

THE CR7 DIPLOMAT  
MICROCOMPUTER

USER REFERENCE MANUAL  
2nd Edition

AAP

CHRISTIAN ROVSING A/S

Copenhagen Denmark

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## THE SCOPE OF THIS DOCUMENT

This manual is intended to answer most of the questions that a potential user of the CR7 microcomputer might ask. It aims at breadth rather than depth of coverage - in other words it is considered more important to provide the user with a "Bible" to give at least some guidance about any CR7 topic, rather than to supply every detail on some topics and omit others altogether. In particular, the section on the CP/M operating system is an overview rather than a comprehensive guide since this operating system is very widely used in the computing industry and many books have already been written about it.

Incidentally, the same thing applies to the Z80 microprocessor which plays host to CP/M.

It is intended that the amount of technical knowledge required to understand this manual will gradually increase as one reads through it. For instance someone with a bare minimum of computer knowledge should be able to understand section 1, whereas section 5 is aimed at people who want to interface their own hardware or system software to the CR7.

The questions that this document attempts to answer are outlined below. Note that the numbering of the questions corresponds to the numbering of the sections that supply the answers. (See Contents.)

1. What is it ?
2. Why should I choose a CR7 ?
3. How do I start it up & make it go ?
4. How do I run my application programs and manage my data and programs ?
5. How does it work ?

### A Note to the Inexperienced User of Computers.

Please do not be dismayed by the large size of this manual. You can safely ignore the vast majority of it - section 5 will be of no interest at all; section 2 is background information only; and to users of the 'Menu' system (which you

probably will be), section 4 is strictly for 'reference only'. You should therefore concentrate on the Introduction (section 1) and the 'Start up & Operation' section (section 3), not forgetting the comprehensive Index as required.

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RM/COBOL	Ryan McFarland Corporation
COGEN	Bytek

Document Reference	CR7/X0003/MAN/1103-2
1st Edition	July, 1983. Provisional
2nd Edition	November 1983. Contains corrections to 1st edition plus a great deal of additional material (section 5).

Published by	CHRISTIAN ROVSING A/S Lautrupvang 2 2750 Ballerup Denmark
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## CONTENTS

### THE SCOPE OF THIS DOCUMENT 1

Contents 4..12

#### 1. INTRODUCTION TO THE CR7 1-1..12

##### 1.1 Brief Description of the CR7 1-1

##### 1.2 Configuration Options - Hardware 1-3

1.2.1 Standard Features 1-4

1.2.2 Optional Extras 1-5

##### 1.3 Configuration Options - Software 1-10

Operating System 1-10

Applications Packages 1-10

Programming Languages 1-11

Communications 1-11

List of the Available Software 1-12

#### 2. FEATURES OF THE CR7 2-1..14

##### 2.1 Hardware 2-1

Block diagram of system 2-1

2.1.1 Processor Board 2-2

##### 2.2 Software 2-2

2.2.1 Operating System - CP/M 2-2

2.2.2 Communications 2-3

2.2.2.1 IBM 2780 Emulation 2-3

2.2.3 Applications 2-4

2.2.3.1 Word Processing Package 2-4

2.2.3.2 Calculation & Financial Planning 2-7

2.2.3.3 Planning & Report Generation 2-9

2.2.3.4 Project Management 2-9

2.2.3.5 Data Base System - dBase II 2-10

2.2.4 Programming Languages for the CR7 2-11

ASM 2-11

Pascal/MT+ with SPP 2-11

Basic 2-13

Fortran 2-13

Cobol 2-14

### 3. START-UP & OPERATION 3-1..38

#### 3.1 Installation 3-1

Positioning 3-1

Checking the Voltage Setting 3-1

Plugging in 3-1

Connecting Printers that were not supplied with the CR7 3-2

Power-up 3-2

Switching off 3-3

#### 3.2 Operation of the CR7 Keyboard and Screen 3-4

##### 3.2.1 Terminal Controls 3-4

Brightness and Contrast 3-4

The Keyboard 3-4

Setting the Terminal Characteristics 3-9

#### 3.3 Printer Operations 3-10

##### 3.3.1 Dot Matrix Printers 3-10

Option 40 Printer 3-10

Option 41A and 41B Printers 3-10

##### 3.3.2 Daisy-wheel Printers 3-11

Option 42A Printer 3-11

Option 42B and 42C Printers 3-12



- 3.4 **Disks, Floppy and Hard** 3-13
  - 3.4.1 **Use of Floppy Diskettes** 3-13
    - Inserting a Diskette 3-14
    - Care and Storage of Diskettes 3-15
  - 3.4.2 **Use of Hard (Winchester) Disks** 3-15
  - 3.4.3 **Disk Formatting** 3-16
    - When 3-16
    - How 3-16
  - 3.4.4 **Copying Disks** 3-17
    - Why 3-17
    - Copying a Complete Floppy Disk  
on the Dual System 3-18
    - Copying Single or Multiple Files 3-18
  
- 3.5 **Operating the CR7 - The Menu System** 3-19
  - 3.5.1 **The Relationship between the Menu system and CP/M** 3-19
  - 3.5.2 **How to get the first menu on the screen** 3-19
  - 3.5.3 **The Main Menu** 3-21
  - 3.5.4 **The Help Menu** 3-23
    - LIST FILE NAMES 3-234
    - CHOOSE CURRENT DISK DRIVE 3-25
    - SET DISKETTE 'WRITE-ENABLED' 3-25
    - COPY FILES 3-26
    - DELETE FILES 3-27
    - RENAME FILE 3-28
    - PRINT FILES 3-28
    - OTHER COMMANDS 3-29
      - FCOPY-Copying a whole diskette 3-30
      - MENUMAN- Manual and Auto operation 3-30
    - MAIN MENU 3-33
  
- 3.6 **Running a Program** 3-33
  - 3.6.1 **Under the Menu System** 3-33
  - 3.6.2 **Under CP/M directly** 3-33
  - 3.6.3 **If your program gets stuck...** 3-33
    - System reset - How to do it 3-34

System reset - What it means 3-34

Selecting the Boot Source 3-34

### 3.7 Startup and Operation - SUMMARY 3-35

Starting up your CR7 for the very first time 3-35

Normal startup procedure 3-35

Before using a brand-new, blank diskette 3-35

To see what files are on a diskette 3-35

To copy one or several files 3-35

To copy a complete diskette 3-36

How to escape from the Menu System 3-36

How to get back to the Menu System from CP/M 3-36

If your program gets stuck 3-36

If the printer does not work 3-36

Switching Off 3-37

Specifying files - Summary Table 3-38

## 4. OPERATING SYSTEM 4-1..16

4.1 Disk Files 4-1

4.2 The System Prompt 4-2

4.3 The Command Line 4-2

4.4 Editing the Command Line 4-3

4.5 File Specification 4-4

Ambiguous file specifications 4-5

4.6 Some System Commands and Utilities 4-6

4.7 Special CR7 Commands 4-7

Setting the Baud Rate 4-8

System Generation on Floppy-only Systems 4-8

System Generation on Winchester/floppy System 4-9

- 4.8 Disk Access Error Codes 4-10
  - Floppy 4-10
  - Winchester 4-11
- 4.9 Assignment of disk drives to CP/M drive letters 4-16

## 5. CR7 TECHNICAL OVERVIEW 50-1..56-2

- Scope of the Overview 50-1
- Internal access and component layout 50-1
- Wiring of modules to back panel - all models 50-3

### 5.1 Workstation or Terminal 51-1..59

- 5.1.1 Features of the Terminal 51-1
- 5.1.2 Components and controls 51-2
  - Screen 51-3
  - Floppy disk drive(s) 51-3
  - Winchester disk drive 51-3
  - Keyboard cable 51-3
  - Keyboard 51-3
  - LED display on keyboard 51-3
  - Illustration of rear panel 51-4
  - Mains socket 51-5
  - Fuse 51-5
  - Mains switch 51-5
  - X-Net connector 51-5
  - Modem connector 51-5
  - Printer connector 51-6
  - Keyboard socket 51-6
  - Brightness and contrast 51-6
  - DIL switches 51-6
  - DIL switch settings 51-7
  - Interface to processor board 51-10
  - Jumper settings (video controller) 51-10
  - Power supply 51-12
- 5.1.3 Programmers' Information 51-13
  - 5.1.3.1 Keyboard output (Hex codes) 51-14
    - Differences between English & Danish Keys 51-18
    - IBM Mode 51-19

- Programming the keyboard 51-20
- 5.1.3.2 Character sets supplied with the CR7 51-20
  - How to select different sets 51-20
  - How to select particular characters within a set 51-23
    - Both sets, normal mode 51-24
    - CR set, special mode 51-25
    - VT 100 set, special mode 51-26
    - CR set, ESC sequence method 51-27
    - VT 100, set ESC sequence method 51-28
    - Notes on particular characters 51-29
- 5.1.3.3 Personalized character sets 51-31
  - The character PROM 51-31
  - How a character is represented in PROM 51-31
  - How to gain physical access to the PROM 51-36
  - Video Controller Board - illustration 51-37
- 5.1.3.4 Note on Control and Escape codes 51-38
- 5.1.3.5 Cursor Control 51-39
  - Move to beginning of current line 51-39
  - Move one position down 51-39
  - Move one position left 51-39
  - Move one position up 51-40
  - Move one position right 51-40
  - Move several positions down 51-40
  - Move several positions left 51-41
  - Move several positions up 51-41
  - Move several positions right 51-42
  - Move to top-left (home) 51-42
  - Move to next tab position 51-42
  - Move to column 1, next line 51-43
  - Move to specified line & column 51-43
  - Move to previously saved position 51-44
  - Save position 51-44
  - Report position 51-44
  - Disappear 51-44a
  - Reappear 51-44a
- 5.1.3.5a Scrolling Region 51-44a
  - Define Scrolling Region 51-44b
  - Switch on Origin mode 51-44c

- Switch off Origin mode 51-44c
- 5.1.3.6 Screen editing 51-45
  - Delete part of line to right 51-45
  - Delete part of line to left 51-45
  - Delete line and leave blank 51-45
  - Delete line & fill gap 51-46
  - Delete several lines and fill gap 51-46
  - Delete top of partition and leave blank 51-46
  - Delete bottom of partition and leave blank 51-46
  - Delete whole partition 51-47
  - Insert blank line 51-47
  - Insert blank lines 51-47
- 5.1.3.7 Screen partitions 51-47
  - Define position of partitioning 51-48
  - Select partition 0 51-49
  - Select partition 1 51-49
- 5.1.3.8 Character attributes 51-49
  - Set/reset attributes 51-50
  - Save and restore attributes 51-51
- 5.1.3.9 Application Mode 51-51
  - Enter Application Mode 51-52
  - Reset to Numeric Mode 51-52
- 5.1.3.10 Keyboard LEDs 51-52
  - Switch Off LEDs 51-52
  - Switch On LED 51-53
- 5.1.3.11 Transmission on/off 51-53
- 5.1.3.12 Various Noises 51-54
  - Bleep 51-54
  - Click 51-54
- 5.1.3.13 Terminal Reset 51-54
- 5.1.3.14 SUMMARY of all Codes that the CR7 VDU will respond to 51-55
- 5.1.3.15 SUMMARY of all Codes generated by the CR7 VDU 51-58
- 5.1.3.16 Table of ASCII Codes 51-59

## 5.2 Processor Board 52-1..24

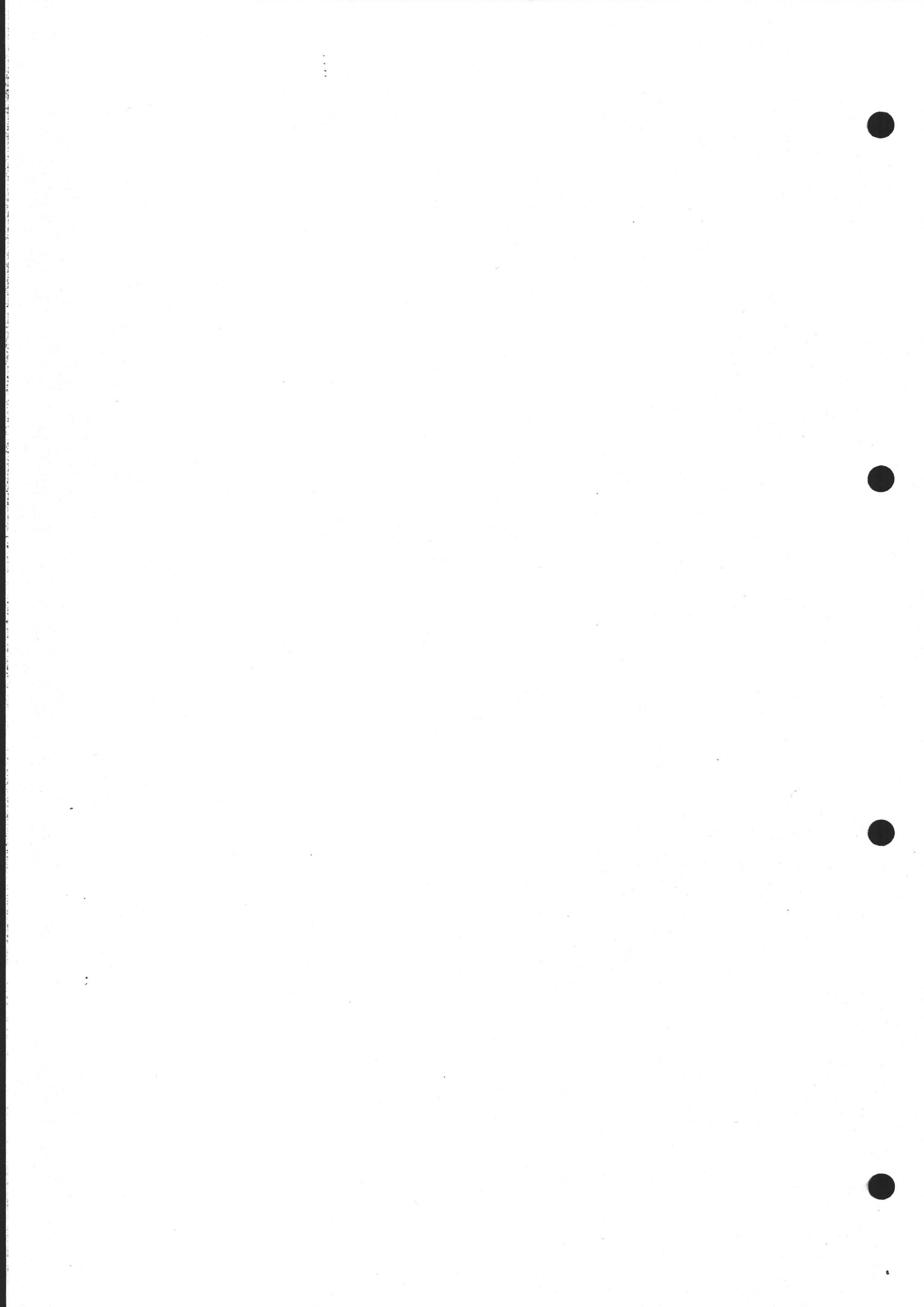
- 5.2.1 Overview of Structure and Function 52-1
  - CPU 52-1
  - Serial Interface 52-1



	Block Diagram	52-2
	Floppy Disk Controller	52-3
	Direct Memory Access Controller	52-4
	Programmable Interval Timer	52-4
	Parallel I/O chip & DIL switches	52-4
	Floppy drive control and Map Register	52-6
	Memory	52-6
	Clock and Power-up logic	52-6
	Interrupt Controller (CTC)	52-7
	Firmware	52-8
	I/O Address Decoder	52-8
	Boot Load PROM	52-8
	Boot PROM select and SIO/RAM synchronization	52-9
	Floppy Disk interface Data/Clock Separation	52-9
5.2.2	Interface Specifications	52-9
	Floppy Disk Interface	52-10
	Serial Line Interfaces	52-12
5.2.3	Extending the System	52-16
	5.2.3.1 RAM Extension to 128 Kbytes	52-16
	Memory Addressing	52-17
	5.2.3.2 PROM Socket Extension	52-19
5.2.4	Operation	52-20
	Memory Address Map	52-21
	I/O Address Map	52-21
	Jumpers	52-21
	Power Requirements	52-23
	Illustration of Board (component layout)	52-24
5.3	The Winchester Disk and its Interface	53-1..18
	5.3.1 SASI Interface	53-1
	5.3.1.1 Purpose of SASI in CR7	53-1
	System Expansion	53-1
	5.3.1.2 Description of SASI in CR7	53-1
	Sequence of Operations	53-2
	Signal Definitions	53-7
	I/O Addresses	53-8
	Electrical Connections	53-9
	Illustration of SASI board	53-10

- 5.3.2 Winchester Controller 53-11
  - Jumpers 53-12
  - Board Layout 53-13
  - Pin Assignments 53-14
  - Error Codes 53-15
  - Formatting 53-17
- 5.3.3 Winchester Drive 53-17
- 5.4 Floppy Disk Drive 54-1
- 5.5 X-Net Terminal Adapter 55-1..11
  - 5.5.1 X-Net 55-1
  - 5.5.2 The Role of the XTA 55-1
  - 5.5.3 Hardware Overview 55-2
    - Description of components 55-3
    - Block diagram 55-4
    - Board Layout 55-6
    - Integration into X-Net 55-7
    - Switch settings 55-7
    - Jumper settings 55-8
    - Fuses 55-8
    - LEDs 55-8
    - Cable connection 55-9
      - X-Net Connectors 55-9
      - V24 Connectors 55-10
- 5.6 System Boot 56-1..3
  - 5.6.1 CP/M 2.2 56-1
  - 5.6.2 CP/M Plus 56-2
- 6. LIST OF ABBREVIATIONS 6-1..3
- 7. INDEX 7-1..8
- 8. FORM FOR READERS' COMMENTS

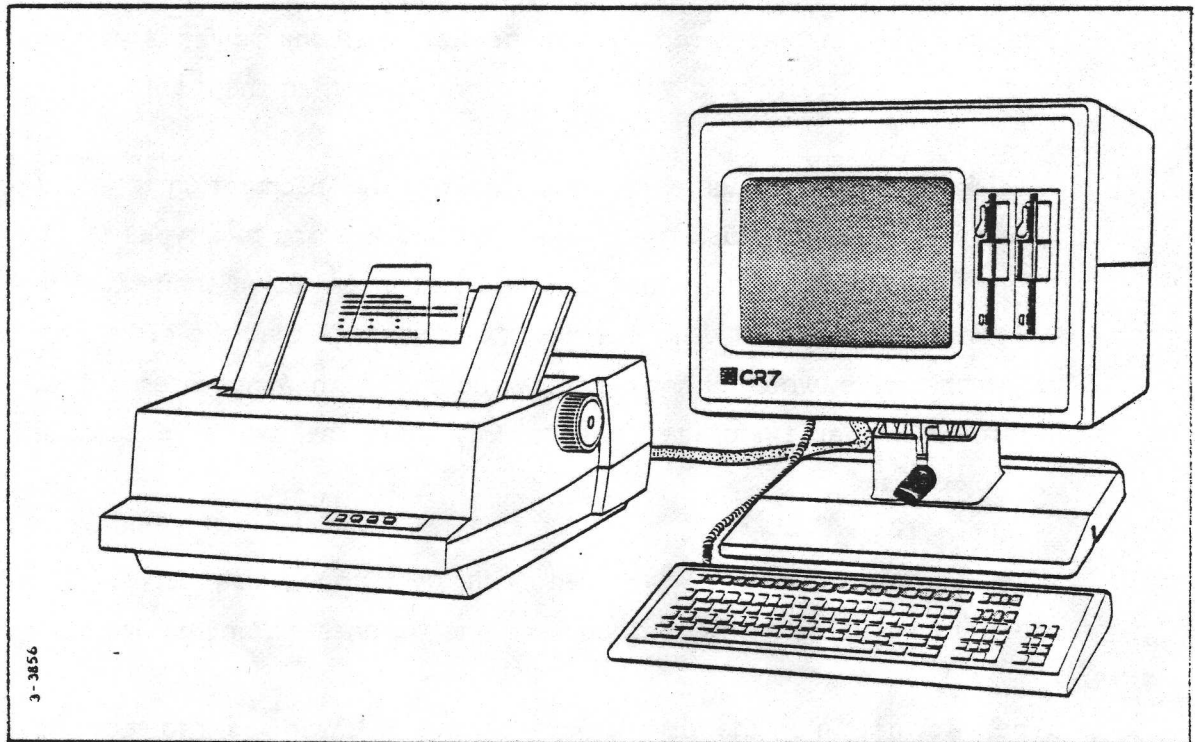




1. INTRODUCTION TO THE CR7

1.1 BRIEF DESCRIPTION OF THE CR7

The CR7 is a general-purpose microcomputer system which includes a VDU, disk drives and processor.



CR7 DIPLOMAT MICROCOMPUTER

**Processor**

At the heart of every CR7 is the Processor Board. This is the part that controls the whole CR7 computer system and does the 'thinking'; it is here that programs 'run'. For the technically minded, this single printed circuit board is a self-contained computer using the Z80A single chip microprocessor. Up to 128K bytes of on-board RAM is accessible; a floppy disk controller and three serial interfaces (for connecting terminals or printers) are also included.



## Disks

The purpose of the disks in the CR7 or any other computer is to store 'information'. Information can mean a lot of things - text, numbers, computer programs, diagrams made from graphics symbols, even photographs. Information is also stored in the CR7's memory chips (which are on the processor board); however, the information on a disk is more permanent than in memory chips (also called RAM), in that it remains on the disk when the power is switched off. Also, a disk will generally hold a lot more information than the memory chips.

A **disk drive** is the machinery which conveys the information to and from the disk itself (it 'drives' the disk round and round). There are two types of disk available - floppy and hard. A floppy disk can hold less information than the hard (otherwise known as Winchester) disk, but has the advantage that the disks may be removed from the drive (which is not normally the case with Winchesters). Thus the upward limit of available storage depends only upon the available cupboard space for floppy disks.

The CR7 is most often supplied with two floppy-disk drives. There are also versions available with one floppy and one Winchester, or just one floppy.

The information on the disks (floppy or hard) is organised into sections called **files**. Each file contains the data or information for a particular purpose, and is given a name which should describe that purpose. A single file might contain, for example, the text of a document, or a computer program, or a list of names and addresses. It would not generally contain something as small as a sentence or as big as 'all this month's correspondence', though in theory a file on the CR7 could be of any size up to the capacity of the disk on which it resides.

## VDU

The third vital component of the CR7 is the terminal itself. The terminal has two parts - a keyboard with which the user communicates with the processor board and a VDU screen with which the processor communicates with the user.

There are also various optional circuit boards inside the CR7 which are needed for certain applications. These include the XTA board which allows connection to any number of the other terminals or computers via an X-Net network; and the Winchester Controller Board. The next section describes the various options in more detail.

### Software

All this equipment would be useless without some software (otherwise known as programs). If the reader will excuse a small digression into some homespun philosophy, a computer without software is like a man without life. In other words a dead man is physically much the same as a live one, he consists of the same organs assembled in the same way. However, he cannot do anything at all, he is totally useless. So it is with a computer without software. Software is the invisible and intangible driving force which causes the computer to work.

**Application programs** or packages are those pieces of software which actually do something useful like word processing; **operating systems** are programs that coordinate and control the useful programs. The CR7 is supplied with the CP/M operating system. It is very popular and commonly found within the microcomputer industry, which means that a large variety of application programs are available for the CR7 - the range of uses to which it can be put, of course, is limited only by the programmer's imagination. However, ready-made programs are already available for, for example, word processing (including spelling correction), report generation, data base management, project planning, and many more - for more details, see sections 1.3 and 2.2.3.

## 1.2 CONFIGURATION OPTIONS - HARDWARE

The CR7 is available in various models ranging from the terminal-only CR7 Comfort up to a CR7 Diplomat microcomputer which can include a built-in adaptor for CR's local area network. The full range is given below, with optional additions in section 1.2.1.

## 1.2.1 Standard Features of the Various CR7 Models

<u>Model Name</u>	<u>Model Number</u>	<u>Description of Features Included</u>
Comfort	CR7 Opt 48C	Terminal only - featuring: <ul style="list-style-type: none"> <li>o Screen: 12" green or 15"yellow.</li> <li>o Tilt control to adjust screen to the most comfortable viewing angle.</li> <li>o Low-profile detachable keyboard (DIN Norm) with special function keys and numeric keypad laid out like a VT100 keyboard.</li> <li>o Supports a subset of ANSI X3.64 standard.</li> <li>o English or Danish keyboard - but <u>all</u> CR7's can display both character sets.</li> </ul>
Comfort-X	CR7 Opt 48D	Network terminal. This is similar to the Comfort described above except that it includes a built-in X-Net Terminal Adaptor for use with CR's local area networking system.
Diplomat	CR7/101	Complete self-contained microcomputer system built into the Comfort terminal described above (also available as cabinet model separate from terminal). Features include: <ul style="list-style-type: none"> <li>o Z80A Processor</li> <li>o 64K bytes RAM</li> <li>o Floppy disk controller</li> <li>o Two serial ports (plus a third used internally)</li> <li>o CP/M 2.2 Operating System</li> <li>o 1Mbyte floppy disk drive</li> </ul>
Diplomat	CR7/102	Same as CR7/101 but has two floppy disk drives (1 Mbyte each)
Diplomat	CR7/103	Same as 101 but has a 1byte floppy plus a 5 Mbyte Winchester disk (+controller)

<u>Model Name</u>	<u>Model Number</u>	<u>Description of Features Included</u>
Diplomat	CR7/104	Same as 101 but with 5 Mbyte Winchester and controller instead of floppy (normally only used with X-Net).
Diplomat	CR7/105	Same as 101 but with two 5 Mbyte Winchesters (and controller) instead of the floppy drive (normally only used with X-Net).
Diplomat	CR7/106	As 101 but with no disks (normally only used with X-Net).

### 1.2.2 Optional Extras

A list of CR7 optional extras is given below, followed by short descriptions of each one. This list was correct on 1st April, 83; new options are added from time to time - for instance, larger capacity disks are shortly to be announced.

<u>Option Number</u>	<u>Description</u>
40	Matrix printer, 80 cps
41A	Matrix printer, 120 cps
41B	Matrix printer, 200 cps
42A	Daisy wheel printer, 40 cps (letter quality)
46A	Tractor feeder for Opt-42A

<u>Option Number</u>	<u>Description</u>
42B	Daisy wheel printer 55 cps (letter quality)
42C	Daisy wheel printer 35 cps (letter quality)
44B,C	Double sheet feeder for Opt-42B,C
45B,C	Single sheet feeder for Opt-42B, C
46B,C	Tractor feeder for Opt-42B, C
96	X-Net adaptor, factory-installed into the CR7 Diplomat. One of the serial ports is used to interface it. See description below.

An extra 64 Kbyte of memory, for use with CP/M+ operating system.

