGN4      1109    1116    1125#
SIGN6      1138    1148#
SIGN7      1136    1138#
SIGNON     1087#   1187
SIGOFF       70#   1134    1137
SIODPB      107#    390
SIOFF        47#   1300
SIORDY       58#    386
SIOX1       386#    388
SOOUT       204     212#
SPACT        87#    622
SPRNT1       74#   1310
SPRNT2       75#    332
START       159#   1369
STCNTR      115#    625
STEPRT       96#   1108
STPCTC1     470     615#
STRKUP      513     925#
SWAP       1215    1318    1348#
SWAP1      1357#   1364
SYSCTL      105#   1093    1095
SYSPIO      106#   1020    1031    1088    1097    1101
SYSVEC       42#     43
TABL        540     808#    917     929    1392
TABLED       92#    789     802     986    1076    1126    1279
TABLES      788     801#   1125
TABLEX      790     917#
TBLSEL      484     532#
TBXFER      183     185#
TCA          44#    224     227    1086    1195
TENTHS      901     902     904#
TICK        596     899#   1386
TOCK        901#   1061
UPASCII     126#    568
UPPER       124#    564
UPS         515     919#    921    1381
UPSSZ       516     520     921#
UPSTRK      481     512#
```

```
UPSX       920#
USTRK      480      973#
VER         28#    1155      1155      1155      1394
WARM        53#    1184
WD1797     108#    1099      1107
XNEG       689      975#
XRBOOT      71#    1323      1326
XRSIGN      69#    1134      1137
XY         469      684       757       759       761       926#
YNEG       703      974#
ZERO       127#     459       729       740
```

## Notes