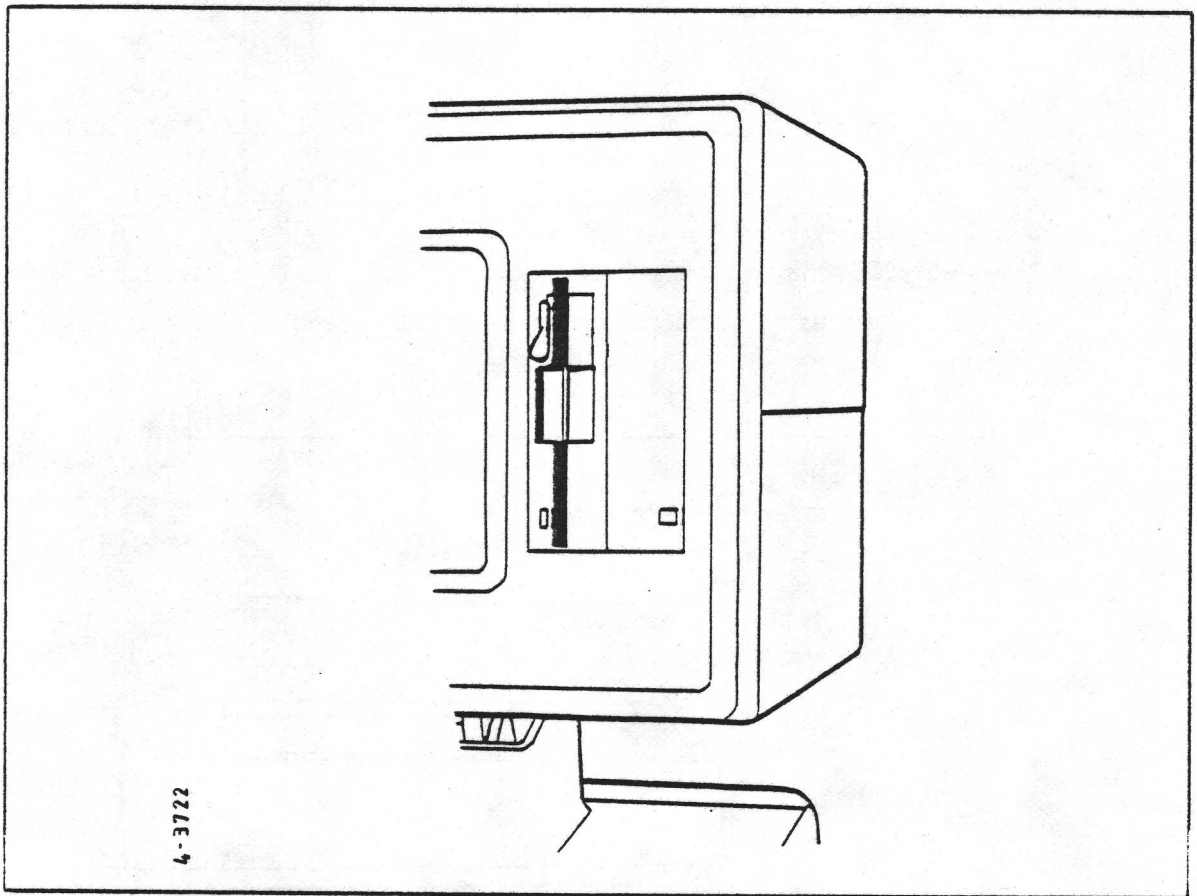
#### **X-Net Interface Board**

X-Net is Chr. Roving A/S's local area network which is used for connecting various computing resources within, say, a factory or university campus. X-Net will connect to any manufacturer's equipment; however, this is simplified in the case of the XTA X-Net interface board, which precludes the use of the separate terminal adapter required by other manufacturers' terminals.

#### **Disk Drives**

All CR7 models have space for 2 disk drives of a standard size (5.88 x 1.69 x 8.00 inches). The capacities quoted in the list of options are all unformatted capacities, i.e. a small proportion of these capacities are used by the system for 'housekeeping' and is not available to the user. Note that the Winchester disk requires a separate controller board whereas up to 2 floppy drives are catered for as standard within the Processor board.





CLOSE-UP OF CR7 WORKSTATION SHOWING FLOPPY DISK (LEFT) AND WINCHESTER (RIGHT)

**Memory**

If the CR7 is to be used with the CP/M Plus operating system, then an extra 64K of RAM must be fitted. This is the upper limit (i.e. a total of 128 Kbytes).

**Printers.**

There are 2 main types of printer that may be supplied with the CR7 - dot matrix and daisy wheel.

The dot matrix printers use continuous stationery which is fed through by a tractor feed mechanism (engaging with the holes in the edges of the paper). These printers are intended for higher speed of output though the print quality is not as good as that of the daisy wheel printer. The dot-matrix printers come in three versions (which outwardly appear very similar):

Option 40:

Speed: 80 characters per second. 80 columns of characters across the paper.

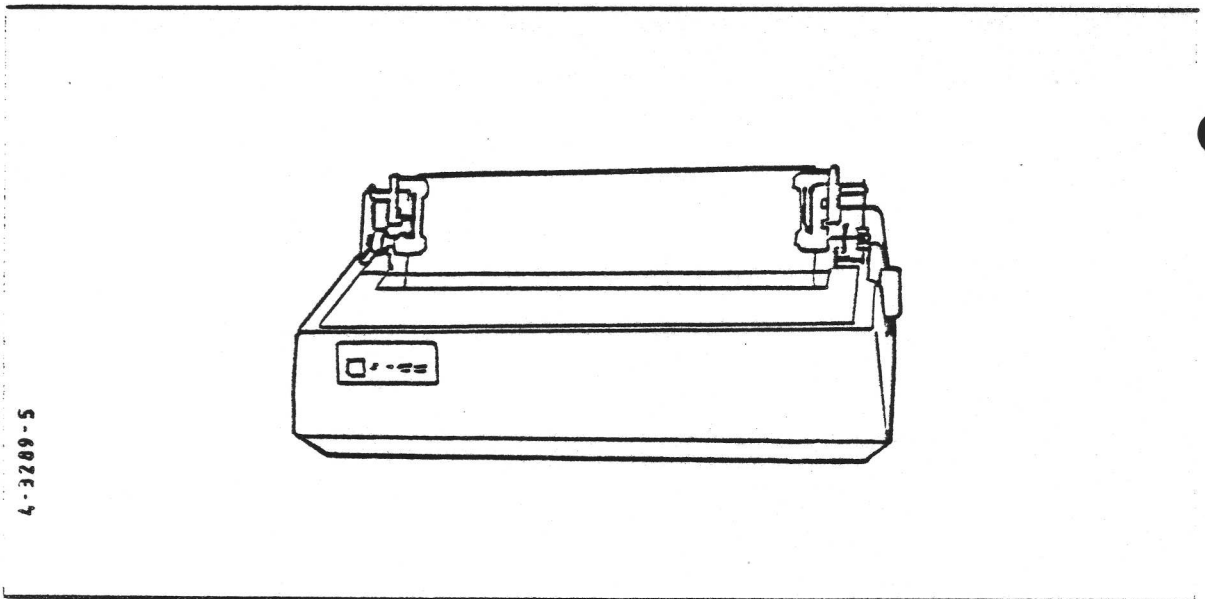
Option 41A:

Speed: 120 characters per second. 132 columns of characters across the paper.

Option 41B:

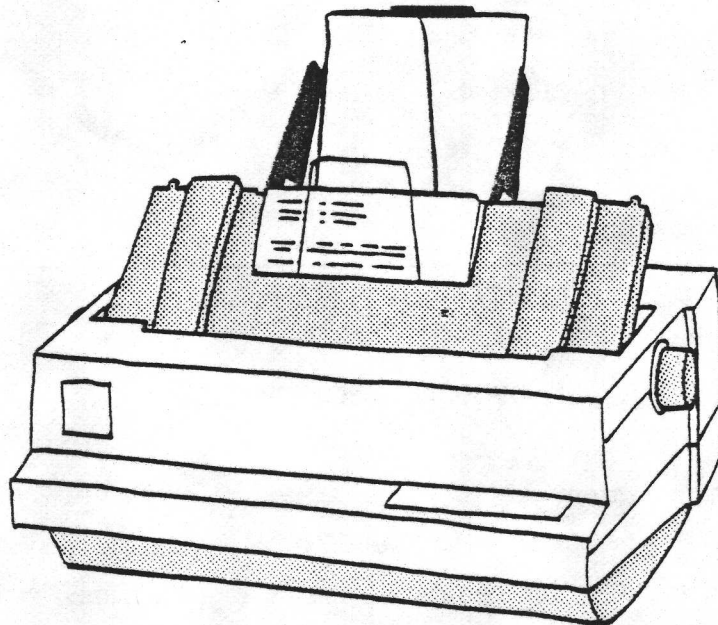
Speed: 200 characters per second. 132 columns of characters across the paper.

This model has the option of running at half speed but with a higher print quality.



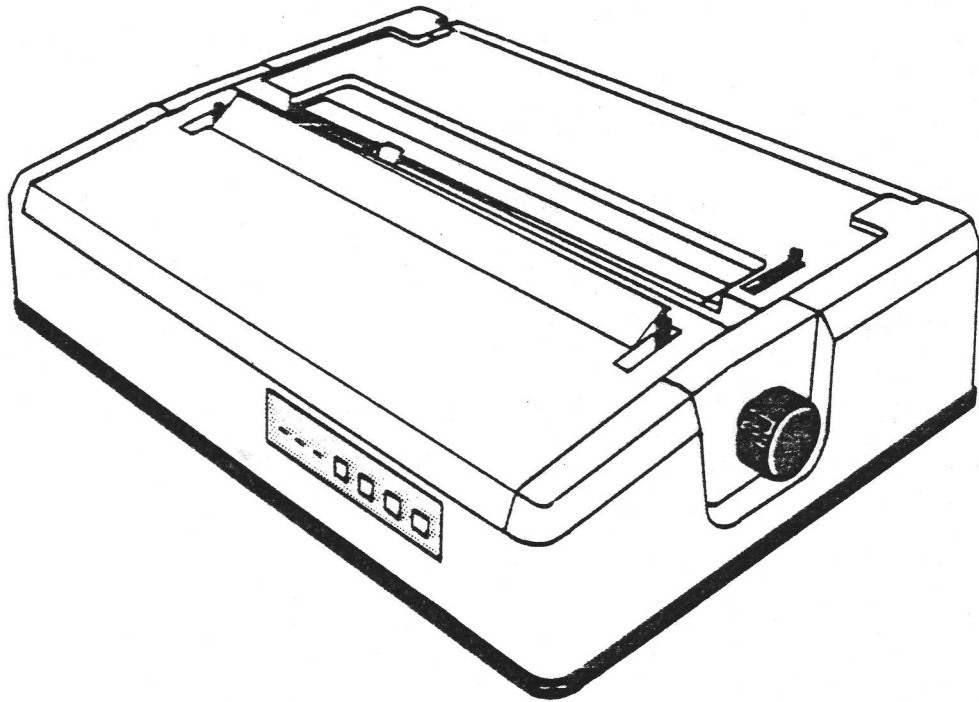
DOT-MATRIX PRINTER

The other type of printer that may be supplied with the CR7 is a **daisy wheel** printer. This is in effect an electric typewriter without a keyboard, so the print is of letter quality. It is intended for word processing applications. There is a choice of three adaptors - a tractor feed for continuous forms, a single sheet feeder, or a double sheet feeder. When the double sheet feeder is fitted, the user may select one of two paper styles when printing different parts of his document. This feature is particularly useful when the first page of a letter requires pre-printed headed paper whereas the continuation sheets use plain paper. It takes only few seconds to swap one adaptor for another.



4-3289-64

DAISY-WHEEL PRINTER WITH SINGLE SHEET FEEDER (OPTION 42B, C)



DAISY-WHEEL PRINTER (OPT. 42A)

### 1.3 CONFIGURATION OPTIONS - SOFTWARE

#### Operating System

The CR7 is supplied with the CP/M 2.2 operating system which is a single user system, suitable for dedicated use in small offices or industrial control applications. There is only one system console, and only one application program may be executing at any time.

The CR7 may be supplied with the more advanced CP/M+ operating system; this option however requires one extra 64 Kbytes of memory (128K total) to be installed.

The following gives a glimpse of the **applications packages** for the CR7 which are available from Chr. Rovsing; more details of them are given in section 2. A full list of the available software is given at the end of this section; it does not include specialist software such as protocol conversion.

**Word-processing system** for text entry and amendment. This includes a **mailing program** to simplify the production of many letters that have sections in common, and optionally a **spelling checker**.

**Financial Modelling** This is a sophisticated screen-oriented calculating package which may be programmed so that numeric fields in the display may be defined as mathematical functions of other fields. Thus the effects of changing a parameter are instantly displayed at all stages through the calculation. The package has many applications including: balance sheets, tax estimation, market share analysis, or statistics calculation in scientific experimentation.

**Planning Tool** This package is an aid to planning and handles report generation. It can also do calculations as part of its report. Its function is similar to the Financial Modelling package described above. The report is programmed in a very high-level English-like language.

A **Project Management** tool is available to aid in the management of small projects, using the technique of critical path analysis. The tradeoffs between time, money and manpower may be investigated : which activities may be delayed without delaying the whole project and which may not.

**Data Management Package - dBase II** This data base management system allows for a flexible user-designed input form. All functions are specified in a command language that can be used interactively or combined into programs to be run as a job (for more complex report generation for example).

### **Programming Languages**

The CR7 will support the following programming language options: Basic (CBASIC interpreter or compiler), Pascal, Cobol, and Fortran. An assembler comes as standard with the CR7.

### **Communications**

The CR7 may be provided with software to solve many communications problems, consult CR for details.

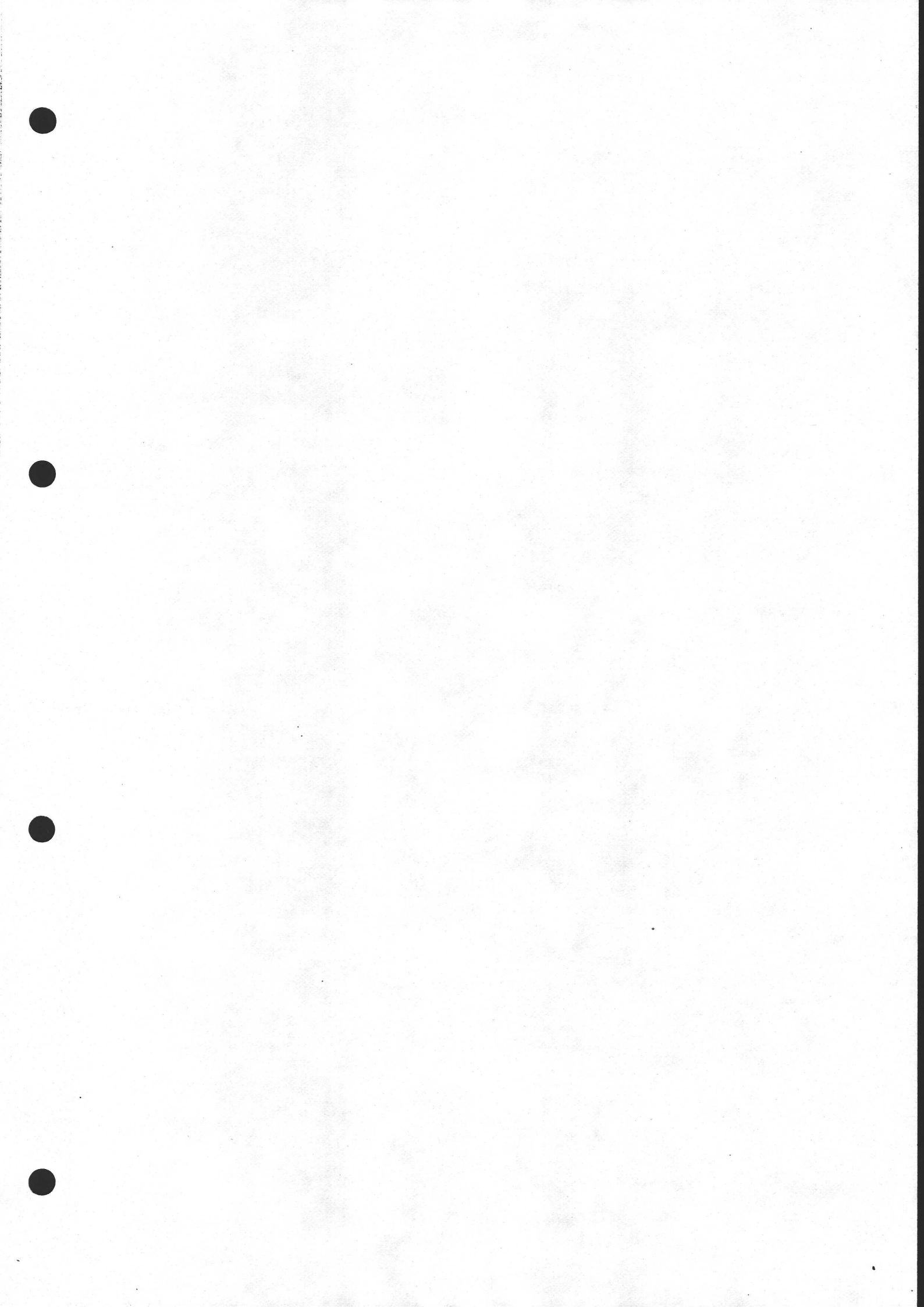


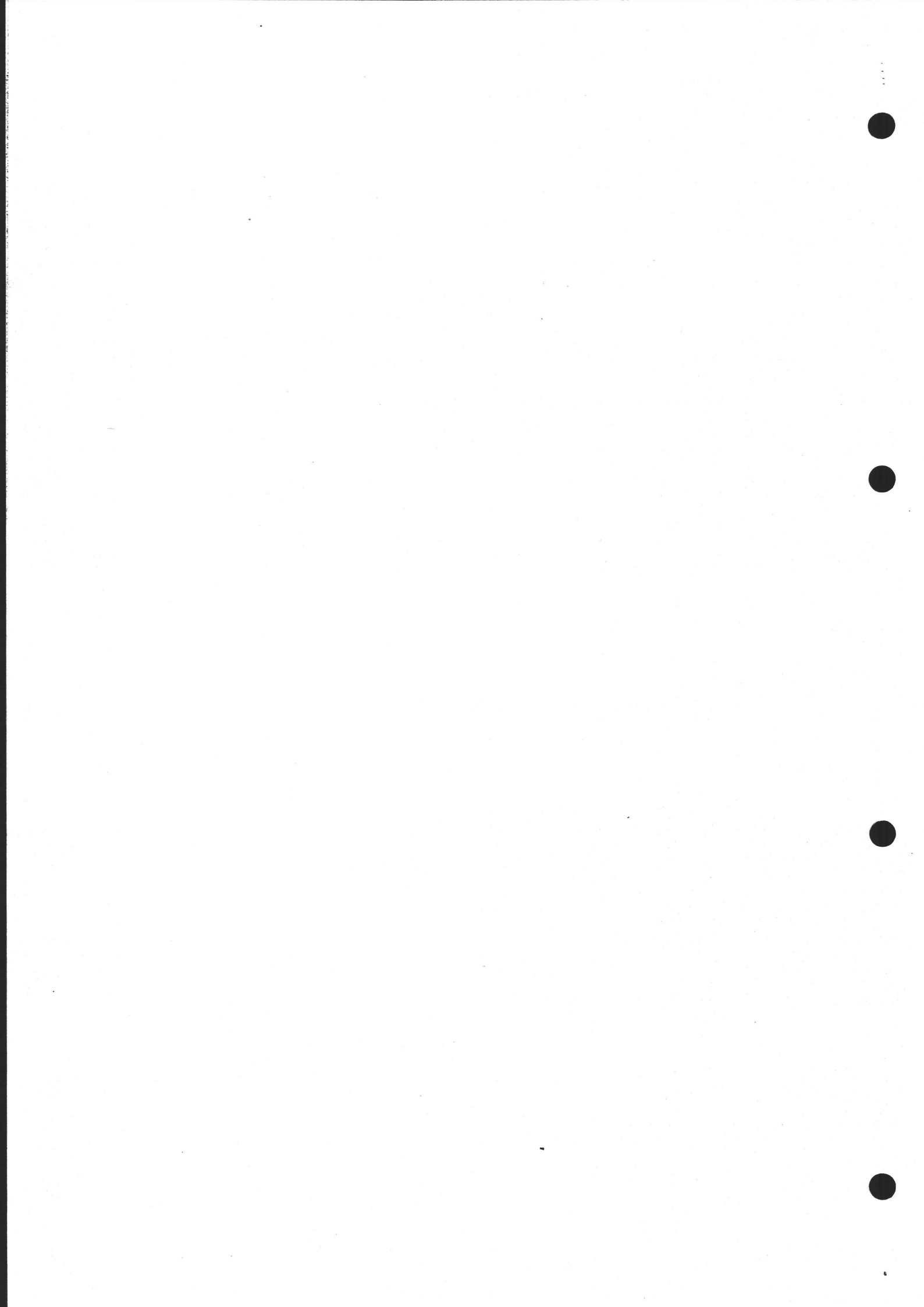
**Others**

This brief overview of the available software is not complete, and will quickly become out of date since CR frequently release new software packages and options. Please contact your local CR representative for a current list, or if you have particular requirements.

<u>Option No.</u>	<u>Name</u>
202	<u>Operating System</u> CP/M 2.2 CP/M Plus
	<u>Languages</u>
60	FORTRAN
61A	C-BASIC
61B	BASIC compiler
62	PASCAL MT+ (incl. SPP)
63	COBOL
	<u>Applications</u>
82A	Word Processing, English
82B	Word Processing, Danish
65	Proof Reading (English)
66B	Calculation & Financial Planning
70	Project Management
71A	Mailing, English
71B	Mailing, Danish
74	dBASE II
75	Finanssystem med budget- modul, Danish
76	Debitorsystem, Danish
77	Lagersystem, Danish
78	Kreditorsystem med Finansintegration, Danish
79	Kundeordresystem, (forudsætter Debitor/ lager) Danish
80	Totalsystem incl. opt.75-79
81	Planning & Report Generation, English

SOME OF THE SOFTWARE AVAILABLE FOR THE CR7

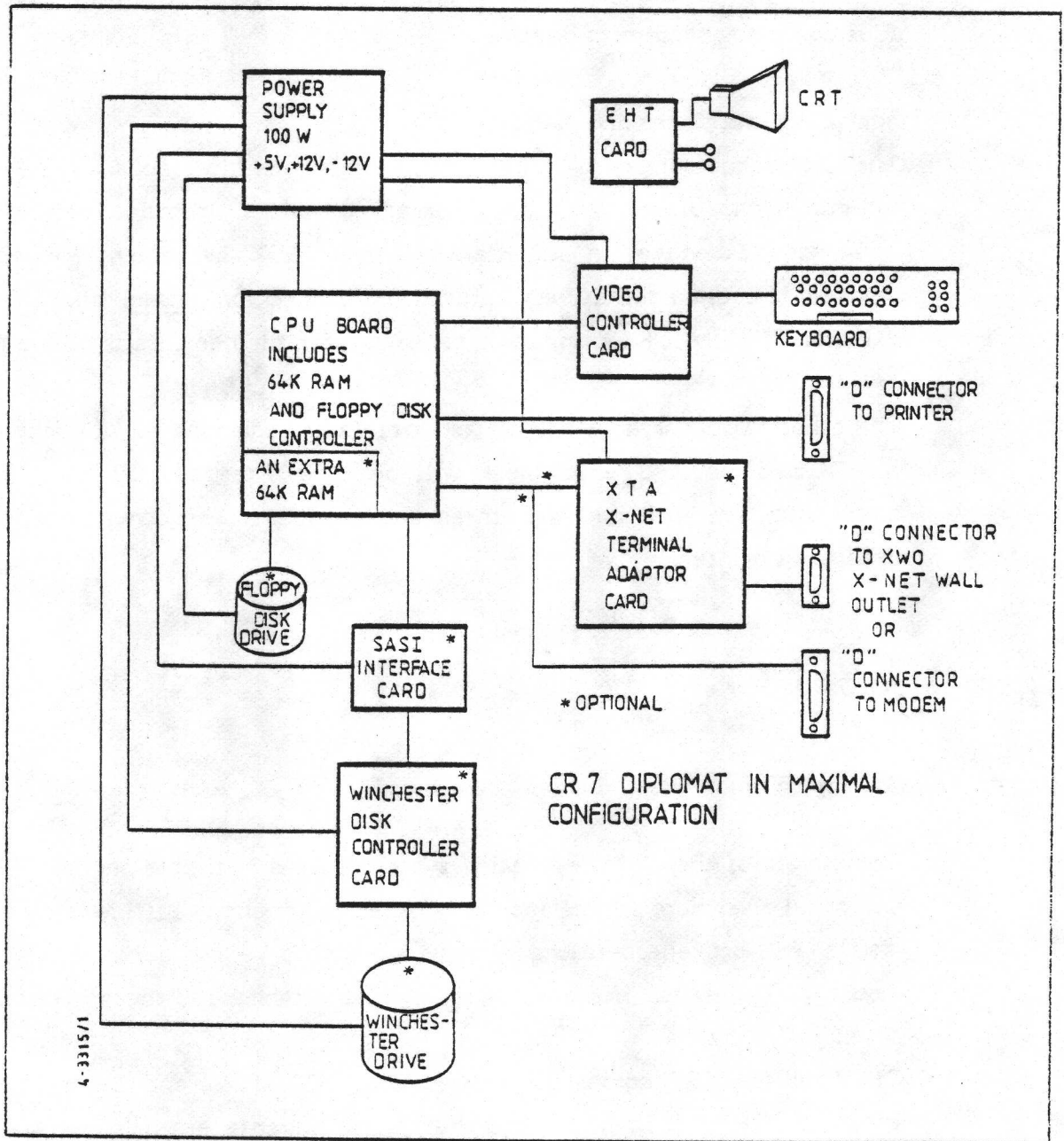




2. FEATURES OF THE CR7

2.1 HARDWARE

The CR7 was designed to be not merely a stand-alone desk-top computer, but as the starting point for building communications systems, local networks, process control systems, and many other applications.



CR7 DIPLOMAT IN MAXIMAL CONFIGURATION

### 2.1.1 The Processor Board

The processor board on the CR7 includes an 8-bit Z80A CPU, a floppy disk controller for up to two drives, and 64 Kbytes of dynamic RAM. It supports three serial I/O interfaces (see next section).

The CR7 processor board supports 16-bit addressing under a single-user operating system. The memory capacity of the board can be extended up to 128 Kbytes total by means of a small additional 'piggy-back' board. This allows the enhanced CP/M Plus operating system to be used.

#### Serial I/O Interfaces and X-Net

The CR7 processor board includes three serial line interfaces. One is a full modem interface, capable of synchronous or asynchronous operation with HDLC, SDLC, BSC, etc. It behaves in accordance with CCITT V24 recommendations for DTE devices. It could alternatively be used for connection within the CR7 to an X-Net Adaptor (XTA) - see sections 5.2 (pages ....) for further details of the XTA.

The other two interfaces are limited interfaces, adhering to V24 recommendations for DCE devices. One of these will be used internally by the CR7 itself for communication with its own screen and keyboard. The other would normally be used for a printer.

## 2.2 SOFTWARE

### 2.2.1 Operating System

The merits of the CP/M operating system that is available on the CR7 have been described elsewhere in this and many other documents. Suffice it to say here that it is a well-proven operating system which are very widely used throughout the industry. Thousands of programs are available for it, and therefore, for the CR7.

CP/M on the CR7 comes in two versions - CP/M 2.2 and CP/M Plus (otherwise known as CP/M 3.0). The latter has many advantages over CP/M 2.2. It does

however require an extra 64K of memory in the CR7. The advantages of CP/M Plus over 2.2 include much faster disk access, and a larger area of memory available for user software. This increase in user memory is gained by transferring most of the operating system to the extra 64K of memory. A cunning switching scheme is employed in order to access the correct 64K at the appropriate times. This scheme is necessary because the processor was designed to access a maximum of 64K.

Another feature of the Plus version of CP/M is an improved command line editor which can recall the previous command line so it can be edited and reused. The new CP/M also supports re-direction of console I/O to or from a disk file.

Over and above CP/M, the CR7 is provided with a menu system which makes all the software much more accessible. The user merely switches on, and (for systems with floppy disk drive(s) only) inserts his system diskette and a list of the available commands appears on the screen. He then just types one number as specified in the menu, to get the service he requires. The menu can also provide help, so that simple questions about how to use the software can be answered without the user having to refer to this or other manuals. The more experienced user may prefer to deal directly with CP/M; in this case the menus can be switched off and will remain disabled, even after switching the CR7 off and on again. A simple command will switch them on again, when desired.

### 2.2.2 Communications Software

The CR7 can be supplied with software that implements various protocols. An example follows.

#### **IBM 2780 Emulation**

The CR7 may be supplied with emulation software so that it acts as an IBM 2780 Data Transmission Terminal. The card reading, card punching and printing operations of the IBM 2780 are simulated on the CR7 as disc read or write operations. The BSC (Binary Synchronous Communications) protocol used by the IBM 2780 is implemented by this software. Furthermore, the CR7 can of course be used to create or edit the JCL or data files needed for the IBM batch job.



### 2.2.3 Applications Software

The following applications packages have been 'tailored' for use on the CR7 and are available from CR; of course, there are hundreds of other programs available for CP/M from other suppliers. Furthermore CR's range of software is continuously being added to and updated. See the list at the end of section 1.

#### 2.2.3.1 Text Master Word Processor (Option 82)

Text Master was developed in Denmark, with the characteristic Scandinavian concern for good design. This has resulted in a product that is simple to use, while still providing a powerful set of facilities. Some of its features are outlined below.

##### Command Keys

The most common editing commands are invoked by a single keystroke on one of the auxiliary keys. This ability to edit quickly and easily is one of the main advantages of text processing. For example, instead of cutting and pasting, as is necessary when using a typewriter, pieces of text can be moved or copied with a few key strokes, and corrections can easily be made without leaving ugly spaces or having to retype.

##### Ease of Use

Text Master is simple to use because you never need to memorise how to use it. The meaning of the command keys is explained on the keyboard itself. Furthermore, if you start typing a command and realize you have made a mistake, you can abandon the command with a single keystroke.

##### On-screen Formatting and Word-wrap

Another way in which Text Master makes things simple to understand, is by displaying a document on the screen as it will appear when it is printed.

For example, text is justified with respect to the left and right margins as you type it. Furthermore, you do not need to worry about pressing the RETURN key

(the equivalent of returning the carriage on a typewriter) at the end of a line, for as soon as you type a word which exceeds the right margin, that word is automatically moved to the start of the next line. This feature is known as Word-wrap.

### **Menus**

Whenever you have a choice of actions, you are presented with an easily understood menu, from which you can choose the appropriate action.

### **Option sheets**

Some commands require extra information, called options, before they are precisely specified. For example, if you want to find a specific piece of text, you must specify what the piece of text is. This extra information is specified by means of an option sheet. When you invoke such a command, its option sheet is displayed on the screen. You can then fill in these options one by one. For most options there is a default choice, which is the most common answer. If you want to choose the default value for a particular option, then just press the RETRN key when you come to that option. If you are in doubt about what an option means, then you can type ? when you come to it and a message will be displayed telling you what values the option may take.

### **Layout**

Another major advantage of a text processor is the ease with which you can adjust the layout of text on a page. With Text Master, margins and tabs are easily set up, and their positions are displayed permanently on the screen. Centering of lines, headers and footers, help in hyphenating long words at the end of a line, and support for inclusion of tables with the aid of column manipulation and decimal tabulators all aid you in obtaining precisely the layout you want.

### **Character properties**

While layout is mainly concerned with the visual relationship between text elements, Text Master provides several character property commands to define the visual properties of individual characters, or groups of characters. Such properties are underlining, boldface, superscript and subscript.

## **Printing**

For each document, Text Master asks you to specify a print format. This can be the built-in default format, or one that you have defined previously, or a completely new format defined via an option sheet. The options specified include page size, line spacing, page numbering, etc.

## **Multiple formats**

Most of these print options can be altered dynamically so that one can have several formats within a single document. This is done by means of "text commands", which are typed in as links in a document but which instead of being printed, change the print format, at the place where they occur.

## **Simultaneous printing**

To save time, Text Master can print out a document at the same time as another document is being edited.

## **Scanning**

Text Master has all the necessary commands to allow you to scan through a document, including searching for a particular piece of text.

## **Robot**

Particularly with scanning and replacing operations, you often need to perform the same operation, i.e. sequence of keystrokes, at many places in the document. This is easily accomplished in Text Master by defining a robot that performs that operation with a single keystroke.

## **Typewriter simulation**

For certain tasks, such as addressing an envelope, a typewriter can be more convenient than a text processor. With Text Master, you get the best of both worlds, since you can tell the system to print what you are typing as you type it (instead of printing everything after the whole document is typed in).

### **Document administration**

Another of Text Master's powerful, yet simple features is the integration of a document administration facility within the text processor. List, copy, rename and delete commands are performed in a similar way to text manipulation, so that the user does not need to learn a new set of commands. In addition, files produced by other applications, e.g. a spreadsheet, can be converted to text files and integrated within a document.

### **Merging**

One of the main advantages of a text processor is that one can reuse parts of previous documents and standard headings and paragraphs, without retyping them. This facility is of course present in Text Master. In addition, one can construct documents of unlimited size by "chaining" smaller documents together.

### **Card index**

But where Text master really outshines other text processors is in its integrated and comprehensive electronic card index facility. This presents a very powerful feature to the user under the guise of the easily understood and familiar concept of a card index. But it is much, much more useful than a manual card index. The production of standard letters and forms is the most obvious and useful application.

### **2.2.3.2 Calculation & Financial Planning. (Option 66B)**

This is a very flexible and generally-applicable "spreadsheet" program which can be used for report generation, complex calculations and cost planning. It is in fact a programmable program, in that the user can set it up to perform certain calculations (including conditional statements). The calculations may then be repeated using different parameters.

The user designs his own report or form - a large sheet of text and/or numbers. It can have up to 63 columns and 254 lines of entries (though the overall total is 600 entries), where an entry is a text string of up to 116 characters or a number of up

to 16 significant figures (maximum  $\pm 10^{63}$ ). Entries can be defined as fixed text or numbers, or variables. In the latter case the value can be accepted by typing it in each time a new calculation is done or it can be extracted directly from a data file; alternatively it can be some mathematical function of other entries on the form. These mathematical functions can call any of the following built-in functions:

Addition, subtraction

Multiplication, division

Raising to a power

Sum of arguments

Number of values in argument list

Mean value

Maximum, minimum value

Logarithms (base e or 10)

Square root

Absolute value

Exponential function

Logical expressions (AND, OR, IF, etc.)

Integer value of

Table lookup

Net Present Value of cash returns at a given discount

PI

Trigonometric function (SIN, ASIN, etc.)

So, using these functions to do a calculation in stages, it is easy to see on the screen **how** the calculation was done - giving greater credibility to the final report! For large or complex calculations that do not fit onto the screen, it is possible to "roam" over the report so that the screen is used as a window onto a part of the large report. Furthermore, whole lines or columns of particular interest may be optionally "fixed" into the display so that these do not disappear when the display is scrolled.

The package is so flexible and powerful that it is impossible to give a comprehensive list of possible applications; however the following gives a taste of the possibilities:



Balance sheets & accounting generally

Tax estimation

Market share analysis

Statistic calculation in scientific experimentation such as analysis of variance, correlation.

Data storage and retrieval (especially where there is a lot of different "facts" relating to each item).

Any application that could be done slowly with a pocket calculator and reams of paper.

### 2.2.3.3 Planning & Report Generation Package (Option 81)

This package serves much the same function as the one just described (Option 66B). The user does not create the report "on the screen" as he would with the other package. This package acts more like a traditional programming language, where a separate program is written which describes the desired report. It does however, have a few more mathematical accounting functions such as Internal rate of return, and four different types of depreciation calculation. It can also do a table lookup (a useful programming feature). It lacks the Linear Regression function that Option 66B has. This package is more flexible in the style and format of final report that it can generate; the 66B Option is more 'User Friendly' but gives a more limited range of reports as a result. The 81 Option could in fact be considered as an inexpensive alternative to Cobol.

### 2.2.3.4 Project Management (Option 70)

This package uses the technique of Critical Path Analysis as an aid in the management of small projects. The tradeoffs between time, manpower and money may be investigated. Parts of the project that constitute "bottlenecks" may be identified. That is, the program highlights those activities which if completed late will delay the whole project. Furthermore, it can generate a report on the project that can help to clarify what has to be done. Unlike many critical path analysis packages, this package is interactive and simple to use (and does not require a vast mainframe in which to run). So its aim is both to clarify the project to the manager and to produce easy-to-read reports on the project so the manager can more easily explain to others where the "vital links" in the project lie. It is



intended for the analysis of small projects (or for a superficial view of a large project). Of course, it is ideal for use on a small subset of a large project.

As well as analysing the use of time, this package can estimate the costs of a project; also it can instantly re-estimate costs (or time) if the user specifies different starting conditions.

Calculations take place virtually instantaneously. The program can handle more than 100 activities in the project. Manpower is divided into nine different skill categories. The user can choose the time unit as being hours, days, weeks, months, quaters, or fiscal quarters; the longest project is 9999 units. It can allow for holidays, and the normal working week can be defined.

The printed output from the program consists of four reports. The first defines the initial parameters such as manpower-skill-types available and dates of public holidays. The second is a detailed description of each task into which the project has been divided in terms of timings and estimated cost. The third report is a timetable of the whole project with the critical path (and non-critical timings) clearly marked. The final report consists of a table showing job number, job name, duration, early and late timings, slack time, costs, prerequisite jobs, and number of men needed in each skill category. If all of these will not fit across the printer, the user can divide them into separate tables as required.

#### 2.2.3.5 Data Base Management System - dBASE II (Option 74)

This software package is used for storing and retrieving large amounts of information - for example, stock control or customer bases. The system is designed to be flexible so that you can easily select the required pieces of information. For example, say the system was being used to catalogue books in a library. You would have to type in, say, the title, author, publisher, classification number, and current borrower for each book. However, once this had been done, it would be very simple to get replies to questions such as:

Which books has Mr. Robinson of 1 Main St. got out at the moment?

Have we any books by Isaac Asimov in stock at the moment?

Do we possess a copy of "War and Peace"?

In other words, the data base system is used to sift through vast quantities of information that we have given it in the past and find out exactly what we want to know at this particular moment.

All communication with the system is via its own high-level language; any applications programs for the package must be written in that language. The user may interrogate the data base with a simple interactive dialogue, or combine commands (i.e. dBASEII language elements) into command files (programs) for the execution of more complex procedures. The "form" is set up using an interactive dialogue, then data is entered into the data base by filling in the blanks in the pre-defined form. The cursor automatically moves to the next box to be filled in. Simple data-type checking takes place during data entry and an audible warning given if data is of the wrong type.

One feature of the system is that it is possible to add data types or categories to an existing data base, without affecting programs already written - the new fields are simply ignored by the old programs.

dBASEII can generate reports from one or more databases; the report-writing software can do simple arithmetic also.

### 2.2.4 Programming Languages for the CR7

All language processors for the CR7 are optional, apart from ASM.

**ASM.** This is the simple assembler for the Z80 processor. It is a standard CP/M 2 utility. It accepts Intel 8080 mnemonics (which cover a subset of the Z80 instruction set). It includes an optional assembly directive (i.e. IF and ENDIF statements surrounding a block of code which is assembled or not according to the value of the IF expression).

Other assemblers are available - contact your local CR representative for details.

**Pascal/MT+.** This Pascal includes every feature specified by ISO DPS/7185, plus the following extensions:

BYTE, WORD and STRING predefined scalars

Expressions may include the predeclared INP array.

User may make assignments to the predeclared OUT array.

The facility to permit recursion may be switched on or off.

Boolean operations on integers (using &,!,? for AND, OR, NOT respectively).

ELSE in CASE statements

External and Interrupt procedures

Bit and byte manipulation

Sophisticated file handling including random access

Move and Fill memory areas

Functions to return address and size of variables

String concatenation, copy and comparison

Heap management using ISO standard or other procedures.

Support for BCD and floating point real data types.

Ability to compile one module at a time.

Facility to send character I/O through via user's own software.

Pascal/MT+ can be used for real-time applications as well as the more usual data processing tasks (which can include systems software such as compilers). Furthermore it can generate code that can be used **without** an operating system, if desired. Note also the Speed Programming Package, described in the next section.

**SPP.** This Speed Programming Package comprises various program development aids for use with Pascal/MT+. SPP has the following features:

- o Its supervisory program is supplied in source code to it can be adapted to any terminal or have new functions added.
- o A screen-oriented editor which includes a syntax checker. The latter can be switched on or off as required.
- o Spelling checker for the user's identifiers. This pinpoints those that have only been used once (and are therefore probably mistakes); it gives a frequency count of all identifiers.
- o Incremental disk backup utility.
- o Logging of source modifications.

**BASIC.** Two types of CBASIC are available from CR for use on the CR7. They are the CBASIC interpreter and the CB-80 compiler. Both support the same language syntax, thus only one source need be maintained for either type.

The CBASIC interpreter is not strictly described by that name; the source must be processed by CBASIC to produce an intermediate file in "pseudo-code". This intermediate file is then interpreted by the Run-time monitor at run-time.

CBASIC (i.e. these 2 BASICs) is the most widely used variety of BASIC in the industry so there are thousands of programs commercially available that will run with no alteration at all.

CBASIC processes floating point numbers in binary coded decimal (BCD) format which maintains accuracy to 14 significant figures. Furthermore, integer arithmetic may be specified where appropriate. These two features imply that arithmetic will be faster and more accurate in comparison with other BASIC implementations.

Character strings are dynamically allocated by both CBASICs. This means that string handling is both fast and efficient in memory use. In the compiled version they can be up to 32,000 bytes long.

Other features of CBASIC include tracing and cross reference listing for debugging, CALL statements (with parameters), overlaying code (to allow programs to run that are larger than the available memory), and error trapping.

**Fortran.** This compiler supports all of the ANSI X3.9-1966 standard apart from the COMPLEX data type. It also supports the following features.

- o Signed integer LOGICAL variables
- o INTEGER\*4 32-bit integer variables
- o LOGICAL DO loop counters for faster execution when applicable
- o Reals and integers can be mixed in an expression.
- o Hexadecimal constants are permitted.

- o Hollerith literals are permitted.
- o Logical operations on integers
- o READ or WRITE statements can include a label to transfer to on error or end-of-file.
- o ENCODE and DECODE statements for FORMAT operations to memory.
- o IMPLICIT statement accepted.
- o INCLUDE statement to insert source code in-line from another file. Very useful for COMMON BLOCKS.
- o Supports random access of up to 65,535 records in a file larger than 8 Mbytes.

The compiler optimises the code in various ways (such as common sub-expression elimination). It also includes an extensive subroutine library.

The user may write his own I/O device driver for each Logical Unit Number in order to access his own "fancy" peripherals.

The program package includes a Z80 macro assembler, a linkage editor and a cross-reference lister.

The Fortran package is available by special order only.

**Cobol.** The Cobol package available from CR is the industry-standard RM/COBOL, developed by the Ryan-McFarland Corporation. It conforms to the ANSI X3.23-1974 standard.

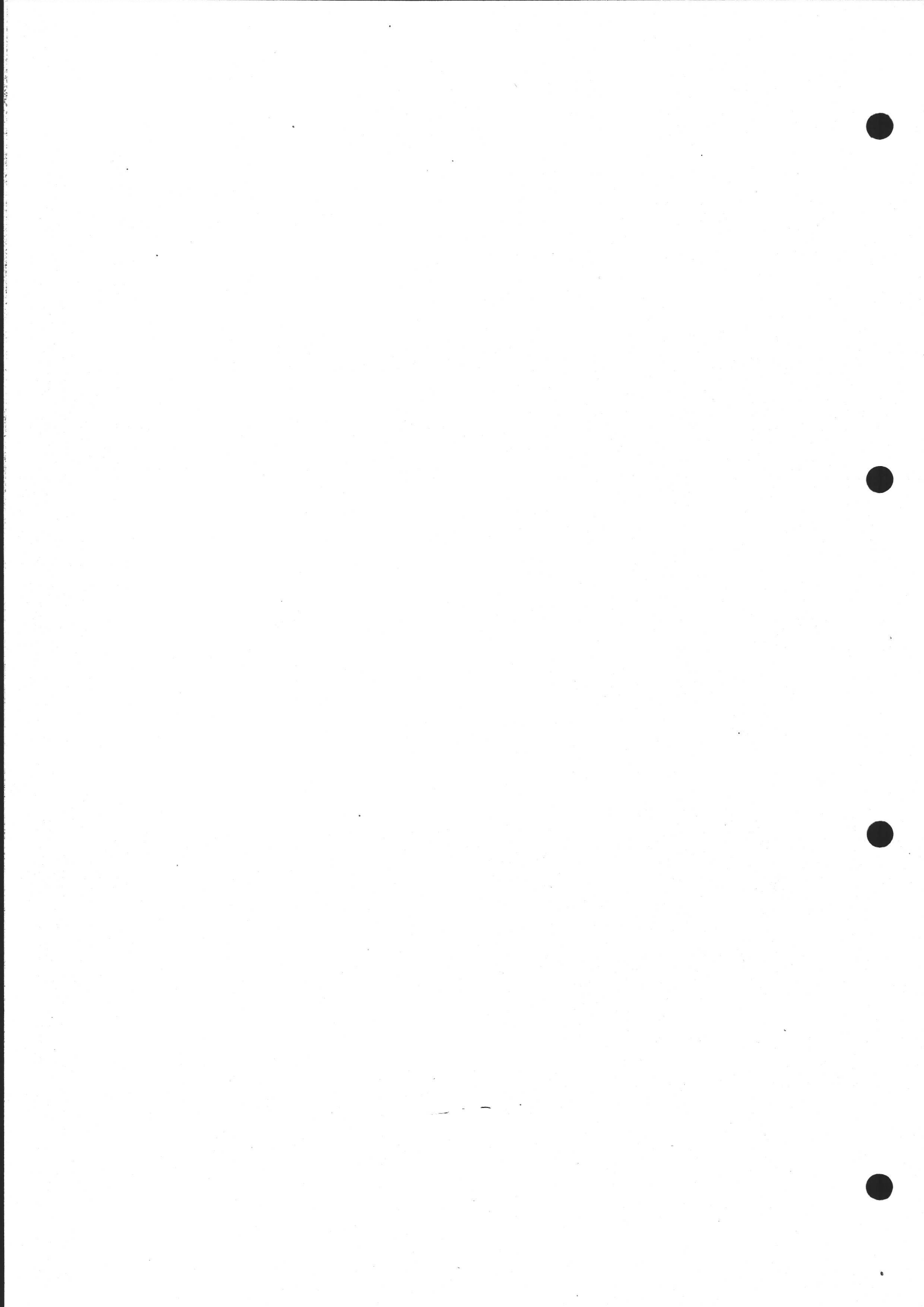
RM/COBOL also supports alternate keys when using indexed data files. Any field in the record can be used as the index key.

The compiler may be supplied with the COGEN utility. This allows the programmer to interactively design the desired screen or report format; then COGEN itself writes the required RM/COBOL source code to define that screen or report. This obviously cuts program development time and to some extent the level of skill required by the user or programmer.









3. START UP & OPERATION

3.1 INSTALLATION

**Positioning the CR7**

The CR7 may be used in any normal office environment. Unpack it and put it on a desk or table.

Although the screen of the CR7 is specially designed to minimise reflections, care should nevertheless be taken that the unit is situated somewhere where reflections of bright lights or windows do not distract the user.

Notice the large black knob on the front of the pedestal, under the unit containing the screen and disk drives. This knob is used to tilt the unit up and down in order to obtain the most comfortable viewing position. Turn it clockwise to tilt it up.

Similarly, the keyboard is separated from the main unit, in order that the most comfortable position can be found for it.

**IMPORTANT**

**Checking the Voltage Setting**

Before connecting the CR7 to the mains, you must check that the rated voltage matches that of your mains supply. In the unlikely event of it being wrong (for instance if a European CR7 is to be used in the USA or vice versa), then a CR technician will have to give it a 'little operation'. The rated voltage is stated on the left hand side of the panel at the rear of the CR7. Note that the 220V AC model can safely be used on 240V (British) AC mains supplies.

**Plugging In**

Connect the coiled keyboard cable to the back of the CR7, into the socket marked 'keyboard'.

When you are sure you have the correct voltage setting as described above, and not before, connect the mains inlet on the back of the CR7 (left hand side) to a

convenient mains wall socket using the lead supplied. If the printer was supplied with the CR7 by CR, then all you have to do is to connect the printer to the CR7 using the cable supplied. Plug this data cable into the socket immediately to the left of the keyboard socket at the rear of the CR7.

Then connect the printer to the mains.

**Never connect or disconnect any printer to/from the CR7 while power is switched on to the printer or CR7.**

**If your printer was NOT supplied by CR with the CR7....**

#### **IMPORTANT**

If you intend to use a printer not supplied by CR for use with the CR7, you should contact CR Hotline first as to wiring and interface details. Damage could be caused to printer and/or CR7 if the interface were wired incorrectly.

Most types of printers with a V24 (DTE) interface can be used if wired correctly, though some applications software packages such as word processors have special requirements of the printer.

Technical details of the printer interface are given in section 5.2, pages 1, 3, 12, 14 and 15. If in any doubt about connecting a non-CR printer, consult CR first.

If the Baud rate of the CR7 interface is unsuitable for your printer, it can easily be changed using LPBAUD or SYSGENF. Both may be called up via "Other commands" in the Help Menu. See pages 4-8..9 for details. Other characteristics can be changed, but no ready-made programs for this are supplied. Consult CR for details.

#### **Power Up**

It should now only be necessary to switch on the mains. The switch is on the back panel. If your system does not include a Winchester (i.e. it has only floppy disk(s), then you should now insert the Menu diskette into the left-hand drive - see pages 3-13..14. When the VDU has warmed up, the following message, or something similar, should appear on the screen.

CR7 BOOTLOADER Vers. 4.0

CHRISTIAN ROVSING A/S 64K CP/M VER. 2.2 07-15-82  
DUAL SIDED 96TPI 5 1/4 MINI FLOPPY BIOS, VER. 2.1  
MENUON?

A>\_

It means that the system has 'booted' itself and is now ready for use.

Notice the character that appears immediately after the > prompt from CP/M. It is illustrated above as an 'underline' character, though it sometimes takes the form of a filled-in rectangle. It may blink or remain steady (depending on the switch settings at the back of the CR7). It is known as the **cursor**. The purpose of the cursor is to show where (on the screen) the next character to be typed in will appear.

If your system has been set to 'automatic menu', then the 'boot-time' text as shown above, will shortly be replaced by the menu itself. If however it was set to manual menu, then the MENUON? message means that by typing MENUOFF after the A> symbol, the menu will then appear. Further details of the menu system are given on pages 3-18..32.

Before you use any software package supplied by CR (or anyone else) for the first time, be sure to make a copy of it first (see the whole of section 3.4, pg. 3-12..18)

The user should familiarise himself thoroughly with the rest of section 3 of this manual before typing anything on the keyboard. It is possible to delete expensive software packages by typing the wrong things (especially but not only, the ERA and FORMAT commands)! It would be wise also to at least glance over the manuals of the application software before starting.

### Switching Off

**N.B.** Never switch off the mains to the CR7 when the light on the front of any of the disk drives is lit. Doing so could corrupt data or programs stored on those disks. Furthermore, it is wise to remove diskettes completely before switching off.

Subject to the provisos above, the CR7 can safely be switched off at any time; you should however be careful to exit from your application software in an orderly way first (i.e. following the method laid out in the documentation for the particular software package). Failure to do this could prevent your data files from being updated. For example you could have typed in a letter using a word processor. If you then failed to exit from the word processor in the approved way before switching off, you would probably find that that letter had mysteriously disappeared, the next time you switched the CR7 back on again.

## 3.2 OPERATION OF THE CR7

### 3.2.1 Terminal Controls Including Keyboard

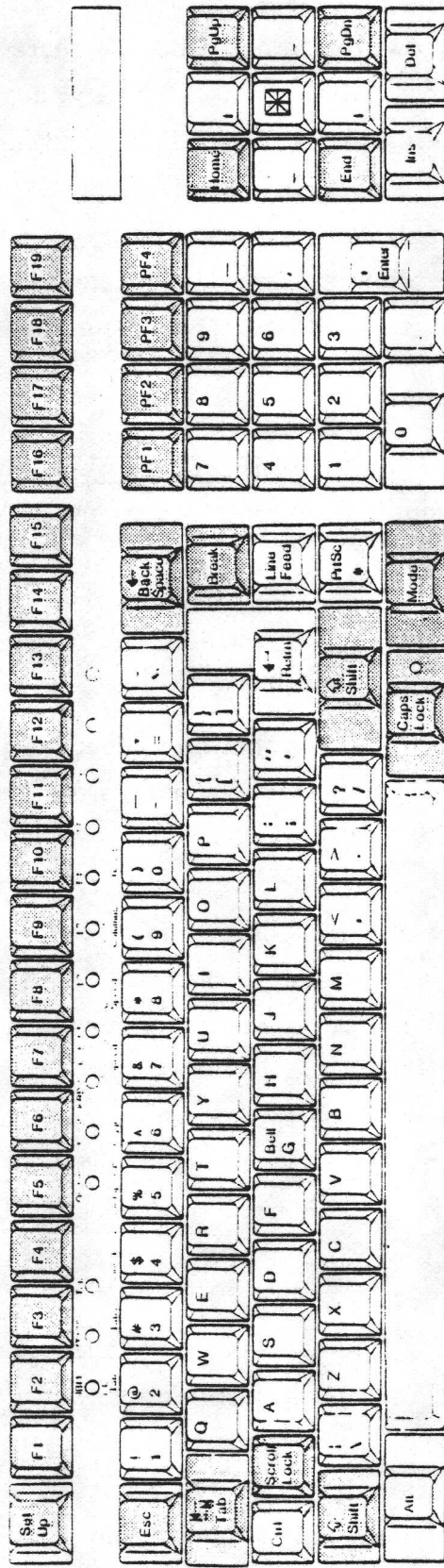
#### The Keyboard

The keyboard is used both to type in text (for example in a word processing application) and to give commands to the CR7. Despite what some people may say, computers are not always very intelligent. Therefore you should always type your commands exactly as laid out in the documentation for your program, otherwise, in most cases, the CR7 will not understand. For instance, some commands require capital letters - the same command in normal (lower case) letters might not be recognised. Another example is that when defining file names, there must be a full stop between the file name and the file type. A full stop plus a space, or a comma instead of a full stop would not be recognised.

Note that most of the keys will repeat if held down - for example the N key held down for a couple of seconds would generate the sequence nnnnnnnnnnn (or NNNNNNNNN if CAPS LOCK were set).

There are two types of keyboard available for the CR7. The larger type is illustrated here; the smaller one lacks the keys on the far right and the long row of function buttons.





THE KEYBOARD



Some of the keys on the keyboard are simply 'text' keys - they merely generate the letter or symbol that is printed on them in the same way that a typewriter would. The other keys however do not generally represent letters but have special functions. These functions will in most cases vary, depending on which program is in use at the time. Alternatively, a key might do nothing useful at all if its normal function is not needed in a particular application.

The following table describes the special (non-text) keys. Those marked with a \* only appear on the larger keyboard. The colour coding of the keys has little meaning.

<u>NAME OF KEY</u>	<u>LOCATION</u>	<u>MOST USUAL FUNCTION</u>
PF0 or SET UP	Left top	Completely dependent on the application.
F1 to F19	Top *	Completely dependent on the application.
ESC	Left top	Application dependent; generally used to ESCape from an 'error' situation.
TAB	Left Middle	Moves the cursor to the next of several fixed column middle positions - exactly as on an ordinary typewriter. Not always implemented.
CTRL	Left Bottom or Middle	Always used in combination with other keys. Must be held down <u>while</u> another key is pressed. Functions are application dependent. Please refer also to the index.
CAPS LOCK	Left or Right Bottom	Causes all alphabetic keys to produce upper case (capital) letters only. Press it again to revert to normal mode. Note that it does not affect the numbers or punctuation keys, so it is not the same as 'shift lock' on a normal typewriter. Red light inside the key illuminates when in 'capitals only' mode.

CR7 USER MANUAL - STARTUP & OPERATION

<u>NAME OF KEY</u>	<u>LOCATION</u>	<u>MOST USUAL FUNCTION</u>
NO SCRL or SCROLL LOCK	Left Bottom or Middle	This enables or disables scrolling of the screen - in other words it can stop text disappearing off the top of the screen while you are reading it. If it does not work for your software, try CTRL-S to stop and CTRL-Q to start.
SHIFT	Left Bottom	Allows access to capital letters or symbols written on the upper parts of the keys. Hold it down while pressing another key. The same as SHIFT on a typewriter.
ALT	Left Bottom*	IBM. See note below.
← ↑ ↓ →	Right top or far right	These four are used to move the cursor, in certain applications.
BACK SPACE	Right Top	Deletes the previous character. Used to correct a mis-typed command before RETRN is pressed. If held down for a second or two it will delete several characters.
BREAK or HOME	Right Top or far right	Sometimes used to send cursor to the top left corner of the screen. Generally does nothing.
DEL	Right Middle (smaller keyboard)	Deletes the previous character from the command line (must be used before pressing RETRN). The deleted character is re-displayed. BACK SPACE serves the same purpose but is easier to use.
RETRN or RETURN or RETN	Right Middle	Most commands to software packages must finish with this key. Also used to denote a new line in word processing applications. Cursor moves to the beginning of the next line.

CR7 USER MANUAL - STARTUP & OPERATION

<u>NAME OF KEY</u>	<u>LOCATION</u>	<u>MOST USUAL FUNCTION</u>
SHIFT	Right bottom	Identical to the other SHIFT.
LINE FEED	Right Bottom or Middle	In some applications it is identical in function to RETRN. In others it moves the cursor one line down but does not move it to the left margin. Sometimes it does nothing at all.
PRT SC	Right Bottom*	IBM. See note below.
MODE	Right Bottom*	IBM. See note below.
PF1 PF2 PF3 PF4	Numeric Keypad	These 4 keys have no general function. Their use (if any) is always specific to a particular software package.
7 8 9 - 4 5 6 , 1 2 3 0 .	Numeric keypad	Either generates the underline symbol or is application-specific.
ENTER	Numeric Keypad	In some applications it can be used instead of RETRN, in others it has special functions, in others it has no function.
HOME	Far right*	Sometimes used to send cursor to top left corner of screen. Generally does nothing.
← ↑ ↓ →	Far right	These four are used to move the cursor, in certain applications.
END	Far right*	IBM. See note below.

<u>NAME OF KEY</u>	<u>LOCATION</u>	<u>MOST USUAL FUNCTION</u>
PG UP and PG DN	Far right	IBM. See note below.
INS	Far right*	IBM. See note below.
⊠	Far right*	Application dependent.

The keys described as IBM keys are not used when the keyboard is used with the CR7.

Sometimes, even the alphabetic and punctuation keys have special functions for certain applications; the rule is always that you must refer to a program's own documentation for precise details of the meaning of any key.

### Setting the Terminal Characteristics

The Baud Rate of the terminal must be set to that of the CR7. This is the speed at which data is transmitted between the processor and the terminal. This will be set in the factory to the correct value before delivery. If for any reason it has been changed, or needs to be changed, refer to pages 51-6..8.

Section 5.1.2 also gives details of how to set other characteristics of the terminal such as cursor style, and interface characteristics.

### 3.3 OPERATING THE PRINTERS

A few details are given below of the various printers supplied by CR. Every printer is supplied with its own handbook to which the reader is referred for full operating instructions.

#### 3.3.1 Dot-Matrix Printers

##### Opt. 40 Dot-Matrix.

This has a mains switch at the rear and one button at the front - the PRINT switch. It must be set to ON. The red lamp on the front panel indicates that the power is on.

##### Opt. 41A or 41B Dot-Matrix.

This has a mains switch at the rear and the following switches and lights on the front panel.

- POWER** Light : Indicates 'power on' when lit.
- PAPER** Light : Lights when paper runs out
- FORM LENGTH** knob : Set this to the length of the paper in use as follows:

<u>Switch Position</u>	<u>Form Length (cm.)</u>	<u>Form Length (in.)</u>
0	7.6	3
1	8.9	3.5
2	10.2	4
3	14.0	5.5
4	15.2	6
5	17.8	7
6	20.3	8
7	27.9	11
8	30.5	12
9	35.6	14

**TOF SET:** Use this button to set up the position of top-of-form. Move the paper to the desired position with the platen knob, set the printer off-line (see SEL button & light), then press TOF.

**SEL.** This toggles between on- and off-line each time the SEL-button is pressed. The SEL light is lit when the printer is on-line, i.e. ready for action. The SEL light will also go out if the paper runs out.

**FORM FEED** and **LINE FEED.** These only work if the printer is off-line. They move the paper up one page or one line respectively.

### 3.3.2 Daisy Wheel Printers

#### Opt. 42A Daisy-Wheel

The mains switch is at the rear. When on, the POWER lamp is lit on the front panel. The other lights and buttons are as follows (left to right).

**PRINT ON** light is lit when printer is 'on-line'.

**ALERT** light is lit if:

The front cover is open, or  
Paper has run out (if paper-out mechanism fitted), or  
The ribbon has run out.

**POWER** Light. Lit when mains switched on.

**STOP CONTINUE** button. This toggles between on- and off-line.

**LF** Button. Moves the paper up one line, or if held down for more than 2 seconds, it causes continuous line feeds to occur.

**PAGE ADV** Button. Moves the paper to the next top-of-form.

**SET PAGE.** When pressed, the line at which the printer's head rests becomes the top-of-form position. The printer acknowledges by moving the head briefly to the right and back again.



**Setting the paper length:** Directly behind the lamps on the front panel (lift the cover) are two sets of tiny switches. Switches 6 to 9 in the right-hand bank of switches control the paper length. Set them to OPEN as per this table:

<u>Switch Position</u>	<u>Form Length (cm.)</u>	<u>Form Length (in.)</u>
6	2.5	1
7	5.1	2
8	10.2	4
9	20.3	8

The effect of the switches is additive; thus for example, switches 6 and 7 closed, and 8 and 9 open would give a form length of 12 inches. The printer must be turned off and on again after setting the paper switches.

**Opt. 42B or 42C Daisy-wheel**

Mains switch is at the rear of the printer. The front panel has a numeric display which shows the number of the print column currently under the print head. It also displays error codes (if the first digit is 'E').

**SELECT.** Press the upper part of this switch to toggle between on- and off-line. When on-line, the light below this switch will be lit.

**RESET/BREAK.** If the upper portion is pressed, certain error conditions will be corrected. If the lower section is pressed, a special code is sent to the CR8.

**GO TO TOF/SET TOF.** If the top section is pressed, the paper will move to the next top-of-form. If the lower part is pressed, the current paper position will become the top-of-form.

**MICRO LINE.** This will move the paper up or down in 1/48 inch increments.

There are some other switches for setting the form length and so on. They are well labelled; they lie to the left of the buttons described above, though they are under the front cover.

### 3.4 DISKS, FLOPPY AND HARD

#### 3.4.1 Use of Floppy Diskettes

A diskette, or floppy disk, is a thin plastic disc coated with magnetic recording material, used for storing quite large amounts of information.

The diskette is sealed in a cardboard envelope. The inner plastic disk rotates constantly inside the envelope when the diskette is in use.

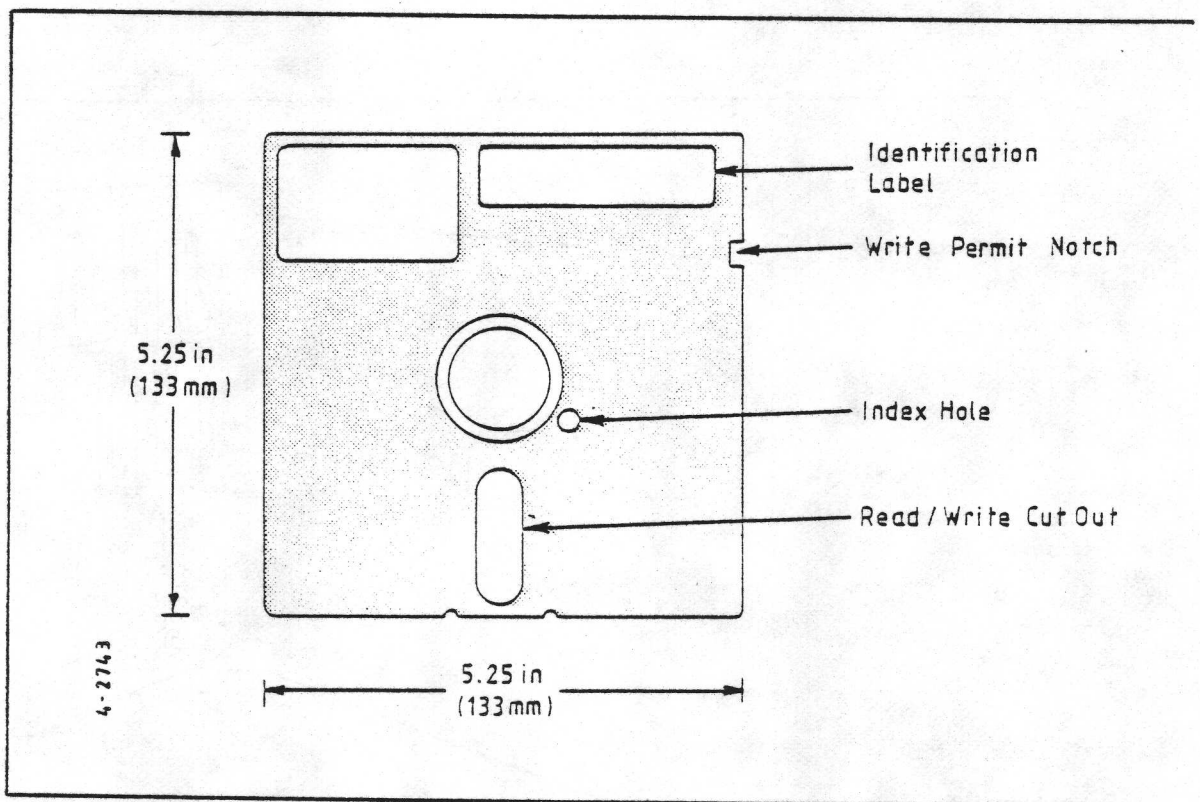


ILLUSTRATION OF A CR7 DISKETTE

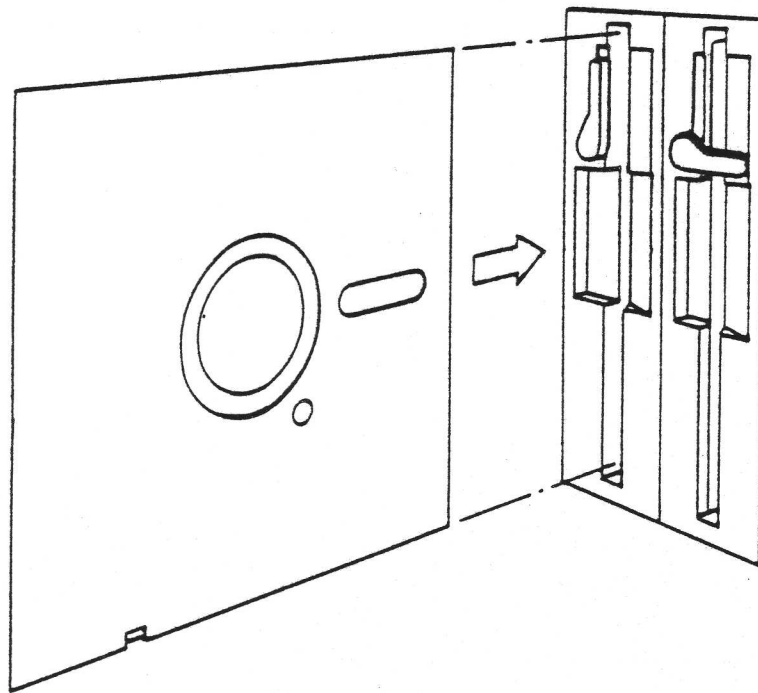
Both sides of the diskette are used by the CR7, but the user must always insert it as shown on page 3-14.

The write permit notch may be used to prevent the diskette from being accidentally overwritten. When this notch is covered (with a piece of hard tape), the diskette can only be read from, not written to.

The red light on the drive will glow when the diskette is being written to or read from.

### Inserting a Diskette

Lift the small handle on the disk drive up (it should be already up if the drive is empty). Then, holding the diskette the right way round - write protect notch below and oval slots towards the CR7 - slide the diskette into the drive slot completely to the end stop. Never force the diskette in. Now turn the handle clockwise to the horizontal position. Do not force it down. The diskette is now ready for use.



4-3721

### INSERTING A DISKETTE

A diskette is removed by simply lifting the handle and withdrawing the diskette. Remember to remove all your diskettes before the computer's power supply is turned off.

If the diskette is put in the wrong way round (or if it has not been formatted - see next section) then an error message with error code 10 will appear on the screen, but no harm will have been done.

### Care and Storage of Diskettes

Diskettes last almost indefinitely if handled carefully. The following is a useful guide to the care of diskettes.

- o When the diskette is removed from the protective paper sleeve **do not touch the exposed surface** or allow dust to settle on it.
- o Do not bend diskettes.
- o Insert gently. Do not force diskettes into drive slots.
- o Avoid heat. Direct heat from strong sunlight or radiators may warp the diskette.
- o Do not switch the computer ON/OFF with diskettes in the drives.
- o Store safely. Specially made diskette storage boxes are available. These boxes hold the diskettes vertical, and may be locked for security.
- o Use felt-tip pens. The identifying label on the diskette should never be written on with ball-point pens or sharp pencils. Whenever possible, write on the label before sticking it to the envelope.

### 3.4.2 Use of Hard (Winchester) Disks

Some CR7 versions contain a Winchester disk. This device stores files in much the same way as a floppy diskette does; the main difference from a user's point of view is that the storage capacity of the Winchester is much greater than that of a diskette. Also with most types of Winchester drive, the disks cannot be removed.

Because (generally) the hard disk on the CR7 cannot be removed, there is little to say about its use. It has no buttons or levers, only a light which will glow when the disk is being written to or read from.

### 3.4.3 Formatting disks

Before any disk (Winchester or floppy) can be used for the first time, it must be formatted. This means that certain signals are "written" onto the disk to define where the different areas to be used start and finish. If the disk has been used before, formatting it again causes the information on it to be lost, so, . . .

#### When to format a disk

1. Before using a brand new floppy diskette.
  2. Before using a used diskette or disk which has no files on it that are of any further interest.
  3. As an attempt to rectify a disk that is giving hardware errors (though all data will be lost).
  4. As a way of being sure of erasing every single byte of data from a disk which contains unwanted but "secret" information.
- Note that the Winchester disk in the CR7 (if fitted) will already be formatted, thus in normal circumstances you will never need to format a Winchester. Should it become necessary, however, see page 4-10.

#### How to format a disk

The formatting program supplied with the CR7 is called FORMAT. It can only be used to format floppy diskettes. The same program can also be reached via the CR7 Menu system.

1. Check that the diskette is not write-protected. The notch must be present (see illustration on page 3-13). Insert the diskette in the drive (normally 'B'). Move the handle down.
2. Select Formatting from the Main Menu, or if using CP/M directly, type FORMAT and press RETRN.



3. A menu of choices appears on the screen. Enter option C to format a floppy disk in drive C, or A or B for the dual floppy system.
4. Type "Y" to the next question, then "F" to the next.
5. Disk formatting will now begin. During floppy formatting, the track number currently being formatted is displayed on the screen, counting up from 00 to 9A (hexadecimal).

TRACK\*\*

FORMATTING COMPLETE

6. You may now format another diskette by entering "Y" in response to the next message. The program will return to step 3. Enter "N" to exit from the formatting program.

Be careful not to format a diskette which already has important information on it. Formatting will completely erase a diskette.

#### 3.4.4 Copying Disks

Why would I want to copy a disk ?

You may want to copy a disk or part of it in order to be able to send the information on it to someone else who also has a CR7 or a similar computer (and still retain the original disk yourself). It is easy to send diskettes through the post. Use stiff envelopes.

Another reason for copying a disk is as a precaution against the accidental loss of the information on it. This can happen in a number of ways, for example when other people decide to use your diskettes. Remember that the information on a diskette will generally be worth much more than the diskette itself. So, you should make a habit of always making a copy of every file you generate from time to time. The copy should be on a separate diskette. A good way to decide how often to make a 'back up' copy of a file is to consider how long it would take to re-

create that file from scratch or the last back-up version (compared with the time it takes to back the file up). If the 're-create' time would be, say, more than twice as long as the 'back up' time, then back it up!

### Copying a complete floppy disk on the dual floppy system

The following procedure should be followed when making a copy of a complete floppy diskette, for example when saving your original system diskette.

1. Format the diskette that you intend to copy to, as described above. (This may have been done already).
2. If using the Menu system, select 'Other Commands' from the Help menu. No parameter is needed. If not using the menu system, the > prompt from CP/M should be displayed.
3. Type "FCOPY" and press RETURN.
4. Insert disks as instructed and answer the questions appropriately.

### Copying single or multiple files (on any type of CR7)

If you are not sure what is meant by the term 'file', see page 1-2. If using the Menu system, see page 3-26.

If using CP/M directly, the PIP utility is used to copy one or more files from one disk drive to another. A few examples follow.

```
A> PIP B:=A: *.*
```

The above command (followed by the RETRN key) would copy all named files to drive B from drive A (apart from files with the SYSTEM attribute, files that are read-protected, and files under other user numbers). Note that the destination is always specified before the source.

```
A> PIP :B:=A:LETTER.DOC
```

This would copy the file LETTER.DOC from A to B.

Fuller details of how to specify file names are given on pages 4-4..6. There is also a summary on page 3-38.

Note that PIP or the Menu system's Copy file(s) commands cannot be used to copy the operating system itself from the special 'system tracks' on the disk. To do this you must use FCOPY (see previous section), SYSGENF, or TOOLBOX (see pages 4-8..10).

### 3.5 OPERATING THE CR7 - THE MENU SYSTEM

The CR7 is supplied with a program called the Menu System. Its purpose is to allow you to select and activate the service you require in the simplest possible way, such that no specialist computer knowledge is needed. It can also provide explanations, hints, and tips - generally known as 'help'.

#### 3.5.1 The Relationship between the Menu System and CP/M

If you have never heard of CP/M, please ignore this section and go straight to "How to get the first menu on the screen" (below). CP/M is supplied with all CR7s; the function of the Menu System is to enable the CR7 to be used without any knowledge of CP/M being required. The menu system in effect translates the user's requests into CP/M commands.

See also the sections describing how to move between CP/M and the Menu System (pg. 3-32).

#### 3.5.2 How to get the first Menu on the Screen

Assuming that this is not the very first time that the CR7 is being used (in which case refer to the 'Installation' section on pages 3-1..3) then:

1. Switch on at the rear of the CR7. If you do nothing then for 25 seconds or so, then the message 'BOOT LOAD FAILED', plus some other text will

appear on the screen. The easiest solution is to switch off then on again, and be a little quicker with stage 2 next time.

2. Insert the Menu Diskette as supplied by CR into the left hand drive, as described on page 3-14. (This would not be necessary for CR7s that have a Winchester disk. A Winchester disk is recognizable by having a red light but no slot - see page 1-7).
3. Press the CAPS LOCK key on the left hand side of the keyboard. A red light inside the key will come on. Some commands will not accept lower case text, so this could save trouble later.

Normally, that is all that would be required. After a few seconds the Main Menu will appear on the screen and you are 'ready for action'.

It is possible that a previous user would have set the Menu Diskette to 'Manual Startup', in which case the result of step 2 would have been 3 or 4 times of text ending thus:-

A>\_

In this case, just type MENUOFF and press RETRN. After a few seconds the Main Menu will appear.

3.5.3 The Main Menu

The CR7 Menu System consists of two menus. The first of these to appear is called the Main Menu. It looks like this, though there may be some local variations, depending on which software packages have been purchased.

```
CHRISTIAN ROVSING A/S CR MICRO SYSTEMS SNR CR9999

MAIN MENU   Please select by number: _

          1.  HELP MENU

          2.  MODULO

          3.  TEXT PROCESSING

          4.  DATABASE

          5.  SPREADSHEET

          6.  BUDGET

          7.

          8.

          9.  FORMATTING
```

THE MAIN MENU

To select any of these facilities, just type its number and press RETRN.

There now follow a few details relating to these nine choices.



## CR7 USER MANUAL - STARTUP & OPERATION

**Choice 1.** This will cause the main menu to be replaced by the Help Menu (see next section). There is a similar command in the Help Menu to get back to this the Main menu.

**Choices 2 to 8.** The consequences of selecting any of these are beyond the scope of this document. These are the application packages which do the various jobs for which the CR7 was purchased in the first place. Descriptions of some of these packages were given on pages 1-10..11 and 2-4..11, but no operating instructions for them are given in this manual. Please refer to the documentation supplied with the different packages. Note that some choices may be left blank, to leave scope for future expansion.

**Choice 9.** This is used for formatting diskettes. See pages 3-16..17.

3.5.4 The Help Menu

This is the second of the two menus in the Menu system. It is obtained by selecting option 1 from the other menu. It looks like this:

CHRISTIAN ROVSING A/S CR MICRO SYSTEMS SNR CR9999

HELP MENU Please select by number: \_

Current Disk = A

1. LIST FILE NAME(S)
2. CHOOSE CURRENT DISK DRIVE
3. SET DISKETTE "WRITE-ENABLED"
4. COPY FILE(S)
5. DELETE FILE(S)
6. RENAME FILE
7. PRINT FILE(S)
8. OTHER COMMANDS
9. MAIN MENU

**THE HELP MENU**

The Help menu is so named for two reasons - it provides some useful facilities that help you use the CR7, and it provides on-screen information (known in the trade as 'help') about those facilities.

With regards to the latter feature, when any of the 9 choices is selected, a message will appear on the screen which includes the phrase:

? <RETRN> = HELP

This means that if you only want information on this choice instead of the facility itself, type a question mark then press the RETRN key. The information given will be a summary of what appears in the following few paragraphs of this manual. Alternatively, if you just press RETRN at this point, you will return immediately to the Help menu.

A few details now follow for each of the nine possible selections in the Help menu. A selection is made in the same way as for the Main Menu, i.e. type its number then press RETRN.

### 1. LIST FILE NAMES

Sometimes you will need to use a file whose exact name you have forgotten, or you may have forgotten which disk it is on. This command can get you out of such problems.

So, press 1 then RETRN. The computer will ask you which file or files you are looking for. If you are sure of the name but want to check whether it is on the current disk or not, type the name of the file, including the file type if it has one. The name and type must be separated by a full stop but no spaces. Remember to press RETRN after the complete title. If you want to list the names of all files on the current disk, answer the "which file(s)?" question with

\*.\*

followed, as usual, by the RETRN key.

The asterisk represents 'everything', thus \*.\* means "all files of all types on the current disk".

Further more, you can list the names of files on a disk that is not the current one by including the disk's name and a colon, e.g.

B: \*.\*

followed by RETRN would tell the CR7 that you wanted it to list the names of all the files on disk drive B.

A summary table on how to specify file names appears on page 3-38, and a more detailed description is given in section 4.5 (pages 4-4..6).

When the file name or names have been displayed, press RETRN once if you want to use the 'List file names' function again, or twice to get back to the Help menu.

## 2. CHOOSE CURRENT DISK DRIVE.

The name (a letter A or B in the dual floppy system) of the current drive is always displayed in the top right hand corner of the Help menu. The 'current' drive merely means the drive that is assumed by the CR7 software if, in a command, you do not state which drive you are referring to. Thus if you know that most of the files you intend to use for the next few minutes are on a different drive to the current one, then use this command to set the current drive to the one that is to be used the most. This command is merely provided as a convenience, so you have 2 less characters to type when specifying files.

So, to choose a different Current Disk, select 2 from the Help menu (press RETRN) then type the disk letter and press RETRN.

On the dual floppy system, the choices are A or B only. 'A' is on the left, B on the right. On systems with the Winchester disk and a floppy, the Winchester will itself count as two disks - A and B, while the floppy is drive E. C and D do not exist.

## 3. SET DISKETTE 'WRITE-ENABLED'

The CR7 and its Menu system are designed to be as 'foolproof' as possible; an example of this is that certain procedures are built in to the system in order to make it difficult for you to change or delete your files by mistake.

There are two ways in which a whole diskette can be protected against accidentally being written on. One has already been mentioned - the Write Permit Notch on the diskette can be covered (see page 3-13). The other way is as follows: Whenever a diskette is taken out of the drive and another one is put in, it will not be possible to write to the new diskette until it has been set 'write enabled' by use of this command, no. 3 on the Help menu. (By 'writing' on a diskette, we mean making any change such as creating a new file, changing an old one, deleting a file, or even changing the name of a file.)

If you forget to use this command after inserting a diskette, the following message will appear (assuming the diskette is in drive B):

Bdos Err On B: R/O

If this happens, press RETRN then select this option 3 from the Help menu.

Incidentally, if the diskette could not be written to because the write-permit notch was covered with tape, the the following error message would have appeared:

\*\*\* MINI FLOPPY DISK I/O ERROR - CODE (40) -DRIVE B: \*\*\*

Press RETRN, another message will appear, press RETRN again and you should be back to the menu.

#### 4. COPY FILE(S)

Some very good reasons for copying a file or files were given on pages 3-17..18.

Having decided to copy a file you should make sure you know its name. Use choice 1 on this menu if you have forgotten.

Before you can select the COPY FILE(S) option from the menu, the following things must have been done or checked.

1. The destination diskette must have been formatted - see pages 3-16..17. Generally this point will only concern you if you are going to copy a brand new diskette that has never been used before.
2. The destination diskette must have enough free space on it to hold all the files you want to copy to it. If in doubt, use an empty diskette.
3. The destination diskette must have its write permit notch uncovered and be inserted in the drive with the lever horizontal.
4. The diskette must have been set 'write-enabled' by means of option 3 on this menu.



Now, you can press 4 and RETRN on the Help menu. The computer will ask the name of the file or files to be copied (from). Type in the file name including the file type if it has one, and press RETRN. See pages 3-38 and 4-4..6 for details of how to specify a file name or names.

Next the Menu system will ask you the name of the disk to copy to. For the dual floppy system, type A (left hand diskette) or B (right hand diskette) and press RETRN. Note that you cannot copy from one disk to that same disk. The file will be given the same name in its destination position as it had originally. The system will inform you of the name of each file as it copies over - this may be of interest if you specified several files for copying (by using the \* or ? in the file specification). Note that after copying, the original is still there. You now have 2 identical copies.

Press RETRN, as instructed, and again to return to the Help menu.

#### 5. DELETE FILE(S)

If you have finished using a file (for ever), for instance if you have made a new and better version of it, you may delete it. This will release the space it occupies on the disk for further use. This can be compared with 'rubbing over' or 'erasing' a part of a tape on a domestic tape recorder when one is bored with the music on the tape.

Press 5 and RETRN. Type the file name, followed by RETRN. You may use the special \* and ? symbols if you like (see page 3-38). The Menu system will then name the file (or each file in turn) and give you a last chance to change your mind. This is a precaution, since files usually cannot be "un-deleted" afterwards. Type Y and RETRN if you are sure, or N (N for No!) and press RETRN if you are not sure. Finally, press RETRN to get back to the point where you can choose another file or files to delete. Another RETRN gets you back to the Help menu.

#### Security

Note that the data is not actually deleted from the disk until new data is created which needs that space - it is merely marked by the operating system as "spare

space". Thus if the file to be deleted contained particularly security-sensitive or secret information, the whole disk would have to be reformatted in order to be sure that the data was erased. Any other files (still required) on the disk would have to be saved to another disk first.

## 6. RENAME FILE

It may happen that you suddenly think of a better, more descriptive name for an existing file, or the use of a file may change, thus making a new name more appropriate. For instance in a word processing application, you may have several different versions of a document. When you created them, you didn't know which one would be the final, correct version. So they are maybe called DOC1, DOC2, etc. At a later stage, you decide that DOC6 is the one you want to keep, so a better name for it now might be FINALDOC. In such a case you would want to rename the file.

In the Menu system you can only rename one file at a time (you cannot use \* or ? in the file specification).

So, select option 6 from the Help menu and press RETRN. Name the file (the old name) and press RETRN. The system asks you for the new name. Check the table on pg. 3-38 if you are not sure of the rules governing which names are allowed and which are not. Remember that you cannot use \* or ? in this case. Type the new name and press RETRN. Then, as always, press RETRN twice to get back to the Help menu.

Note that you can use this function to change the file name and/or the file type, but not the drive designation (the A: or B: part of the file specification). This is because renaming does not physically move a file; it would be illogical and impossible to have a file called B:THISFILE.DAT on drive A.

## 7. PRINT FILE(S)

This command, of course, should only be used if you have a printer connected to the CR7! It can be used to print out text files, for example those you may have created using CP/M's editor ED. If you have a word processing package in your

system, it will no doubt include its own printing commands, in which case use those rather than this.

The PRINT FILE(S) option is used in exactly the same way as option 5, DELETE FILE(S).

If you accidentally instruct it to print a file when there is no printer attached, or if the printer has some troubles of its own, you may have to reset your system - see pages 3-34..35.

Remember always to check that your printer is switched on, is ON-LINE, and has paper in, before issuing the PRINT FILE(S) command.

### 8. OTHER COMMANDS

This option can be thought of as a 'back door' out of the Menu system; that is it is used to run programs that have not been installed into the Menu system. Most programs that exist in files of type .COM may be run in this way - thus if you have a 'home-made' program it could be run via the Help menu choice no. 8.

The procedure in all cases is as follows:

1. It is best to use command 2 in the Help menu to set the current disk to that of the 'Other Command' (external program) that you intend to use. This is not necessary in all cases (depending on which external program you are going to use), but it does no harm to set the Current disk anyway.
2. Select 8 on the Help menu and press RETRN. Then type the name of the program you want to use (excluding the .COM). This can be preceded by a disk drive specification (e.g. B:); though if you have carried out step 1 above, it will be unnecessary.
3. The system then asks you for a parameter. This an additional piece of information (very often the name of a file that is to be processed by the program you are calling up). Type in the parameter (see the documentation for the program in hand) and press RETRN. If there is no parameter, just press RETRN.

The external program should now run, after which you will normally be returned directly to the Help menu.

If you have difficulty in accessing any programs via this Other Commands option, you should try running the program directly under CP/M. Use the Menu Manager (see MENUMAN below) to get access to CP/M.

The two programs that you are most likely to want to use via command 8 are FCOPY and MENUMAN. Details of these follow.

**FCOPY.** This is used to copy a complete floppy disk on the dual floppy system. Select 8 from the Help menu, type **FCOPY** followed as always by the RETRN key. Press RETRN again when it asks for the parameter (since there is no parameter).

You now enter the FCOPY program. It announces itself and asks you to insert the diskettes. The diskette to be copied from goes in the left hand slot. Remember to copy to a formatted diskette (see pages 3-16..17). Note that FCOPY will delete any files that are already on the destination diskette. Follow the instructions that it gives. The program will start to copy the diskette. It displays the current track number. These go up to 9A in the Hexadecimal numbering system. Incidentally, halfway to Hex 9A is Hex 4D, so you are half way through when 4D flashes past! The CR7 will click each time it switches from one disk to the other. It will then ask you if you want to copy any more disks and eventually put you back to the Main menu (or if switched to Manual menu start up, you will be returned to CP/M).

**MENUMAN.** This is a special Menu-system management program. It is used to make adjustments to the way the menu system runs. It is also a way of getting out of the Menu system and into the CP/M operating system, if so desired.

The Menu system can be set up in one of two ways. Either the Main menu will appear automatically after switching on and inserting the Menu Diskette, or the CP/M operating system will appear ("A>" will appear just before the cursor). In the latter case, you can type MENUOFF and press RETRN, and then the Main menu will appear. (The reason why the command to turn the menus ON is called MENUOFF is that the name refers to the current mode of operation - i.e. Auto Menu is OFF.)



**Using MENUMAN to switch from Auto to Manual operation**

1. Select 8 from the Help menu and press RETRN.

The Menu diskette cannot be switched between Auto and Manual if its write permit notch is covered. If in doubt about this, remove the diskette (when the light on the disk drive is out). Remove the sticky tape (if any) covering the write permit notch (see pg. 3-13). Reinsert the diskette and move the lever down.

2. Type MENUMAN and press RETRN. Wait for the question

ARE THE MENUS TO BE SET TO MANUAL STARTUP...?

to appear on the screen.

3. Type Y and press RETRN.
4. Press RETRN again (as instructed). The CP/M prompt will then appear.

Thereafter, the CP/M prompt will appear every time the CR7 is switched on (and the Menu diskette is in place), until MENUMAN is used again to set it to 'automatic menu'.

To get back to the menu system, execute the command MENUOFF under CP/M, i.e. type MENUOFF and press RETRN in response to the CP/M prompt.

**Using MENUMAN to switch from Manual to Auto operation**

1. Get into the Menu system from CP/M (if you are not there already) by typing MENUOFF and pressing RETRN. Select the Help menu.
2. Select 8 from the Help menu and press RETRN.

The Menu diskette cannot be switched between Auto and Manual if its write permit notch is covered. If in doubt about this, remove the diskette (when



the light on the disk drive is out). Remove the sticky tape (if any) covering the write permit notch (see pg. 3-13). Reinsert the diskette and move the lever down.

3. Type `MENUMAN` and press `RETRN`. Wait for the question

`ARE THE MENUS TO BE SET TO AUTO STARTUP...?`

to appear on the screen.

4. Type `Y` and press `RETRN`.
5. Press `RETRN` again (as instructed). You will then be returned to the Help menu. The next time the CR7 is switched on, and the Menu diskette is inserted, the Menu system will appear automatically.

#### **Using `MENUMAN` to leave the Menu system and gain access to CP/M**

There are two ways of doing this, depending on the current setting of the Auto/Manual mode. After selecting `MENUMAN` under the Help menu option 3, one of these two messages will appear:

- 1) `ARE THE MENUS TO BE SET TO MANUAL STARTUP ... ?`
- 2) `ARE THE MENUS TO BE SET TO AUTO STARTUP ... ?`

If 1) appears, press `Y` then `RETRN`, then `RETRN` again. It will be necessary at a later stage to reset the menu system to Automatic, if so desired.

If message 2) appears, press `ESC`. The Menu system will remain in manual mode; you will go directly to CP/M.

#### **How to get back to the Menu system from CP/M**

This was described at the end of the introductory section on `MENUMAN` (page 3-30).

## 9. MAIN MENU.

The final option on the Help menu is your route back to the Main menu. Press 9 then RETRN to get access to the application programs available on that menu.

### 3.6 RUNNING A PROGRAM

The user must refer to the documentation applicable to his particular piece of software. However, generally speaking, the default (current) disk must be set to the disk on which the program lies (see pages 3-25 and 4-1), and the program must exist in a suitable form in a file of type .COM.

#### 3.6.1 Under the Menu System

If using the Menu system, there are two possibilities. Either the program has been installed into that system, in which case it is simply selected from the Main Menu. However, if it does not appear on the Main Menu, it can be reached via the 'Other Commands' option on the Help Menu. See pages 3-29..32 for details of the 'Other Commands' option.

#### 3.6.2 Under CP/M Directly

In response to the CP/M '>' prompt, type the file (program) name (excluding the .COM) and press RETRN.

#### 3.6.3 If Your Program Gets 'Stuck'...

You may find yourself in the situation whereby the program you are using fails to respond to further commands, or shows some other more dramatic form of 'mental breakdown'. This will almost certainly be because you have typed the wrong things on the keyboard. (Another symptom may be that the 'KBD LOCKED' light on the keyboard is illuminated.)

The best solution to such problems is to read the documentation for the program, if it is available. The easiest solution, however, is to perform a System Reset. Often, both techniques should be applied.

### **System Reset - How to do it**

This is very simply performed on the CR7. First remove any floppy disks from their drives; if at all possible, wait for the light on the drive to go out before removing the diskette. Then switch off the CR7 (the switch is at the back). Pause for a second or so, then switch it back on again. Then re-insert any diskettes you may have been using, and proceed as described in the "Power Up" section (pages 3-2..3).

Note that all information stored in memory (but not disk) prior to switching off will be lost; thus for example if you had been editing a file, then all changes since the last "save to disk" command would be lost.

### **System Reset - What it means**

System Reset, otherwise known as 'Booting' is a process that normally takes place automatically when the CR7 is switched on. It is the sequence of events that causes the operating system to be copied into the memory. The purpose of the operating system was described briefly on pg. 1-3. The act of booting the system can be compared to that of starting a car engine before going for a drive. It gets all the machinery from the 'dormant' state to the 'ready for action' state.

For a more detailed description of what happens in the hardware at 'boot' time, see section 5.6.

### **Selecting the Boot Source**

Normally the CR7 will decide for itself on which disk drive it will find the operating system (in order to boot it). However, system programmers and the like may prefer to select a particular drive if they have, for example, just generated a new system.

In order to manually select the source disk for the boot, hold down the space bar on the keyboard immediately after switching on. A menu will the appear on the screen, from which the required drive may be selected by number.

3.7 CR7 (DUAL FLOPPY MODEL) STARTUP AND OPERATION - SUMMARY

**Starting up your new CR7 for the very first time**

1. Check the voltage (pg. 3-1).
2. Start up as normal (see next section).
3. Make copies of your software.
4. Run your programs as normal (see next section).

**Normal Startup Procedure**

1. Switch on the mains (at the back).
2. Insert Menu Diskette into the left-hand drive, the diskette having the long oval slots forward and the write-permit notch downward, (see pg. 3-13). Move lever down to horizontal position.
3. Wait for a few seconds until Main Menu appears on screen. If it doesn't, refer to the end of section 3.5.2.
4. Select required program by typing its number, then press RETRN.
5. From now on, refer to documentation for the specific program in use.

**Before using a brand-new, blank diskette ...**

The diskette must be formatted - select no. 9 on the Main menu and follow instructions.

**To see what files are on a diskette ...**

Select no. 1 on the Help menu and follow instructions.

**To copy one or several files from one diskette to another ...**

Select no. 4 on the Help menu and follow instructions.

**To make a complete copy of one diskette to another ...**

Select no. 8 on the Help menu, then select FCOPY. Press RETRN. Follow instructions.

**How to escape completely from the menu system**

1. Call up MENUMAN via option 8 of the Help Menu.
2. Either set system to Manual mode, or, if it asks you if you want Auto mode (because it is already in Manual mode), press ESC instead.

**How to get back to the menu system from CP/M**

Type MENUOFF, press RETRN. If that doesn't work, type MENUON and press RETRN.

**If your program gets completely stuck ....**

1. If possible, wait for disk drive lights to go out.
2. Remove diskette(s) from drive(s).
3. Switch off mains
4. Follow 'Normal startup procedure' as described near the beginning of this summary.

**If the printer does not work ...**

1. — Check that it is "ON-LINE". To do this press a button called SEL, STOP



CONTINUE, SELECT, or ON LINE (depending on which printer you have). A light will glow when it is ON LINE which goes out when it is OFF LINE.

2. Check it has not run out of paper or ribbon, then do check 1. again.
3. If the printer was not supplied by CR, and especially if this is the first time the printer has been used with the CR7, then the Baud rate or other interface characteristics may be set wrong. Refer to page 3-2.
4. If it still does not work, read the manual supplied with the printer.

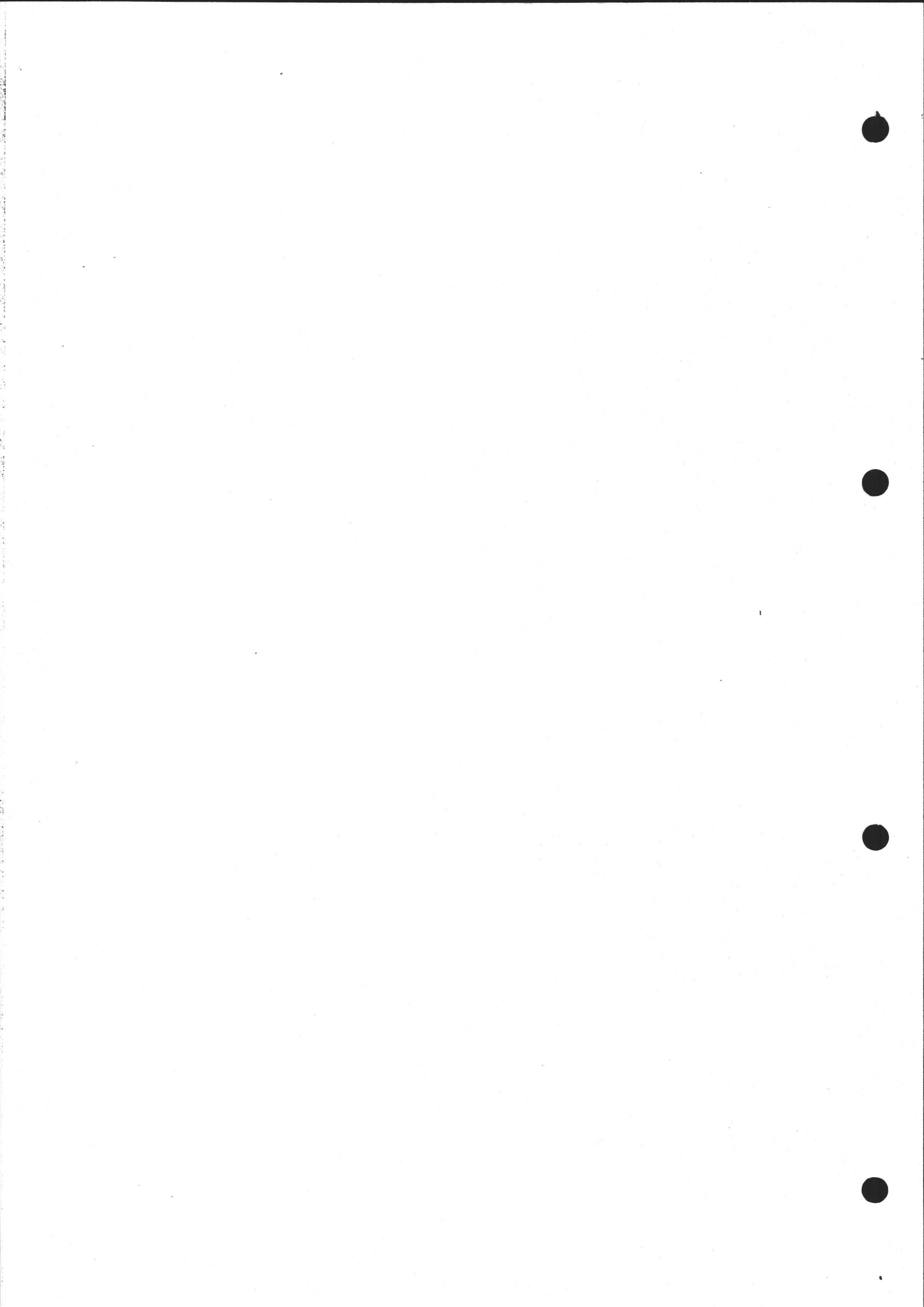
#### **Procedure for switching off after use**

1. Exit from your application program (word processing, budget programs, etc. etc.) in the way described in that program's documentation.
2. Wait for both disk drive lights to go out.
3. Remove diskette(s) from drive(s) and store in either envelopes in a safe (see pg. 3-15) place.
4. Switch off mains (at the back).

What you want to specify	Examples	Rules for specifying
Single file on the 'Current' disk drive (see top right corner of Help Menu)	123.456 MYFILE.DAT FILE1 FILE2.001 A 123.4A	<ol style="list-style-type: none"> <li>1. 1 to 8 letters or digits (can be a mixture).</li> <li>2. Optionally followed by: a dot and one to three letters or digits (can be a mixture) called the <u>File Type</u>.</li> <li>3. If the file is given a File Type, then the dot must be included and the file type must be stated when referring to the file subsequently.</li> <li>4. No spaces between (or within) name and File type.</li> </ol>
Single file on any disk drive	A:123.456 B:MYFILE.DAT B:FILE1 A:FILE2.001 A:A B:123.4A	<p>As above, but with the addition of the <u>Drive letter</u>, which is A or B on a dual floppy system.</p> <ol style="list-style-type: none"> <li>1. If the Drive letter is included, the colon (:) must also be included.</li> <li>2. No spaces allowed between drive letter and file name.</li> </ol>
All files on a certain drive whose name and/or file type starts with a certain character or characters	12*.456 M*.DAT B:F* MYFILE.4* * A:123*.4A	<ol style="list-style-type: none"> <li>1. The * can represent any number of characters (including none) - all sequences that match existing files are used.</li> <li>2. Letters or numbers should not be placed between a * and a . in a file name or after a * in a file type. If they are, they will be ignored.</li> <li>3. A * cannot be used as a drive letter.</li> </ol>
All files on a certain drive whose names or types include the specified characters in the specified positions	M?FILE.DAT A:FIL?.001 FIL2.0?1 ?IL?2.?0?	<ol style="list-style-type: none"> <li>1. Any <u>single</u> character can be substituted for the ? symbol.</li> <li>2. The ? can represent 'no characters' but only at the <u>end</u> of a file name or file type.</li> <li>3. ? cannot be used as a drive letter.</li> <li>4. The * and ? symbols may be used in the same file specification.</li> </ol>
All files on a certain drive	*.* A:*.*	(This is just a special case of the use of the * symbol)

HOW TO SPECIFY FILES: SUMMARY TABLE





## 4. OPERATING SYSTEM

The operating system provided with the CR7 is called CP/M. A brief overview only of its use is given here, since full details may be obtained from Digital Research's own documentation or from other sources.

Note also section 3.5 which describes the Menu System.

### 4.1 DISK FILES

The operating system organizes information on disk into named files. The operating system maintains a record (held on each disk) of which files are currently on the disk. This record, called the file **directory**, contains at least one entry for each file. The directory entry contains the file name, file type, file attributes, user number and sector map. File type is designated by the user and has no significance to the operating system. File attributes are such factors as whether the file can be written to (or merely read), or whether it is a system file. Disk space for a file is not necessarily contiguous (i.e. a file may be divided into different parts dotted here and there about the disk). The purpose of the sector map is to record the positions of the various disk sectors that comprise the file.

The operating system does not need to know how big a file will become. When more storage space is needed, CP/M will add more sectors to the file. If the file is deleted, the sectors are 'freed', and may be reallocated to another file.

CP/M can support up to 16 disk drives, referenced by the first 16 letters of the alphabet, A-P. (A CR7, however, will never have as many as 16 disk drives.) When issuing commands to CP/M, if the drive name is omitted, it will assume the **default drive** name. The assignment of 'default drive' status to a particular drive is under full user control. Other names for 'default drive' include 'current' or 'logged' drive.

Files may belong to one of 16 **user numbers**. These numbers can be used to provide a logical division of files into different applications. For example, files used within a word-processing system may belong to one user number, while files used within a financial planning system may have a different user number. This would



protect against accidental misuse of files. User number can of course also be used to differentiate between files belonging to different users of the CR7. The user number is always set to 0 when the CR7 is started up.

## 4.2 THE SYSTEM PROMPT

The system prompt is a short string of characters that appears on the console to denote that the operating system is ready to receive a command. It consists of the default drive, and the > character. For example,

```
B>
```

indicates that the default drive is B, and that it is ready to receive a command. The user number may be changed to a value between 0 and 15, for example:

```
B> USER 3
```

```
B>
```

When the CR7 is switched on, the user number will always initially be set to 0.

Note that throughout this document, text typed by the user is shown in bold face and text issued by the CR7 is in normal type script. On the screen itself, however, they will appear the same.

Here is another example of a user issuing a command. The default drive is changed by entering the required drive letter followed by a colon.

```
B> A:
```

```
A>
```

## 4.3 THE COMMAND LINE

The user initiates programs and controls system facilities by entering commands at the keyboard. Only one command may be entered on a line. A command line consists of a keyword, a command tail (optional), and a carriage return character (the RETURN key).

The keyword identifies the command to be executed: either a built-in command or the name of a program file on disk. Note that built-in commands are those that reside permanently in memory; they are faster to use than other commands. The optional command tail contains additional information required by the command.

```
A> DIR *.BAK
```

In this example "DIR" is the command name, "\*.BAK" is the command tail.

An unrecognised command will be echoed on the display, followed by a "?".

```
A> DTR
```

```
DTR?
```

```
A>
```

Commands may be entered in either upper or lower case, or in a mixture of both. The command line processor (part of CP/M) converts all letters internally into upper case, before performing any file searches, etc.

Thus:

```
A> dir testprog.bak
```

is equivalent to

```
A> DIR TESTPROG.BAK
```

#### 4.4 EDITING THE COMMAND LINE

Typing errors in the command line may be corrected before the RETURN key is pressed by using the control characters given in the table below. Control characters are entered by holding down the CTRL key and pressing the required letter. For example, CTRL-Z is entered by holding down the CTRL key and pressing Z. The most useful editing control character is available on a single key, the BACKSPACE key. Pressing this key deletes the last character entered. (The sequence "cursor left, space, cursor left" is sent to the display.) The most useful keys are outlined below:

<u>KEYSTROKE</u>	<u>ACTION</u>
BACKSPACE	deletes previous character, moves cursor back one space.
RETURN	command terminator, sends command to system
CTRL X	cancel line, cursor moves to the start of current line

Note also that holding down a key for a second or two causes the key to repeat. Thus if one had typed in a long command line then noticed an error half way along the line, one could hold down 'BACKSPACE' until the offending character(s) had disappeared. Then only the latter half of the line would need to be re-typed.

Note that CP/M Plus includes some additional powerful commands for command line editing.

#### 4.5 FILE SPECIFICATION

Note that there is a summary of this on page 3-37.

A "file Specification" is that part of a command line which specifies the file or group of files to be used in the command. The file specification has three parts in CP/M. Some fields are optional.

`<d:> <filename> <.filetype>`

`<d:>` is the drive specification, a single letter from A - P followed by a colon. If this field is omitted the default drive will be used instead. The current default drive is shown in the system prompt.

`<filename>` is a 1 to 8 character file name. The following characters are used by the command processor as separators, so must not be used in a file name (or file type):

`< > . , ; : = ? * & ! ( ) / $ % &Ograve; &agrave; &aring; &atilde; &oslash; &cedil; &uarr; &darr; &uarr; &darr;`  
 tab space carriage return

Any of the printable characters, other than the separators above, may be used in a file name; however, it is recommended that only numbers and English letters are used.

<.filetype> is an optional 1 to 3 character file type. The file type (if used) is separated from the file name by a dot.

Example: NEWFILE1.TEM

The file type is useful for dividing files into groups, depending on their nature or use. In fact, in some cases the file type must not be specified, but is added to the file name by the command processor or executing program. E.g.:

A> PIP

CP/M looks for and executes the file PIP.COM on drive A

Some utility programs create files with the same name as the input file but with a different file type, to indicate the nature or stage of processing of the file.

A> ASM TESTPROG

In this example, the assembler ASM.COM looks for a source file TESTPROG.ASM and creates two files: - TESTPROG.HEX containing the assembled program in hexadecimal format and TESTPROG.PRN containing the listing.

#### Ambiguous File Specifications

Some utilities and programs accept ambiguous file specifications, with the "wildcard" characters (\* and ?) being used in the <filename> and <filetype>. This allows a range of files to be specified to a program. For example,

A> DIR \*.BAK

lists the names of all files on drive A with file type .BAK.

The ? character is used to match any single character in that position; a \* will match any number of characters from that position. A \* is converted internally into a number of ?'s, as many as are required to fill the file name or file type. For example, AB\*.\* is treated as AB?????.??? . The \* must be the last character in

the file name or file type. For instance, A\*B.BAK is not valid because it is treated as A???????B.BAK which has one too many characters (only 8 being allowed in the file name).

In this case, the user should not use a \* but should type in the correct number of ?'s (six - A???????B.BAK).

The following examples, using the DIR command, will illustrate the use of the wildcard characters. Text typed in by the user is in lower case.

```
A>dir
A: A          COM : AA          COM : LETTER1  TXT : AAA      COM
A: A          ASM : B           ASM : B        COM
A>dir *.com
A: A          COM : AA          COM : AAA      COM : B      COM
A>dir ?.com
A: A          COM : B           COM
A>dir ?.*
A: A          COM : A           ASM : B        ASM : B      COM
A>dir a?.com
A: A          COM : AA          COM
A>dir a*.com
A: A          COM : AA          COM : AAA      COM
A>
```

#### 4.6 SOME SYSTEM COMMANDS AND UTILITIES

DIR. This displays a list of the files on a given drive.

STAT. Displays the amount of disk space available, disk status, etc. It can also be used to change file status, for example setting a file to Read Only.

USER. This changes the user number. The user number is a means of separating files belonging to different people or applications.

TYPE. Displays a text file on the terminal. Use CTRL-P (see below) before TYPE to print out a file.



ERA. Deletes a file or files in order to release the disk space used.

REN. Renames a file (without copying it).

CTRL-P. By holding down CONTROL while pressing P, from then on all the text appearing on the terminal will also be printed. By pressing it again, text will no longer be printed. Note that if the printer is disconnected, switched off, or set to Off-line then the CR7 will stop until the printer is properly connected.

SUBMIT. This executes several command lines in a text file, in order to reduce typing when a sequence of commands is used often. It includes a parameter passing capability, so the commands need not be identical each time the SUBMIT file is used.

PIP. A copying utility. It will copy a file, a part of a file, or several files from one disk to another or to some other peripheral such as a printer.

ED. A simple editor for entering text into a file or altering existing text.

ASM Assembler, which uses Intel 8080 mnemonics (a subset of the Z80 instruction set).

DDT. A program-debugging aid that enables a user's program to be stepped through, breakpoints or trace points to be read, memory to be read or written, and so on.

DUMP. This displays the contents of a disk file in hexadecimal format.

#### 4.7

### SPECIAL CR7 COMMANDS

The CR7 is furnished with certain utilities in addition to those provided by CP/M. These are described in detail below. (The disk formatting program, menu system and FCOPY floppy disk copying programs also come into this category but were described in section 3.)

#### 4.7.1 Setting Baud Rates

The program LPBAUD is used for setting the Baud rate on the line printer interface. To use it, type LPBAUD. It is menu-driven, that is it will tell you what to type. However, the Baud rate will revert to its original setting the next time the CR7 is switched on.

To avoid having to use LPBAUD every time the computer is switched on (for example where a non-standard printer is in use), use SYSGENF to change it permanently.

A more general description of SYSGENF is given below; however, in this application, the following procedure should be carried out:

1. Get the system tracks from the Menu diskette in drive A (left hand drive).
2. Patch the memory (SYSGENF option M) at address 3486 (Hex) with one of the following values:

<u>Baud Rate Required</u>	<u>Value to be inserted as required by SYSGENF</u>
9600	0800
4800	1000
2400	2000
1200	4100
300	0401

3. Put system back on the diskette (option P).
4. Use CTRL-C to exit from SYSGENF.

#### 4.7.2 System Generation - Floppy-only System

The SYSGENF program is available for writing CP/M 2.2 to the system tracks of the system diskette (for CP/M+ systems, contact CR Hotline for details). The reason that a special program is needed is that PIP only references files within the normal directory system. The file containing the operating system resides on two reserved tracks of the disk and does not fall within the normal file management system.

SYSGENF will read or write the entire system at a time. The sequence of events would be to read in the system from one drive to starting address 3480 (hex) in memory. Then the system would be patched, if required, in accordance with Digital Research's documentation. For example, the initial value for the default drive could be changed or an initial command to be executed could be put into the command buffer. Finally the system (in original or patched form) would be written back to disk - possibly to a different drive.

A typical application of the program would be to put an operating system onto a diskette that had just been formatted.

The command syntax for SYSGENF is given below:

The program displays a menu offering:

Getting information from system tracks

Putting information on system tracks

Memory patching the operating system

C - press CTRL-C to exit.

#### 4.7.3 System Generation - Winchester/Floppy Systems

Any CR7 with Winchester and floppy disk drives is supplied with a diskette known as the **Installation Floppy**. This can be used to re-create the operating system on the Winchester if it is lost after some accident such as switching off the system while the Winchester's LED is illuminated. This particular use of the Installation Floppy is described at the end of this section (page 4-11).

The Installation Floppy contains not only the special menu program described below, but also the Winchester operating system, and the standard CP/M utility programs such as PIP.

To use the Installation Floppy, boot from it in the normal way, but do not forget to hold down the space bar after switching on, so that you get the chance to boot from the floppy rather than from the Winchester. A menu will appear on the

screen. The items in that menu are described below. All items are selected by pressing the first letter of the item's name, followed by RETRN.

### **Copy System Files**

You are asked to specify a destination disk. Then all files of type .SYS on the installation floppy are copied to that disk. This command is only used under CP/M+ since CP/M 2.2 does not have any .SYS files.

### **Formatting**

Both (or if for some reason you have more than two, all) Winchester drives are formatted. Formatting is discussed in more detail on pages 3-15 and 53-17.

### **Help**

This provides information about the choices in the menu - useful if you lose this manual!

### **System Track Installation**

This option asks if you want auto or manual operation. The manual operation is for use with CR8 computers, so just select 'Auto'. The program then writes the file DRIVE-x.BIN from the Installation Floppy to the reserved system tracks (see page 4-16). So if x were 'A' the system-file image would be called DRIVE-A.BIN and will be written to Winchester drive A. The contents of this file will depend on the operating system in use. For CP/M 2.2, the file contains the operating system itself; for CP/M+, the file contains the secondary bootloader.

### **Toolbox**

In some cases, this does not appear on the menu, but it is available nevertheless.

**N.B.** The Toolbox should not be used by people who are not familiar with the operating system - the operating system could easily be rendered useless by misuse of some of the Toolbox's powerful utilities.

When 'T' (Toolbox) has been selected, another menu will appear. These choices are now described. Only two are useful on a normal CR7, namely ^C and G.

**^C** - Press C while holding down the CTRL key in order to exit from the Toolbox.

**ESC** - This option is totally useless and is there for historical reasons only.

**F** - This disk formatting option is for use with an earlier type of Winchester controller; do not use it on CR7's supplied after July '83 (i.e. do not use it on any CR7 supplied with this manual). Instead, use the option from the Installation Diskette main menu (see page 4-10) for for the Winchester, or the FORMAT program under CP/M for floppies.

**G** - This Get/Put/Patch has identical function to SYSGENF, as described on pages 4-8..9.

**T** - Track-by-track floppy to floppy copying. Obviously, this option is of no use on the normal Winchester/floppy CR7 since there is only one floppy drive.

#### **@ Reboot**

This, the final option on the Installation Floppy main menu, is used to perform a cold boot (apart from the hardware reset which is not done). The distinction between warm and cold boots (which has nothing to do with the blood supply to one's feet) is outlined in section 5.6.

The primary purpose of the Installation Floppy is to provide a means of re-creating the operating system on the Winchester in the event of some misfortune which has corrupted the disk. However, the procedure outlined below completely erases the Winchester so it should only be used as a 'last resort'.

Now the system can be re-installed on the Winchester in the following way:

1. Boot from the Installation Floppy.
2. Select 'Formatting' from the menu.
3. Select 'System track installation' from the menu.
4. Select 'Copy system files' from the menu. This is only necessary if using CP/M+.

Further details on the use of the Installation Floppy are included in a text file which is included on that diskette.



4.8 DISK ACCESS ERROR CODES

**Floppy Disk**

CODE: DESCRIPTION:

- 08           **Checksum error (data)**  
One or more data bytes have not been read correctly from disk - Press RETRN twice to ignore (the user may want to correct the error himself).  
Press CTRL-C to abort reading.
- 10           **Checksum error (sector heading)**  
The sector cannot be found due to reading error in sector header. Press RETRN twice to ignore (the entire sector will be lost - 128 characters).  
Press CTRL-C to abort reading.
- 40           **Write protected disk**  
Remove the cover from the write-permit notch on the diskette (see pg. 3-8). Then press CTRL-C, before re-trying the disk write.
- FF           **Controller timeout error**  
This can be caused by the handle on the floppy drive being left in the vertical position, or by the absence of a diskette in the default drive.

**Winchester Disk**

All of the following codes that have 0 as the first digit can be caused by a cabling fault between the Winchester drive and the Winchester controller board.

All of the following codes that have 1 as the first digit, apart from 18, 19, 1C and 1F may be caused by bad formatting. This means that an attempt should be made to recover any useful data from the disk before reformatting. If the space bar is depressed after the error is reported, the erroneous read or write should then

continue. This would mean that a portion of the file would then contain garbage but not necessarily all of it.

These formatting errors can be caused by physical abuse of the drive (e.g. dropping the CR7 or rough handling during transportation).

CODE:	DESCRIPTION:
01	<b>No Index Signal</b> Index signal not detected: sensor defective or disk not rotating.
02	<b>Seek Timeout</b> The drive has failed to complete a seek operation within 1.243 seconds.
03	<b>Write Fault</b> Hardware error.
04	<b>Drive not Ready</b> Drive is not running at the correct speed of rotation (maybe low mains voltage or motor faulty).
05	<b>Drive not Selected</b> Attempt to address a non-existent disk drive. Software problem - possibly operating system is incorrectly installed.
06	<b>No Track 00 Indication</b> Drive cannot locate track 0. Hardware fault.
07	<b>Multiple Drives Selected</b> Attempt to access more than one drive simultaneously. Hardware error.
0D	<b>Seek in Progress</b> 'Seek complete' signal not found after a seek operation. Hardware fault.

CODE:	DESCRIPTION
10	<b>ID Read Error</b> An ID field on the track contains errors which the controller's ECC (error correcting circuit) is unable to correct. Caused by defect on disk surface or bad formatting. Try re-formatting (all data will be lost). This error can be caused by dropping the CR7.
11	<b>Uncorrectable Data Error</b> Same as error 10 above except that the erroneous bits lie in the data area in the file's record.
12	<b>ID Address Mark not Found</b> Address mark defines the beginning of a sector. This error caused by bad formatting or fault on disk surface.
13	<b>Data Address Mark not Found</b> Data address mark defines the beginning of data in a sector. As above.
14	<b>Record not Found</b> Controller successfully selected drive head and cylinder, but not the sector. Track formatting error.
15	<b>Seek Error</b> Read/write head positioned on the wrong cylinder and/or wrong head selected. Possibly caused by step rate being set too high (step rate is a parameter set at system generation).
18	<b>Correctable Data Field Error</b> Software error - operating system corrupted.
19	<b>Bad Block Found</b> A track on the disk has the Bad Track Flag set in the ID field. Software error - operating system corrupted.
1A	<b>Format Error</b> Disk not correctly formatted, or not formatted at all.

CODE:	DESCRIPTION
1C	<b>Unable to Read Alternative Track Address</b> Software error - operating system corrupted.
1F	<b>Sequencer Time-out</b> Controller self-test error. Hardware error within controller.
20	<b>Invalid Command</b> Invalid command received from software, for instance if user's software attempts to send commands directly to controller using incorrect command block. Could also be caused by corruption of operating system itself.
21	<b>Illegal Disk Address</b> Attempts to address a non-existent block (outside the drive capacity) - usually caused by using the wrong operating system for the disk.
23	<b>Volume Overflow</b> Address space overflowed when doing a multiple-block read or write. Could be caused by mismatch between operating system configuration and actual disk in use.
43	<b>Parity Error</b> 'Parity check' strap in controller board is in 'enable' position. Move it to 'parity disabled'.
FF	<b>Controller Timeout</b> Controller did not respond to command within 8 seconds. Cure this by switching off and on; however controller will be suspect and should be checked or replaced by a CR service engineer.

## 4.9 Assignment of disk drives to CP/M drive letters

The "Drive Letter" is used in CP/M commands to specify which disk drive a particular file is on. The table below shows which actual drives will be reached by specifying A:, B:, etc. The relationship between these logical drive names and the physical drives will be decided before the operating system is supplied to you; the user would not normally change this.

It is proposed that all systems will eventually be delivered in accordance to the scheme "A and B = Floppy, C onwards = Winchester(s)". The table below shows all the current and proposed possibilities (and allows for both CP/M 2.2 and CP/M +). If in doubt, see which drive letter appears in the prompt immediately after switching on. This will be the drive containing the System tracks, i.e. the drive from which the system is booted. Then refer to the table below.

<u>Boot Disk</u>	<u>Floppy Disk(s)</u>	<u>Winchester(s)</u>
A	A, B	None
B	E	A,B or A,B,C,D
C	A	C or C,D or C,D,E,F

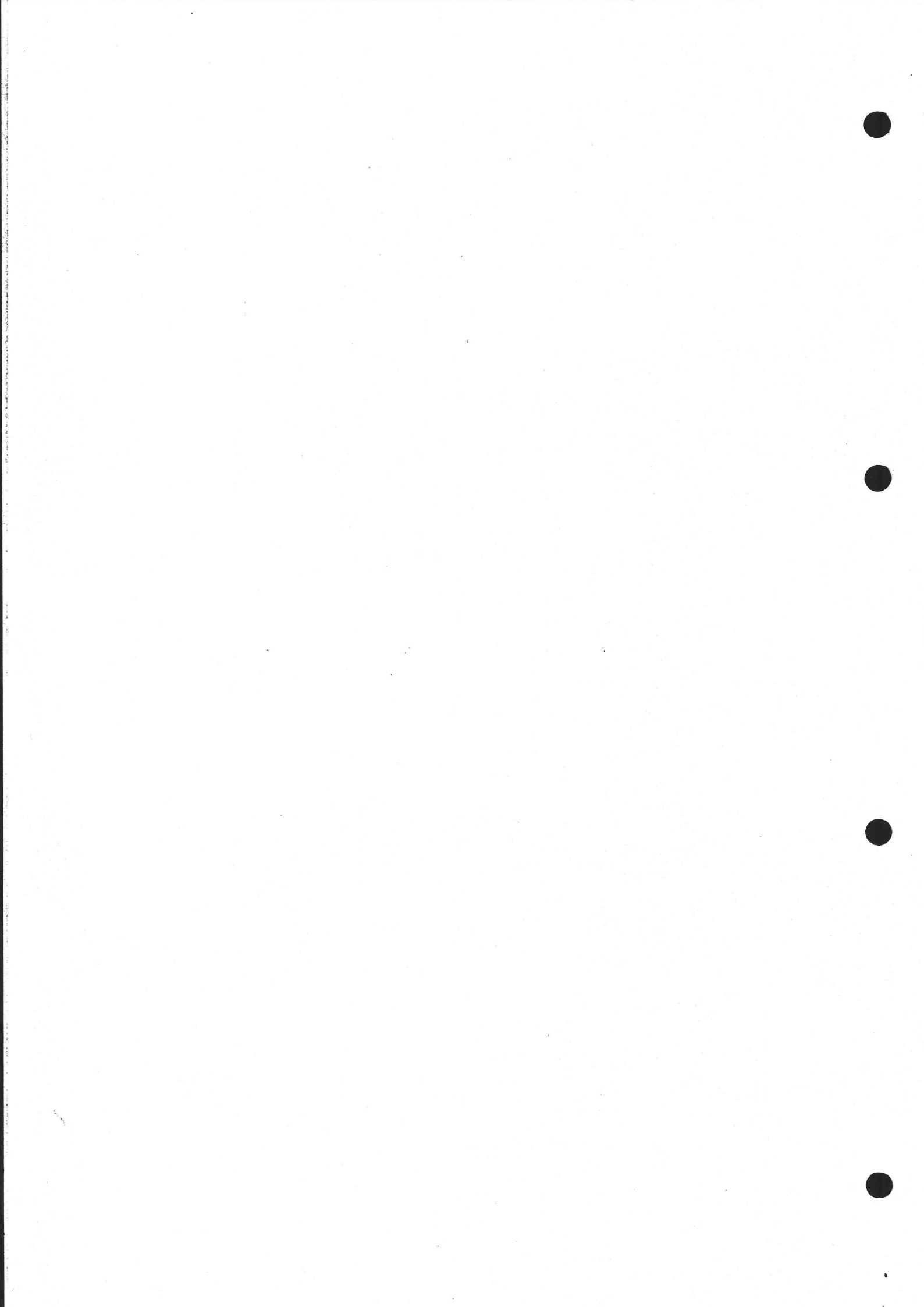
Note also that in the case of hard (Winchester) disks, one physical drive may be divided up into two or four logical drives (Drive Letters). To see how many you have got, try to list the directories of the various CP/M drives (using the DIR command). The message:

Bdos Err On x: Select

means that that drive does not exist. Then press the RETRN key to regain the CP/M prompt.







5. TECHNICAL OVERVIEW

**The Scope of this Overview**

This section provides the operational parameters for every component module of the CR7 microcomputer. A complete description of the hardware is not given; this is not a repair manual. For instance, circuit diagrams are not included. However it should give an idea of the overall hardware design, for those who are interested. It also gives detailed programming information, and some detail of the hardware interfaces between the different component modules. This Technical Overview, then, is aimed at the "Expert User" rather than someone who wants to take the entire thing to bits and re-design it.

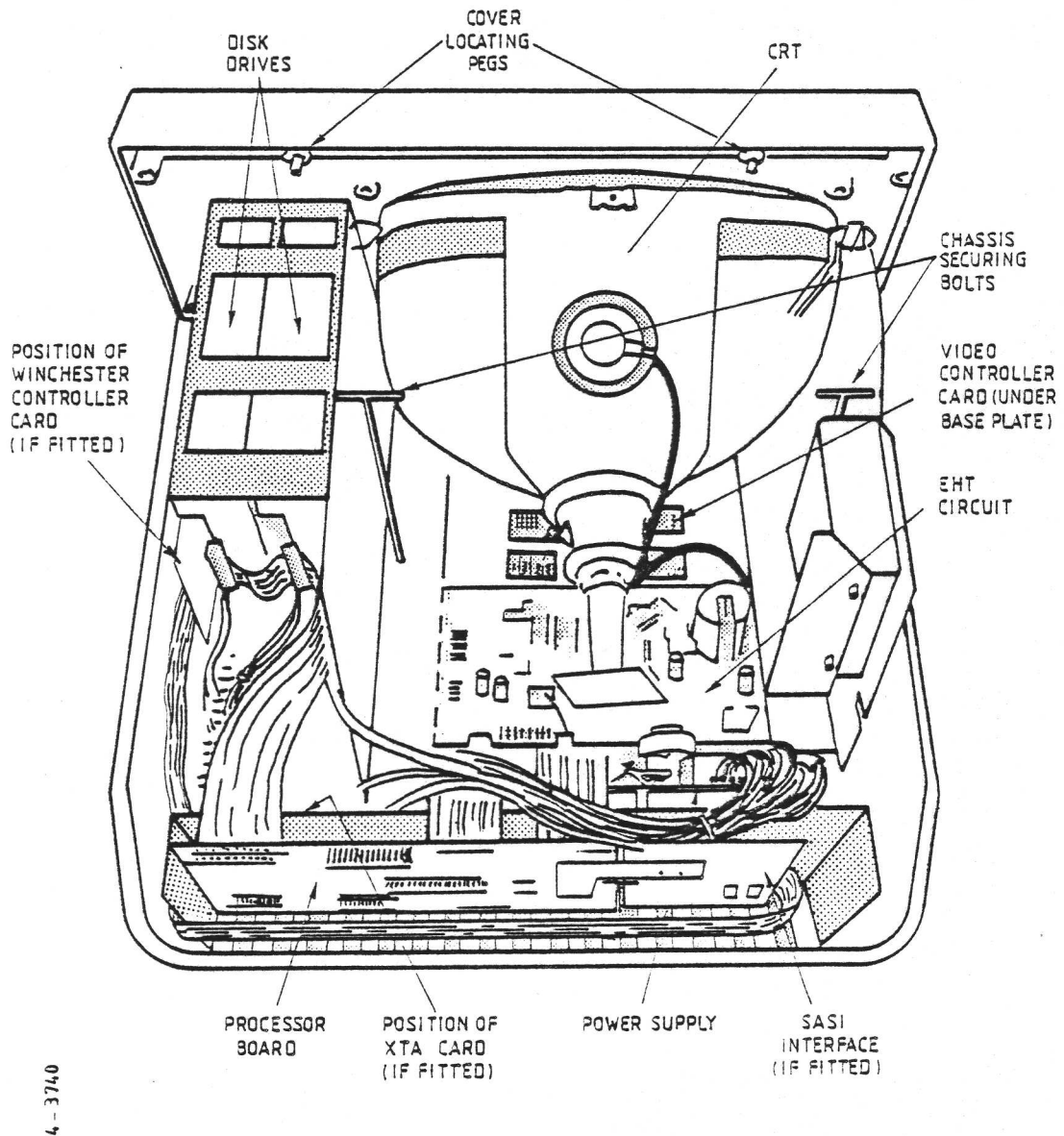
**Layout of Components and internal access**

The positioning of the different components in the Workstation model is shown overleaf. The various circuit boards in the Cabinet model may be recognised from their illustrations elsewhere in this manual.

All normal adjustments to the CR7 may be made without opening the cabinet. The cabinet should only be opened by qualified technicians, for reasons of repair or equipment upgrade (e.g. changing the character PROM). The procedure in such cases is as follows. Disconnect from the mains, then:

**Workstation model:** The rear cover of the display unit may be removed by removing the upper two case mounting screws at the rear then sliding the cover back. It can then be lifted off when the two plastic locating pegs at the top near the front are free (see illustration on the next page).

**Cabinet model:** CR7s that are not built into a VDU are opened by removing the 8 outermost screws underneath and sliding the cover forward. The cover can then be completely removed.

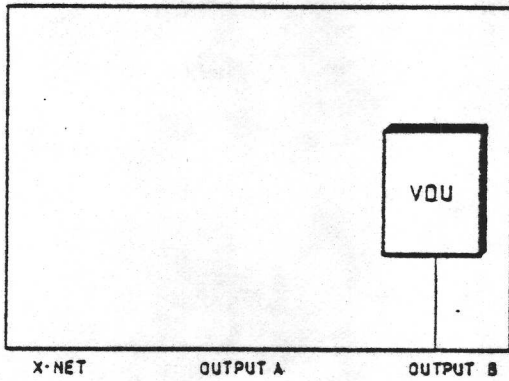


**CR7 INTERNAL VIEW**

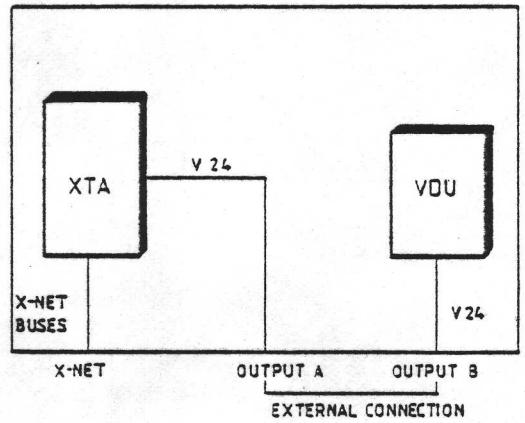
Note that a block diagram of the whole CR7 system was given on page 2-1.

The differences in the connections for the various CR7 models are shown overleaf.

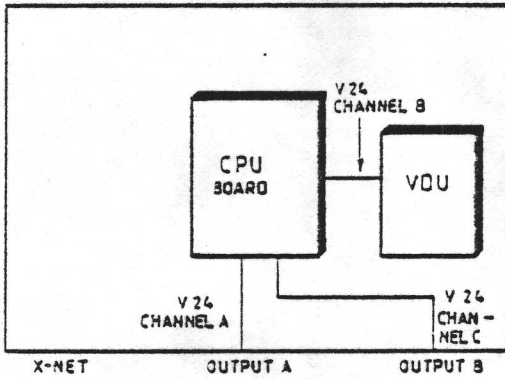
CR7 COMFORT



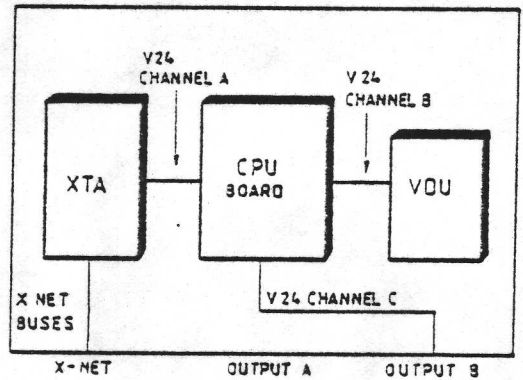
CR7 COMFORT -X



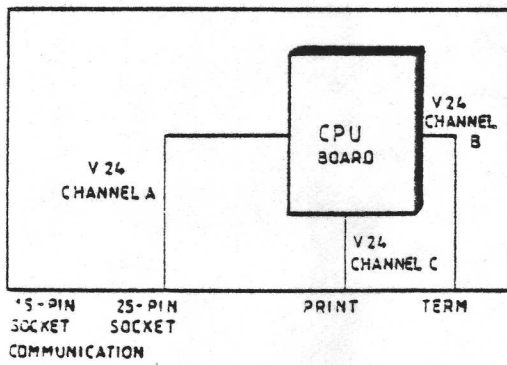
CR7 DIPLOMAT



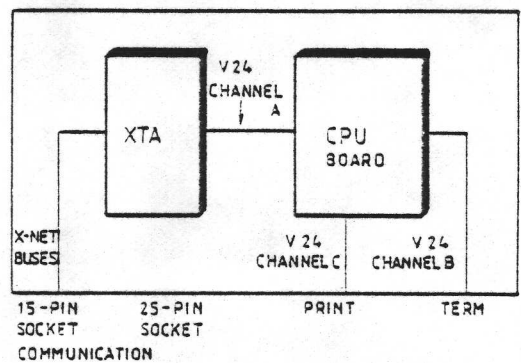
CR7 DIPLOMAT -X



CR7 DIPLOMAT  
(CABINET MODEL)

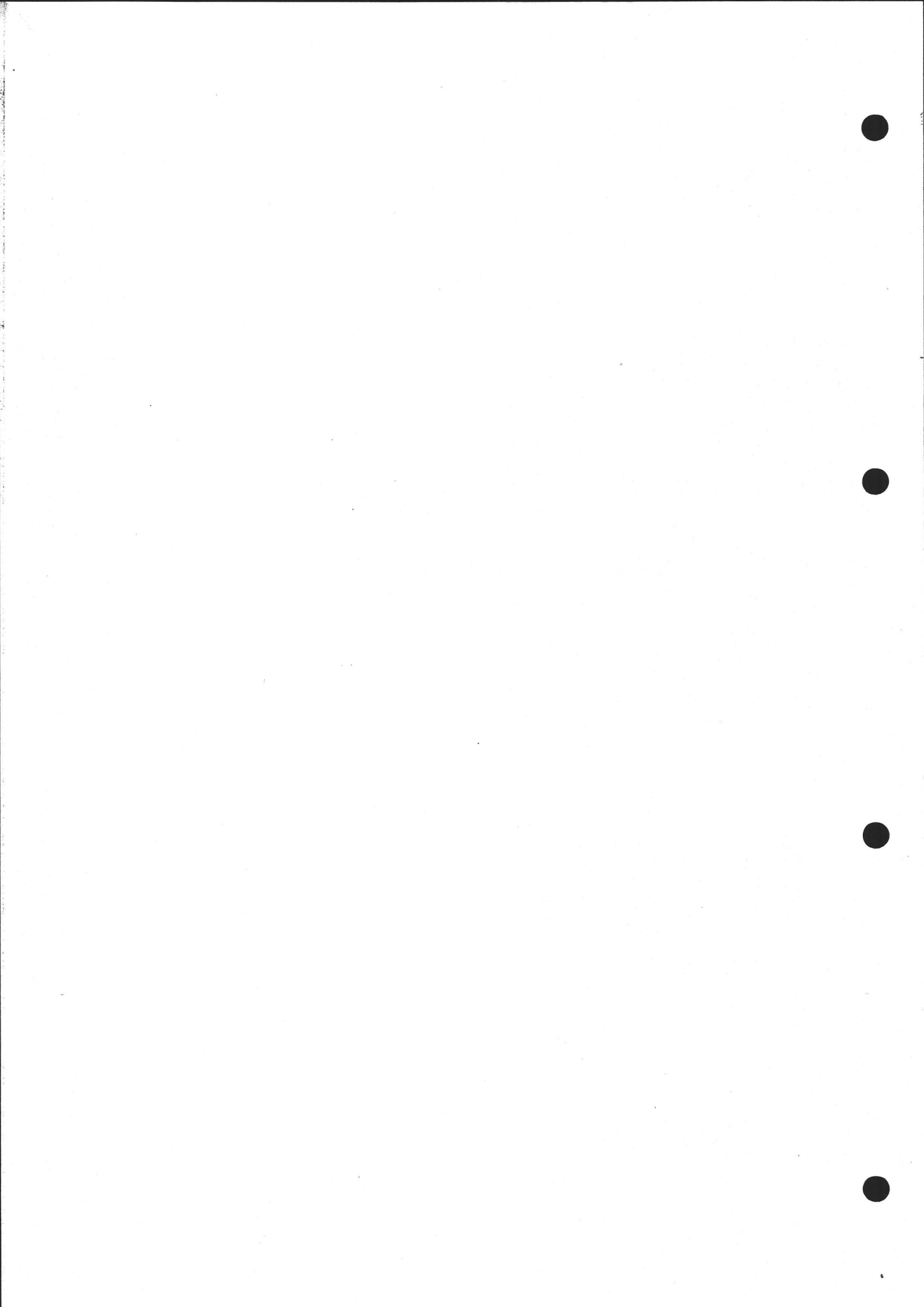


CR7 DIPLOMAT -X  
(CABINET MODEL)



97658E-4





## 5.1 THE WORKSTATION

This section deals with those parts of the CR7 Diplomat (Workstation model) which one would expect to find in a terminal, i.e. everything but the processor board and the disk drives.

### Note for users of the Cabinet model CR7

If your CR7 is a Cabinet model (i.e. a box containing processor and disk drives but using a separate terminal), then this section is not relevant unless the terminal used with the CR7 Cabinet happens to be the CR7 Comfort, CR7 Comfort-X, or CR5 Compass terminal. In other words, the CR7 Diplomat Workstation consists of a CR7 Comfort (or Comfort-X) terminal, plus a processor board, plus disk drives, all built into one unit.

The CR5 terminal is essentially the same, apart from its physical appearance.

### 5.1.1 Features of the Terminal

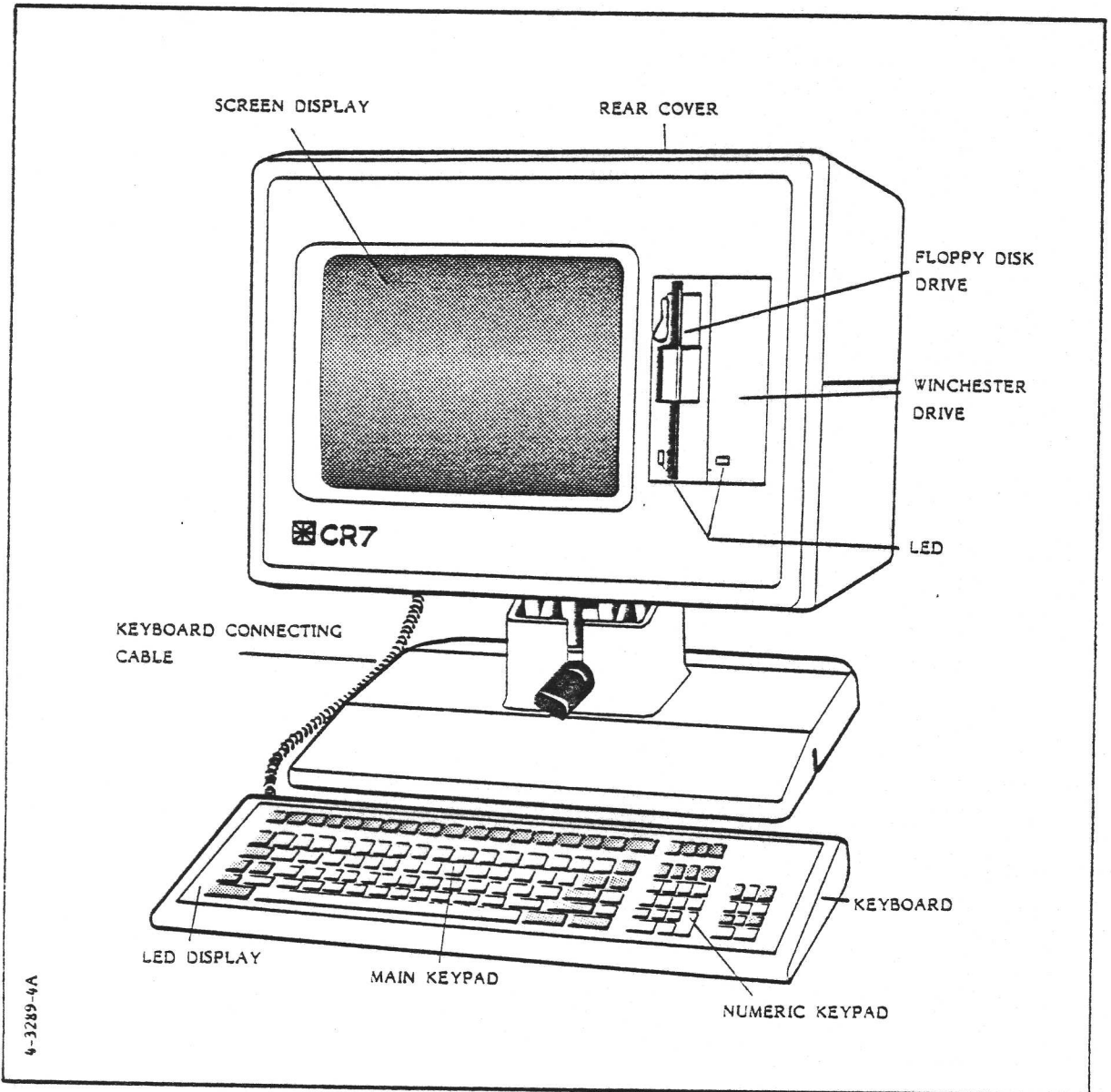
The terminal forms the basis of the CR7 Diplomat Integrated Workstation models. It includes a 12" or 15" CRT display, and a high-capacity switching power supply. The unit has many advanced features, including the following:

- o ANSI X3.64 (subset) compatibility
- o Cursor addressing
- o Screen editing
- o Alternate character set, which may be supplied by the user
- o Character attributes: underline, blink, reverse video, and highlight
- o Characters include those for form- and graph-drawing, plus Danish characters

- o Numeric keypad keys may be switched to "Applications Mode", enabling them to be used as additional special function keys

### 5.1.2 Terminal Components and Controls

In this section, the various components of the terminal are identified and brief details are given.



THE CR7 DIPLOMAT - FRONT VIEW

The features highlighted in the drawing are described below. Access to the inside was described on pages 5-1..2.

**Screen Display** The 12" or 15" CRT display is connected internally to the processor board using a 9600 Baud V24/V28 link. The unit displays 80 characters on 25 lines.

**Floppy Disk Drive** This is a 5.25" dual side, dual density, narrow profile model. Its capacity is 608 Kbytes formatted (though specification may be improved from time to time). Usually, two will be fitted. The LED (illustrated) is lit when the diskette is being accessed.

**Winchester Disk Drive** This hard disk unit has a capacity of 5 Mbytes formatted (though specification may be improved from time to time). Most CR7s have a second floppy disk drive fitted in this position instead of the Winchester. The LED (illustrated) is lit when the Winchester is being accessed.

**Keyboard Cable** A coiled cable connects the keyboard to the main section of the terminal via a DIN plug and socket at the rear of the latter.

**Keyboard** Earlier models have 83 keys; the current one has 111. The larger model when switched to VT100 mode behaves identically to the smaller keyboard (except of course that the larger one includes some extra keys).

Both models are available in English and Danish versions. The 111-key English one is illustrated on page 3-5.

**Numeric Keypad** Most of the keys here may be used either as a convenient duplication of the number keys for rapid data entry, or, when set to Applications Mode (by software) as an extra set of function keys.

**Keyboard LED Display (83-key model)** The keyboard has a set of 8 LEDs (in some examples, one is hidden). For CR7s delivered after Nov. '83, the meanings of the LEDs correspond to those outlined for the larger keyboard (described below). For earlier CR7s, contrarily to how it may be labelled, only one is meaningful - the leftmost one, which indicates Power On.

**Keyboard LED Display (111-key model)** This keyboard includes a row of 14 LEDs between the main set of keys and the special function keys. The meanings of these LEDs is as follows:

IBM  
VT100  
Tele

Only one of these may be lit at one time. It indicates which mode the keyboard is in as set on the switches on the far right of the keyboard. Only the VT100 mode should be used.

On line  
Local

Only one of these may be lit at one time. The illumination of one or the other indicates "Power on". They indicate the setting of the On/Off -line DIL switch in the main section of the terminal. When in Local (off line) mode there is no communication with the processor board.

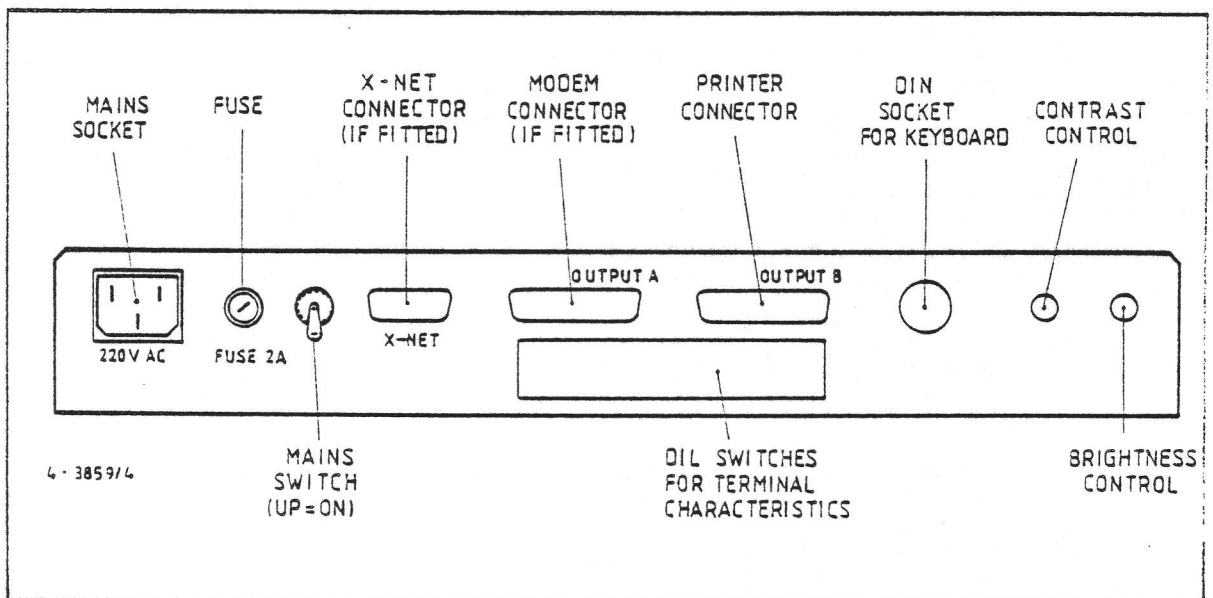
KBD Locked

This LED is lit when NO SCRL (or Scroll Lock) has been used to temporarily suspend output to the screen or from the keyboard. The LED goes out again when NO SCRL is pressed again to re-start communication. CR7s supplied prior to Nov. '83 use CTRL-S and CTRL-Q instead of NO SCRL.

L1 to L4 These are application specific, user-programmable LEDs.

L5 to L8 Not used.

For the remaining components and controls, please refer to the illustration below of the rear panel of the terminal.



DISPLAY UNIT - REAR PANEL



The various items on the back panel are described below.

**Mains Socket.** Check that the label by this socket matches your mains supply before plugging in the cable. 240V (e.g. British) supplies can safely be used with the 220V AC model.

**Fuse.** The fuse can be reached by unscrewing it. Use a 2A slow-blow type for the 220V model or a 3.15A slow-blow for the 110V model.

**Mains Switch.** Pull this up to switch on. This also functions as a "reboot" switch. See pages 3-1 and 3-2 for more details on what to do before "powering-up" for the first time.

**X-Net Connector.** Cr7s that have the built-in X-Net interface card (XTA) should be connected to the Wall Outlet (XWO) via this connector. (X-Net is CR's local area network system for interconnecting many terminals, computers, etc.) Note also that the sockets labelled "A" and "B" (next to the X-Net connector on the rear of the CR7) should be interconnected before the CR7 Diplomat-X terminal is connected to the XWO.

Take care to wire external equipment to this connector correctly, otherwise damage may result to the CR7 or the external equipment. Always disconnect from the mains before connecting or disconnecting with the XWO. Never connect anything but an XWO to this socket.

If your CR7 has no X-Net socket (i.e. it has no built-in XTA) then a separate XTA unit must be used. In this case, "A" and "B" are not connected together; "A" is connected to the XTA. Switch off at the mains before making this connection. This is all illustrated on page 50-3. The XTA is covered in section 5.5.

**Modem Connector ("A").** This is only fitted to CR7s that do not have a built-in X-Net Terminal Adaptor. The connector provides a full V24 DTE interface. Signal details appear on pages 52-13 and 52-15.

Take care to wire external equipment to this connector correctly, otherwise damage may result to the CR7 or the external equipment. Always disconnect from the mains before connecting or disconnecting any equipment via this socket.

See also page 50-3.

**Printer Connector ("B").** The connector provides a limited V24 interface. Signal details appear on pages 52-14..15.

Take care to wire external equipment to this connector correctly, otherwise damage may result to the CR7 or the external equipment. Always disconnect from the mains before connecting or disconnecting any equipment via this socket.

See also page 50-3.

**Keyboard Socket.** The keyboard supplied as part of the CR7 is plugged in here.

**Brightness and Contrast.** For the best viewing conditions, the following procedure should be carried out (assuming light characters on a dark background):

1. Set Contrast to an intermediate level.
2. Set Brightness so that the "black" parts of the screen just disappear. In other words, set the Brightness as high as it will go without light appearing on those parts of the screen without characters.
3. Use the Contrast to set the text on the screen to a comfortable and readable brightness. This may seem paradoxical but is recommended nevertheless.

Unfortunately a few CR7s delivered prior to July '83 have the brightness control labelled as Contrast and vice versa.

**DIL Switches for Baud rate, etc.** This is the last item to be shown in the Rear Panel illustration. They are dealt with in the following section.

### DIL Switch Settings

To gain access to these switches, undo the two knurled screws thus removing the small panel that covers these switches (at the back of the CR7). The switches are in three DIL units of eight switches each. These may be covered with little doors which are hinged at the right.

**Disconnect the CR7 from the mains before attempting to alter the switch settings.** This is for safety, and because the new switch settings will not be read by the computer until it is re-booted (which requires switching it off and on again).

Some switches may be hidden by ribbon cables.

The little door(s) can now be opened with the aid of a small screwdriver, which can also be used to operate the switches.

The orientation of the switches (i.e. which position corresponds to ON and which to OFF) is written on the DIL units themselves. Note that OPEN is synonymous with OFF.

A few early CR7 examples were produced with jumpers instead of switches, but the following table still applies.

A few CR7s were delivered prior to July '83 with an incorrectly annotated panel covering the DIL switches. If your panel does not agree with the table overleaf it will be replaced, on request, by a correct one.

Going down the following table corresponds to moving along the switches from right to left, as viewed from the rear of the CR7 (i.e. DIL 3, switch 8 first). The asterisks represent the normal factory settings for CR7s with the English keyboard types. Factory settings that differ in the Danish keyboards are indicated by a double asterisk against the Danish settings.

	<u>FUNCTION</u>	<u>ON</u>	<u>OFF</u>	
DIL 3	Flow control	XON/XOFF	DTR/ <u>DTR</u>	*
	Mode	Normal	* Test (used by CR only)	
	Cursor blink	Yes	* No	
	Cursor shape	Block. See note 1	Underline. See note 1	*
	Keyboard type	Includes Æ, Ø, Å	** Includes [, ], \	*
	G1 graphics	Normal. See note 2	* Special. See note 2	**
	G0 graphics	Normal. See note 2	* Special. See note 2	**
	Character set	CR. See note 2	** VT100. See note 2	*
DIL 2	Baud rate settings for the VDU part of the CR7 which is wired internally to processor board	On-line	* Off-line	
		75 Baud	Some other speed	*
		110 Baud	Some other speed	*
		150 Baud	Some other speed	*
		300 Baud	Some other speed	*
		600 Baud	Some other speed	*
		1200 Baud	Some other speed	*
DIL 1	Other characteristics of internal VDU / Processor interface	2400 Baud	Some other speed	*
		4800 Baud	Some other speed	*
		9600 Baud	* Some other speed	
		19200 Baud	Some other speed	*
		1 Stop Bit	* 2 Stop Bits	
	Odd parity	* Even parity		
	Parity disabled	* P. enabled. See note 4		
	Data len. See n. 3	See notes 3 & 4	*	
	Data len. See n. 3	* See notes 3 & 4		

**DIL SWITCH SETTINGS**

Notes on the above table

1. The "cursor shape" switch also has an effect on the graphics characters, namely to blank out the top line of each character matrix when set to "Underline" cursor shape. (Only the graphics characters use this top line. See page 51-34.) This means that when using form-drawing graphics, the

"Block" cursor should be selected; otherwise vertical lines in forms drawn on the screen will have gaps in.

Also, for technical reasons, the "Underline" character attribute is transmuted to "Blinking" when the Block cursor is selected. That is, text on the screen can only be underlined if "Underline" cursor type is selected on the DIL switch. If it is programmed to underline some characters when Block cursor is selected, then those characters will blink instead.

2. The CR7 is supplied with two character sets, each of 128 different characters - many are common to both sets, and both contain various graphics characters. The "Character set" switch is used to select between VT100 (to emulate DEC's terminal of that name) or CR (which includes the Danish letters Æ, Ø, and Å and some block graphics.) See also jumper ST9 (page 51-11).

The "G0 graphics" switch is used to select which characters out of the chosen set will be displayable when the CR7 is first switched on (e.g. the Danish letters within the CR set are reached by setting Special mode on this G0 switch.

The "G1 graphics" switch is used to select which subset of the selected character set is used after CTRL-N is pressed on the keyboard (e.g. square and curly brackets instead of Danish letters are obtained by setting Normal mode on this switch). Press CTRL-O on the keyboard to revert to the G0 part of the character set.

Note that the factory settings for the G0 and G1 switches are the same; thus CTRL-O and CTRL-N will normally have no effect.

The interactions between the settings of these 3 DIL switches (Character set, G0, and G1) and various commands in software (e.g. CTRL-N) is explained rather more clearly on pages 51-20..23.

3. The "Data Length" switches for the internal VDU/Processor interface are set as follows:



<u>Data Length</u>	<u>Next to last switch</u>	<u>Last (rightmost) switch</u>
5 bits	ON	ON
6 bits	ON	OFF
7 bits	OFF	ON
8 bits	OFF	OFF

4. In accordance with ANSI X3.64, if 8-bit (no parity) data is selected instead of 7-bit, then the terminal will react to codes starting with 9B (Hex) in the same way as it will to codes starting with 1B 5B. In other words, the terminal will always respond as described elsewhere in this manual to code sequences starting with "ESCAPE" "OPEN SQUARE BRACKET", but, if set to 8-bit data, it will also respond if the "ESCAPE" "OPEN SQUARE BRACKET" is replaced by Hex 9B in a command. Furthermore, there is one case in which 1B 5B is sent to the terminal by the processor. In this case, Cursor Position Report, the code 9B is sent instead, if the terminal is set to 8-bit data.

#### Interface to Processor Board

The line interface to the processor board is of standard V24 type with a 25-pin female D-connector. The connector is wired as follows:

<u>V24 Circuit No.</u>	<u>Signal Name</u>	<u>Pin Number</u>
101	Protective ground	1
103	Transmitted data	2
104	Received data	3
105	Request to send	4
106	Clear to send	5
107	Data set ready	6
102	Signal ground	7
108	Data terminal ready	20

#### Jumper Settings on the video controller board

The layout of the jumpers is shown on page 51-37. A jumper is defined as being in the "A" position when fitted between the two pins nearest to the spot



marked on the board. "B" is the other position, and "N" means "no jumper" (maybe even no pins).

Jumpers having no description in the table below should never be changed from the factory settings.

<u>Jumper Name</u>	<u>Factory Setting</u>	<u>Description</u>
ST1	B	Protection ground wire on V24 interface (coming in from the outside) is connected to: A: Signal ground circuit. B: Protection ground wire on Video controller board.
ST2	A	
ST3	N	
ST4	N	
ST5	B	
ST6	B	
ST7	B	
ST8	A	This is set according to the type of firmware EPROM installed. A: 2764. B: 2716 or 2732.
ST9	A	A: Character set defined by DIL 3 switch 1 B: Character set is VT100, irrespective of DIL 3 switch 1 position.
ST10	N	
ST11	N	
ST12	N	
ST13	N	
ST14	A	A: V24 interface uses internal Receive clock signal. B: External Receive clock used.
ST15	B	
ST16	A	
ST17	B	

### Power Supply

The CR7 is fitted with a power supply of CR's own manufacture. It provides an output of 100 Watts. It is a switching power supply of advanced design, which is very efficient and therefore gives out very little heat.

The CR7 can be used in both 220V/50Hz and 110V/60Hz power installations, but will have to be returned to CR if this is necessary.

The specifications of the power supply are given below.

#### Input Specification

Mains voltage: 264V max., 187V min. (European setting)  
132V max., 94V min. (USA setting)

Mains frequency: 45 to 440 Hz

Inrush current: Maximum 40A at cold turn-on

#### Output Specification

Output voltage: +5.1V  $\pm 2\%$  at 10 - 100% load  
+12V  $\pm 5\%$  at 10 - 100% load  
-12V  $\pm 5\%$  at 0 - 100% load

#### Output current

(continuous): 19.6A at +5.1V  
8.3A at +12V  
8.3A at -12V

{ BUT the total  
must not exceed  
100 Watts

Output power: 100W

Load regulation: 0.5% typical

Line regulation: Better than 0.1%

Transient response: Within regulation in less than 0.5 msec for a 50 - 100  
- 50% load change, over 0 to 30 MHz

Noise: +5.1V: <150mV peak-to-peak over 0 to 30 MHz  
-12V: <300mV peak-to-peak over 0 to 30 MHz  
+12V: <300mV peak-to-peak over 0 to 30 MHz

Temperature range: 0 - 55 °C

Temperature  
stability: 250 ppm/°C

Energy storage: 30 msec typical from last peak of line voltage (nominal  
input voltage and full load)

Overvoltage  
protection: 6.5V  $\pm$  8% on 5.1V

Current limit: All outputs are current limited and will automatically  
restart.

### 5.1.3 Programmers' Information

#### 5.1.3.1 Keyboard Output

The following tables give the actual hexadecimal values generated by each key. Strictly speaking, the codes listed are not necessarily those output from the keyboard, since the video controller board's firmware automatically changes some of the codes to those listed. Thus the table gives the values which would be received by the processor board when the keys are pressed. The purpose or meaning of each key was described on pages 3-6..9. All keyboard types generate ASCII values.

Note that some of the keys generate a sequence of values rather than a single value. Note also that some of the keys on the numeric keypad will supply different values when the CR7 is set to "Applications Mode". This mode is described on pages 51-51..52.

The **auto-repeat** feature (i.e. a key generating its assigned value repeatedly if the key is held down for a few seconds) is implemented in most keys. The only exceptions are:

1. Those marked as "See note 1"
2. Any key used with CTRL.

The Key Number in the tables below indicate the position of the key on the larger keyboard (starting in the top left corner and continuing sequentially as if reading a written page). The earlier model keyboard, which has only 83 keys, generates the same codes as those listed below, but of course in this case the keys must be referred to via the "Name" column rather than the Key Numbers.

ENGLISH KEYBOARD - VT100 MODE

<u>Key No.</u>	<u>Key's Name</u>	<u>Normal (lower case)</u>	<u>Key + SHIFT</u>	<u>Key+ CTRL</u>	<u>Key + SHIFT +CTRL</u>	<u>See Note below</u>
1	SETUP or PF0	1B 6F 54	X	X	X	1, 2
2	F1	1B 6F 54 31	1B 6F 54 21	Y	Y	1, 3
3	F2	1B 6F 54 32	1B 6F 54 40	Y	Y	1, 3
4	F3	1B 6F 54 33	1B 6F 54 23	Y	Y	1, 3
5	F4	1B 6F 54 34	1B 6F 54 24	Y	Y	1, 3
6	F5	1B 6F 54 35	1B 6F 54 25	Y	Y	1, 3
7	F6	1B 6F 54 36	1B 6F 54 5E	Y	Y	1, 3
8	F7	1B 6F 54 37	1B 6F 54 26	Y	Y	1, 3
9	F8	1B 6F 54 38	1B 6F 54 2A	Y	Y	1, 3
10	F9	1B 6F 54 39	1B 6F 54 28	Y	Y	1, 3
11	F10	1B 6F 54 30	1B 6F 54 29	Y	Y	1, 3
12	F11	1B 6F 54 27	1B 6F 54 22	Y	Y	1, 3
13	F12	1B 6F 54 3D	1B 6F 54 2B	Y	Y	1, 3
14	F13	1B 6F 54 60	1B 6F 54 7E	Y	Y	1, 3
15	F14	1B 6F 54 71	1B 6F 54 51	Y	Y	1, 3
16	F15	1B 6F 54 77	1B 6F 54 57	Y	Y	1, 3
17	F16	1B 6F 54 65	1B 6F 54 45	Y	Y	1, 3
18	F17	1B 6F 54 72	1B 6F 54 52	Y	Y	1, 3

CR7 USER MANUAL - WORKSTATION

<u>Key No.</u>	<u>Key's Name</u>	<u>Normal (lower case)</u>	<u>Key + SHIFT</u>	<u>Key+ CTRL</u>	<u>Key + SHIFT +CTRL</u>	<u>See Note below</u>
19	F18	1B 6F 54 74	1B 6F 54 54	Y	Y	1, 3
20	F19	1B 6F 54 79	1B 6F 54 59	Y	Y	1, 3
21	ESC	1B	X	X	X	1, 2
22	1 !	31	21	31	21	
23	2 @	32	40	00	00	
24	3 #	33	23	E5	E5	
25	4 \$	34	24	34	24	
26	5 %	35	25	35	25	
27	6 ^	36	5E	1E	1E	
28	7 &	37	26	37	26	
29	8 *	38	2A	38	2A	
30	9 (	39	28	39	28	
31	0 )	30	29	30	29	
32	- _	2D	5F	1F	1F	
33	= +	3D	2B	3D	2B	
34	' ~	60	7E	E5	7E	
35	BACK SPACE	08	X	X	X	2
36	PF1	1B 4F 50	X	X	X	1, 2
37	PF2	1B 4F 51	X	X	X	1, 2
38	PF3	1B 4F 52	X	X	X	1, 2
39	PF4	1B 4F 53	X	X	X	1, 2
40	TAB	09	X	X	X	1, 2
41	Q	71	51	11	11	
42	W	77	57	17	17	
43	E	65	45	05	05	
44	R	72	52	12	12	
45	T	74	54	14	14	
46	Y	79	59	19	19	
47	U	75	55	15	15	
48	I	69	49	09	09	
49	O	6F	4F	0F	0F	
50	P	70	50	10	10	
51	[ {	5B	7B	1B	1B	
52	] }	5D	7D	1D	1D	
53	BREAK	1B 5B 48	1D	1D	1D	1, 3



CR7 USER MANUAL - WORKSTATION

<u>Key No.</u>	<u>Key's Name</u>	<u>Normal (lower case)</u>	<u>Key + SHIFT</u>	<u>Key+ CTRL</u>	<u>Key + SHIFT +CTRL</u>	<u>See Note below</u>
54	7 (num. mode)	37	X	X	X	2, 4
	(app. mode)	1B 4F 77	X	X	X	2, 4
55	8 (num. mode)	38	X	X	X	2, 4
	(app. mode)	1B 4F 78	X	X	X	2, 4
56	9 (num. mode)	39	X	X	X	2, 4
	(app. mode)	1B 4F 79	X	X	X	2, 4
57	- (num. mode)	2D	X	X	X	2, 4
	(app. mode)	1B 4F 6D	X	X	X	2, 4
58	HOME					1, 6
59	Up arrow	1B 5B 41	X	X	X	2
60	PG UP					1, 6
61	CTRL					5
62	SCROLL LOCK					1
63	A	61	41	01	01	
64	S	73	53	13	13	
65	D	64	44	04	04	
66	F	66	46	06	06	
67	G	67	47	07	07	
68	H	68	48	08	08	
69	J	6A	4A	0A	0A	
70	K	6B	4B	0B	0B	
71	L	6C	4C	0C	0C	
72	; :	3B	3A	3B	3A	
73	' "	27	22	27	22	
74	RETRN	0D	X	X	X	1, 2
75	LINE FEED	0A	X	X	X	2
76	4 (num. mode)	34	X	X	X	2, 4
	(app. mode)	1B 4F 74	X	X	X	2, 4
77	5 (num. mode)	35	X	X	X	2, 4
	(app. mode)	1B 4F 75	X	X	X	2, 4
78	6 (num. mode)	36	X	X	X	2, 4
	(app. mode)	1B 4F 76	X	X	X	2, 4
79	, (num. mode)	2C	X	X	X	2, 4
	(app. mode)	1B 4F 6C	X	X	X	2, 4

CR7 USER MANUAL - WORKSTATION

<u>Key No.</u>	<u>Key's Name</u>	<u>Normal (lower case)</u>	<u>Key + SHIFT</u>	<u>Key+ CTRL</u>	<u>Key + SHIFT +CTRL</u>	<u>See Note below</u>
80	Left arrow	1B 5B 44	X	X	X	2
81	Rovsing logo					1, 6
82	Right arrow	1B 5B 43	X	X	X	2
83	SHIFT					5
84	\	5C	7C	1C	1C	
85	Z	7A	5A	1A	1A	
86	X	78	58	18	18	
87	C	63	43	03	03	
88	V	76	56	16	16	
89	B	62	42	02	02	
90	N	6E	4E	0E	0E	
91	M	6D	4D	0D	0D	
92	, <	2C	3C	2C	3C	
93	. >	2E	3E	2E	3E	
94	/ ?	2F	3F	2F	3F	
95	SHIFT					5
96	* PRT SC					1, 6
97	1 (num. mode)	31	X	X	X	2, 4
	(app. mode)	1B 4F 71	X	X	X	2, 4
98	2 (num. mode)	32	X	X	X	2, 4
	(app. mode)	1B 4F 72	X	X	X	2, 4
99	3 (num. mode)	33	X	X	X	2, 4
	(app. mode)	1B 4F 73	X	X	X	2, 4
100	END					1, 6
101	Down arrow	1B 5B 42	X	X	X	2
102	PG DN					1, 6
103	ALT					1, 6
104	Space bar	20	X	X	X	2
105	CAPS LOCK					5
106	MODE					1, 6
107	0 (num. mode)	30	X	X	X	2, 4
	(app. mode)	1B 4F 70	X	X	X	2, 4
108	. (num. mode)	2E	X	X	X	2, 4
	(app. mode)	1B 4F 6E	X	X	X	2, 4

<u>Key No.</u>	<u>Key's Name</u>	<u>Normal (lower case)</u>	<u>Key + SHIFT</u>	<u>Key+ CTRL</u>	<u>Key + SHIFT +CTRL</u>	<u>See Note below</u>
109	ENTER + (num. mode) (app. mode)	0D 1B 4F 4D	X X	X X	X X	7 1, 2, 4 1, 2, 4
110	INS					1, 6
111	DEL	7F	X	X	X	1, 2

#### Notes on the above table

The numbers in the last column refer to these by number.

1. This key does not have the Auto-repeat feature.
2. "X" means that the code for this key is the same, irrespective of SHIFT and CTRL.
3. "Y" means that this code was not defined at time of writing.
4. This key generates different codes, depending on whether the terminal is currently set to Numeric or Application mode. See pages 51-51..52 for details.
5. This key generates no value of its own; it only modifies the values of other keys.
6. This key does nothing at all (the same keyboard is used with other Rovsing products which do use this key).
7. The "+" on this key does not mean that the key generates a "+" when SHIFT is pressed.
8. On CR7s delivered after November '83, BREAK generates no code; the transmission line to the processor board or other host is forced to Zero for 0.24 seconds. If SHIFT plus BREAK are pressed, this time is increased to 3.6 seconds.

#### Differences between the English and Danish keyboards

The Danish keyboard generates the same values as the English one, but the mapping between the codes and the keys is different in certain cases. In other words, both keyboards generate the same set of codes but you sometimes have to press different buttons to get them.

The following table lists all the keys which are not identical in both keyboard types.

DANISH KEYBOARD - VT100 MODE

<u>Key No.</u>	<u>Key's Name</u>	<u>Normal (lower case)</u>	<u>Key + SHIFT</u>	<u>Key+ CTRL</u>	<u>Key + SHIFT +CTRL</u>	<u>See Note above</u>
12	F11	1B 6F 54 27	1B 6F 54 22	Y	Y	1, 3
32	' "	27	22	27	22	
51	Å	7D	5D	1D	1D	
52	/ ?	2F	3F	2F	3F	
72	Æ	7B	5B	1B	1B	
73	Ø	7C	5C	1C	1C	
84	< >	3C	3E	3C	3E	
92	, ;	2C	3B	2C	3B	
93	. :	2E	3A	2E	3A	
94	- _	2D	5F	1F	1F	

Note that the appearance on the screen of these characters will depend upon the character set in use, not on the keyboard type. Thus both English and Danish keyboards can cause both English and Danish characters to be displayed on the screen.

The character sets, and how to select them, are described in section 5.1.3.2 (pages 51-20..23).

**IBM Mode**

The 111-key keyboard may be set to IBM mode by means of a small switch under the cover on the right hand side. However, this mode is not intended to be used when the keyboard is part of the CR7 terminal (the same keyboard is used in conjunction with other Roving products where IBM mode is used).

### Programming the keyboard

The only user-programmable feature of the CR7 keyboard (111-key version) is the LED display. Four of these lights may be controlled via software. Details are on pages 51-52..53. The 83-key keyboard cannot be programmed by the user.

#### 5.1.3.2 Character sets supplied with the CR7

The CR7 contains two character sets, called CR and VT100. Each contains 128 characters. Both include the English alphabet in upper and lower case, the normal punctuation symbols and numbers, plus form-drawing graphics characters. The CR set also has bar and block graphics, the CR logo, and the three letters that appear in the Danish alphabet but not in the English - Æ, Ø, and Å. The VT100 set has some mathematical symbols, plus some special symbols that represent normally non-displayable characters such as carriage return.

Within each of these two character sets, there are two modes of operation which allow access to different subsets of the chosen character set. Most characters are unaffected by the mode - i.e. the same character will be displayed in both modes. However, there are 6 characters in the CR set (Danish letters in upper and lower case) and 32 characters in the VT100 set (maths symbols, form-drawing symbols, and symbols for carriage return, etc.) which appear only in the so-called Special mode. They are replaced by other characters in the Normal mode.

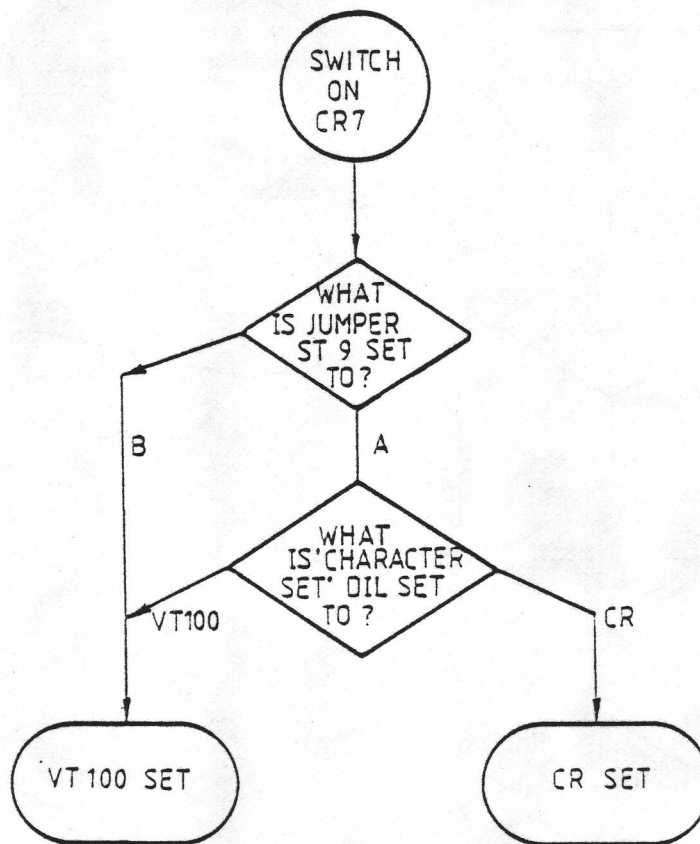
#### How to select the different character sets

This is done by a combination of DIL switch settings on the video controller board (and a jumper), the use of the control functions CTRL-N and CTRL-O in software, and certain Escape sequences in software.

The use of the DIL switches was explained in the table on page 51-8, in footnote 2 to that table, and in the following flowcharts.

Note that it is not possible by software to switch between the VT100 set and the CR set, though of course many characters are common to both.

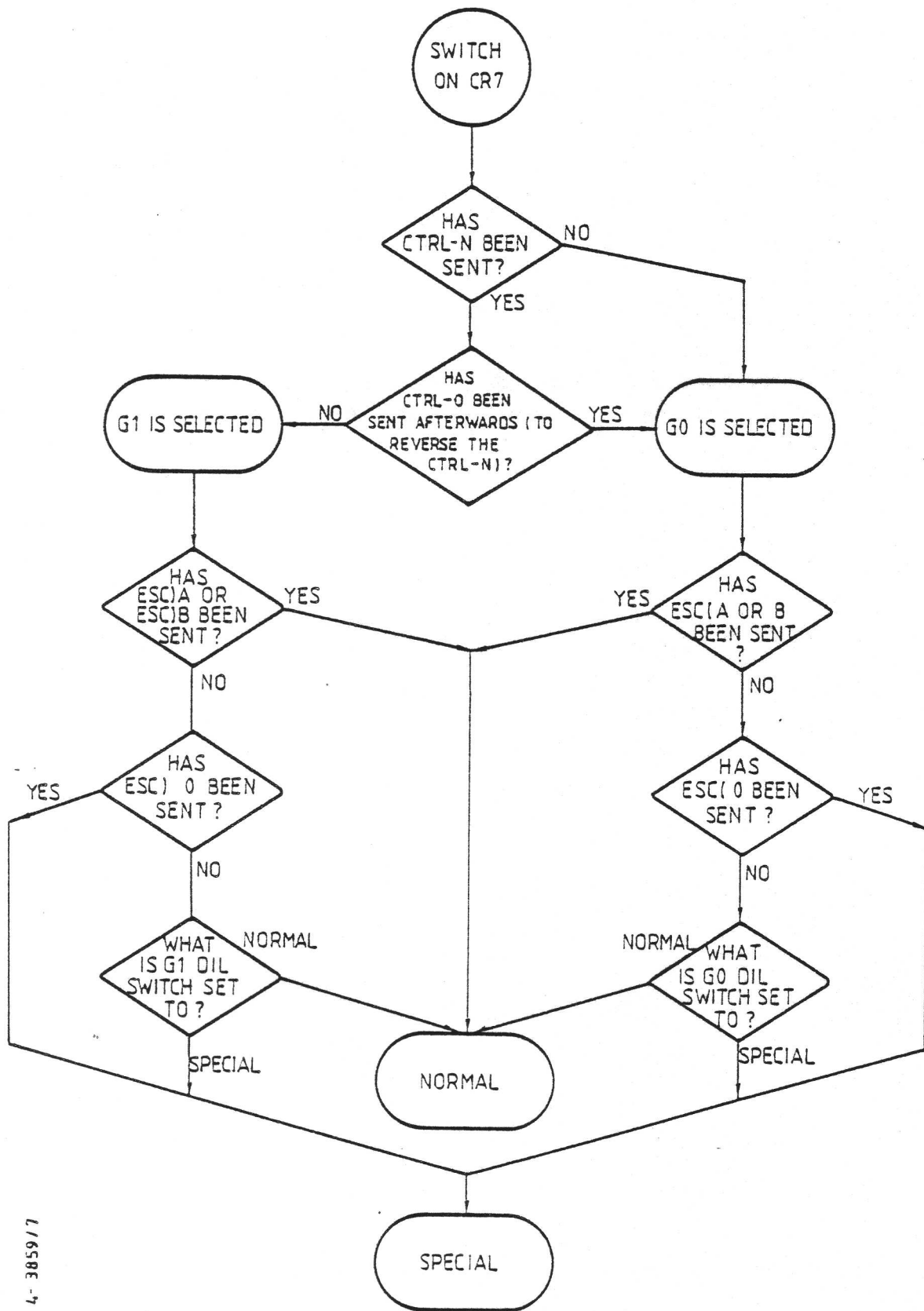
The following flowcharts describe how the DIL switch settings and software commands interact to give one of the four character subsets illustrated on pages 51-24..26. (Two of these subsets are identical on the PROM supplied with the CR7; thus only 3 subsets are actually illustrated.)



4-3859/12

HOW THE DIFFERENT CHARACTER SETS ARE SELECTED





4-3859/7

HOW THE 'MODE' WITHIN A CHARACTER SET IS SELECTED

The Hex. codes for the software commands mentioned in the second flowchart are given below:

<u>Command</u>	<u>Hex</u>	
CTRL-N	0E	
CTRL-O	0F	
ESC ( A	1B 29 41	} These have the same effect
ESC ( B	1B 29 42	
ESC ( 0	1B 29 30	
ESC ) A	1B 28 41	} These have the same effect
ESC ) B	1B 28 42	
ESC ) 0	1B 28 30	

#### How to select particular characters within those sets

In the 5 sections that follow, the available characters are tabulated and their methods of access described. Each section deals with one of the 5 groups of characters. The division into groups is on grounds of access method rather than any particular properties of the characters themselves.

Note that many of the characters appear in more than one group; thus the comments on particular characters are left until the end (page 51-29).

Group 1: CR/VT100/Normal

The following characters are available when switched to either character set and when Normal Mode has been selected (as described previously). Notes on individual characters start on page 51-29.

HEX CODE	CHARACTER	NOTE NO.	HEX CODE	CHARACTER	NOTE NO.	HEX CODE	CHARACTER	NOTE NO.	HEX CODE	CHARACTER	NOTE NO.
20		1	38	8		50	P		68	h	
21	!		39	9		51	Q		69	i	
22	"		3A	:		52	R		6A	j	
23	#		3B	;		53	S		6B	k	
24	\$		3C	<		54	T		6C	l	
25	%		3D	=		55	U		6D	m	
26	&		3E	>		56	V		6E	n	
27	'	2	3F	?		57	W		6F	o	
28	)		40	@		58	X		70	p	
29	(		41	A		59	Y		71	q	
2A	*		42	B		5A	Z		72	r	
2B	+		43	C		5B	[		73	s	
2C	,		44	D		5C	\		74	t	
2D	-	3	45	E		5D	]		75	u	
2E	.	4	46	F		5E	^		76	v	
2F	/		47	G		5F	_	5	77	w	
30	0		48	H		60	`	6	78	x	
31	1		49	I		61	a		79	y	
32	2		4A	J		62	b		7A	z	
33	3		4B	K		63	c		7B	{	
34	4		4C	L		64	d		7C		
35	5		4D	M		65	e		7D	}	
36	6		4E	N		66	f		7E	~	
37	7		4F	O		67	g		7F		7

Group 2: CR/Special

The following characters are available when switched to CR character set and when Special Mode has been selected (as described previously). Notes on individual characters start on page 51-29.

HEX CODE	CHARACTER	NOTE NO.	HEX CODE	CHARACTER	NOTE NO.	HEX CODE	CHARACTER	NOTE NO.	HEX CODE	CHARACTER	NOTE NO.
20		1	38	8		50	P		68	h	
21	!		39	9		51	Q		69	i	
22	"		3A	:		52	R		6A	j	
23	#		3B	;		53	S		6B	k	
24	\$		3C	<		54	T		6C	l	
25	%		3D	=		55	U		6D	m	
26	&		3E	>		56	V		6E	n	
27	'	2	3F	?		57	W		6F	o	
28	)		40	@		58	X		70	p	
29	(		41	A		59	Y		71	q	
2A	*		42	B		5A	Z		72	r	
2B	+		43	C		5B	Æ	8	73	s	
2C	,		44	D		5C	Ø	8	74	t	
2D	-	3	45	E		5D	Å	8	75	u	
2E	.	4	46	F		5E	↑		76	v	
2F	/		47	G		5F	_	5	77	w	
30	0		48	H		60	'	6	78	x	
31	1		49	I		61	a		79	y	
32	2		4A	J		62	b		7A	z	
33	3		4B	K		63	c		7B	æ	8
34	4		4C	L		64	d		7C	ø	8
35	5		4D	M		65	e		7D	å	8
36	6		4E	N		66	f		7E	~	
37	7		4F	O		67	g		7F		7

Group 3: VT100/Special

The following characters are available when switched to VT100 character set and when Special Mode has been selected (as described previously). Notes on individual characters start on page 51-29.

HEX CODE	CHARACTER	NOTE NO.	HEX CODE	CHARACTER	NOTE NO.	HEX CODE	CHARACTER	NOTE NO.	HEX CODE	CHARACTER	NOTE NO.
20		1	38	8		50	P		68	⌘	10
21	!		39	9		51	Q		69	⌘	10
22	"		3A	:		52	R		6A	⌘	12
23	#		3B	;		53	S		6B	⌘	12
24	\$		3C	<		54	T		6C	⌘	12
25	%		3D	=		55	U		6D	⌘	12
26	&		3E	>		56	V		6E	+	12
27	'	2	3F	?		57	W		6F	-	13
28	)		40	@		58	X		70	-	13
29	(		41	A		59	Y		71	-	12,13
2A	*		42	B		5A	Z		72	-	13
2B	+		43	C		5B	[		73	-	13
2C	,		44	D		5C	\		74	†	12
2D	-	3	45	E		5D	]		75	†	12
2E	.	4	46	F		5E	↑		76	†	12
2F	/		47	G		5F		1	77	†	12
30	0		48	H		60	◆		78		12
31	1		49	I		61	⌘	9	79	≡	11
32	2		4A	J		62	⌘	10	7A	≡	11
33	3		4B	K		63	⌘	10	7B	≡	11
34	4		4C	L		64	⌘	10	7C	#	11
35	5		4D	M		65	⌘	10	7D	ε	
36	6		4E	N		66	°	11	7E	•	11
37	7		4F	O		67	±	11	7F		7

## Group 4: CR/Escape

The following characters are available when switched to the CR character set by issuing a sequence of four or five bytes of the form:

ESC [ X t

where X can be one or two bytes. The Mode setting (normal vs. special) is immaterial.

Notes on individual characters start on page 51-29.

<u>Hex Code Sequence</u>	<u>Character</u>	<u>Note no.</u>
1B 5B 30 74	┌	12
1B 5B 31 74	┐	12
1B 5B 32 74	└	12
1B 5B 33 74	┘	12
1B 5B 34 74	├	12
1B 5B 35 74	┤	12
1B 5B 36 74	┆	12
1B 5B 37 74	┇	12
1B 5B 38 74	┈	12
1B 5B 39 74	┉	12
1B 5B 31 30 74	+	12
1B 5B 31 31 74	■	14
1B 5B 31 32 74	■	15
1B 5B 31 33 74	■	16
1B 5B 31 34 74	■	17
1B 5B 31 35 74	■	18
1B 5B 31 36 74	■	19
1B 5B 31 37 74	■	20
1B 5B 31 38 74	■	21
1B 5B 31 39 74	■	22
1B 5B 32 30 74	C	23
1B 5B 32 31 74	R	23
1B 5B 32 32 74	S	23
1B 5B 32 33 74	S	23
1B 5B 32 34 74	S	23
1B 5B 32 35 74	S	23



**Group 5: VT100/Escape**

The following characters are available when switched to the VT100 character set by issuing a sequence of four or five bytes of the form:

ESC [ X t

where X can be one or two bytes. The Mode setting (normal vs. special) is immaterial. Note that all of these characters are also available in Group 3.

<u>Hex Code Sequence</u>	<u>Character</u>	<u>Note no.</u>
1B 5B 30 74		1
1B 5B 31 74	◆	
1B 5B 32 74	⦿	9
1B 5B 33 74	HT	10
1B 5B 34 74	FF	10
1B 5B 35 74	CR	10
1B 5B 36 74	LF	10
1B 5B 37 74	•	11
1B 5B 38 74	±	11
1B 5B 39 74	NL	10
1B 5B 31 30 74	VT	10
1B 5B 31 31 74	↓	12
1B 5B 31 32 74	↵	12
1B 5B 31 33 74	↶	12
1B 5B 31 34 74	↷	12
1B 5B 31 35 74	+	12
1B 5B 31 36 74	—	13
1B 5B 31 37 74	—	13
1B 5B 31 38 74	—	12,13
1B 5B 31 39 74	—	13
1B 5B 32 30 74	—	13
1B 5B 32 31 74	┆	12
1B 5B 32 32 74	┆	12
1B 5B 32 33 74	┆	12
1B 5B 32 34 74	┆	12
1B 5B 32 35 74		12

## Notes on Particular Characters in the above 5 lists.

1. The "Space" Character.
2. "Close Quotation" mark or apostrophe.
3. "Minus" or "Dash".
4. Full stop (period). Note that there is a larger, centred dot at the end of group 3 which can be used as a decimal point.
5. Underline. This occupies the first 7 pixels in line 9 of the character matrix (see page 51-34). It can not be used to underline another character, the "Underline" character attribute is used in this case (see pages 51-49..51). The symbol is treated as a regular character by many programming languages so is often used in compound names such as FILE\_1.
6. "Open Quote".
7. The code 7F does not generate a displayable character. It is not a space. It is called the DEL character and its effect is program dependent.
8. The Danish alphabet includes these letters.
9. "Checkerboard" pattern, sometimes used as an error indicator.
10. These 6 symbols represent various cursor or printer control movements: horizontal tabulator, form feed, carriage return, line feed, new line, and vertical tab.
11. Mathematical symbols (degrees, plus or minus, less than or equal to, greater than or equal to, pi, not equal to, and decimal point.) Note that the decimal point (group 3, code 7E) differs from the full stop (groups 1 to 3, code 2E) in that the former appears at the centre of the character area, and is smaller (One pixel instead of four - see page 51-31 for a definition of "pixel").
12. Form-drawing graphics characters. These 11 characters are used to draw tables, forms and boxes. Any combination of horizontal and vertical lines may be drawn on the screen at a resolution of 25 lines by 80 columns. These characters are designed to form continuous lines when used in combination. Remember that "Block Cursor" must be set on the relevant DIL switch to ensure continuity of lines.
13. High-resolution graphics characters. These horizontal lines are on scan lines 1, 3, 5, 7 or 9 in the character matrix. The final one in the series, scan line 11, is obtained by setting the "Underline" attribute and displaying a space (then setting "Underline" off again). Their purpose is to increase the vertical resolution of the screen when drawing points on a graph.

By selecting the correct one of these, in the correct character position, a total of 144 (6 x 24) different distances from the bottom of the screen are selectable. If, say, a minus sign instead were used to mark points on a graph, then only 25 different positions in the vertical direction would be possible.

Unfortunately, if using the "Underline" for scan line 11, it is necessary to switch the DIL to "Underline" cursor, which precludes the drawing of continuous vertical lines with the form-drawing characters. Both areas of a graph could be drawn as dashed lines however by using the vertical line graphic and the minus sign.

14. This is the first of the series of horizontal and vertical bars or blocks of various thicknesses, for use, for example, when displaying histograms. (A histogram is a graph where a value is represented by the height of a filled-in rectangular column or block).

These bar graphics occupy the whole of the rectangle assigned to each character on the screen - that is 8 pixels (positions within that rectangular cell) wide by 13 pixels (scan lines) high. Each horizontal bar sits on the bottom of that 8 x 13 area, and the vertical bars start on the far left hand sides of those cells. In other words, the bar graphics have been designed so that when used in combination, continuous blocks may be drawn on the screen with no gaps at the boundaries of character cells.

"Block Cursor" must be set on the relevant DIL switch when using these characters.

The first of the series is a horizontal bar, 3 scan-lines thick.

15. 5 scan lines. See note 14 for details.
16. 7 scan lines. See note 14 for details.
17. 9 scan lines. See note 14 for details.
18. 11 scan lines. See note 14 for details.
19. The 13x8 character matrix completely filled in. See note 14 for details.
20. Vertical block 13x6 pixels. See note 14.
21. Half-a-matrix. 13x4 pixels. See note 14.
22. Column 2 pixels wide. See note 14.
23. These characters form the initials and logo (the latter in two halves) of our company - Christian Røvsing Aktie Selskab (Limited Company). The initials are bigger than the normal capital letters.

### 5.1.3.3 Obtaining your own "Personalized" Character Set

You may have a special need to display some symbols which are not available on the character sets described previously. CR will be happy to "tailor-make" the necessary PROM for you. Alternatively, if you have access both to a piece of equipment known as a PROM programmer, and to a human being who goes under the same name, then CR's charge for this service can be avoided. The rest of this section provides the necessary background information to perform this task.

#### The Character PROM

The character sets as described in section 5.1.3.2 are all coded into one chip, of type Intel 2732 (or equivalent). This is a Programmable Read-Only Memory of 4 Kbytes capacity.

PROMs of Intel types 2716 or 2732 or equivalents may be used. These are of capacities 2 or 4 Kbytes respectively. The 8 Kbyte 2764 chip could also be used but only 4 Kbytes of it would be accessible.

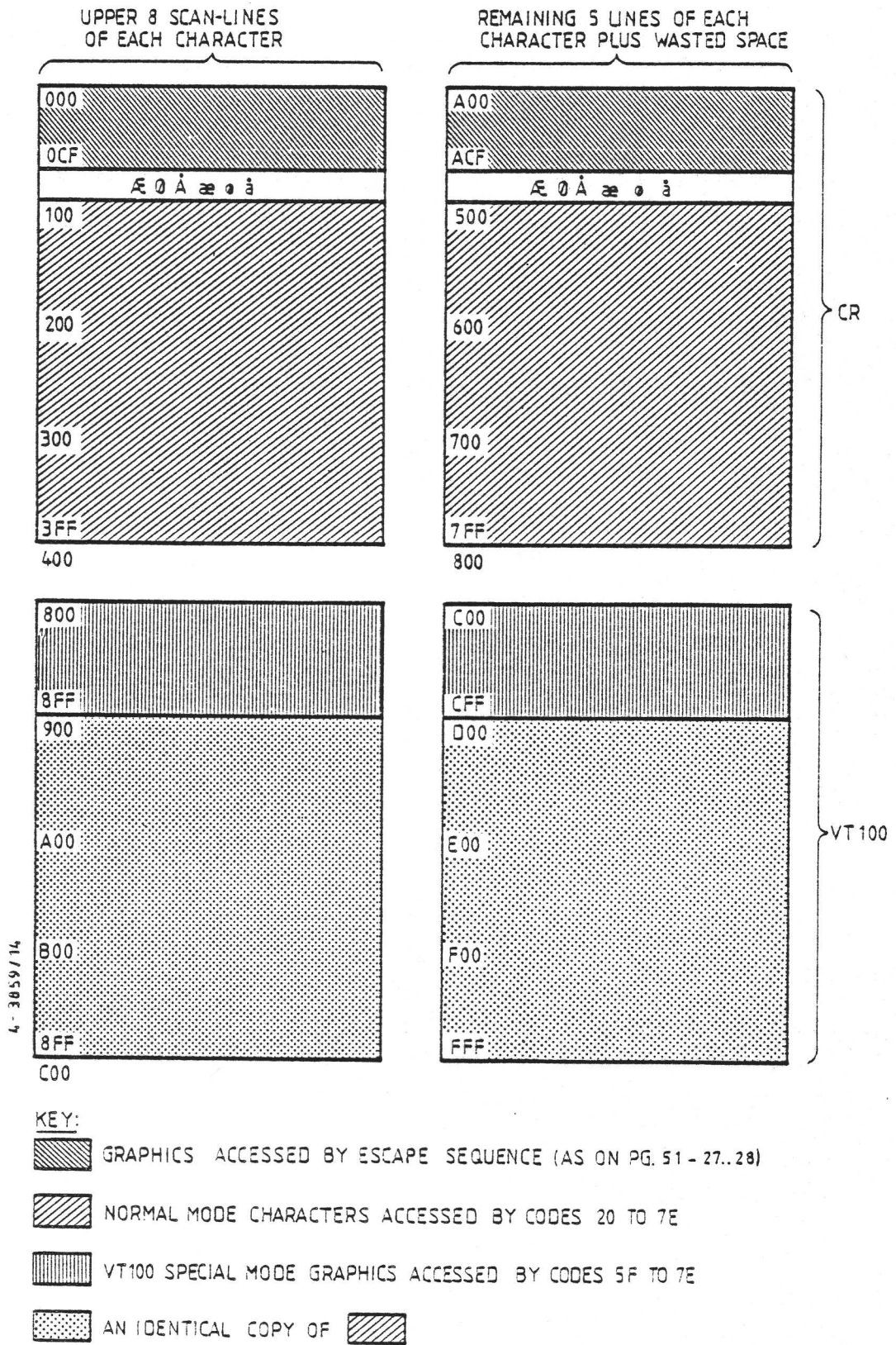
Access to a tailor-made PROM (to display the characters therein) is exactly as described in section 5.1.3.2. However the following additional information concerning the standard CR7 PROM will be required:

#### How a character is represented in the PROM

Characters on the screen of the CR7 are made up of a matrix or rectangular grid of tiny dots of light. Each dot is called a pixel and is represented in the character PROM memory as one bit: "0" means "background" (normally dark - unless Reverse Video is in operation), and "1" means "part of a character" (normally bright).

Each character in the PROM occupies 16 bytes. Each of these bytes represents 8 pixels within a scan line. The full character matrix is 8 pixels across by 13 down. Thus the last 3 bytes assigned to each character is wasted, but addressing is simplified.

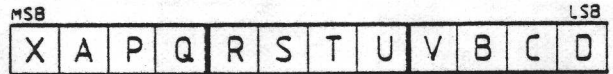




ADDRESS MAP FOR CHARACTER PROM SUPPLIED WITH CR7

For obscure technical reasons, each character is split into two sections; the lower part of each character (as it appears on the screen) is stored at an offset of 400 Hex from its upper part.

The 12-bit address of a byte in the standard 4 Kbyte PROM is divided up as follows:



4-3859-3

The most significant bit of the PROM address, labelled X above, defines which of the two main character sets is selected. 0 = CR, 1 = VT100.

The four bits ABCD are the scan line address within the character matrix. Line 0 is normally blank and is the top line of the matrix. Line 12 (i.e. when ABCD is 1100) is the bottom line.

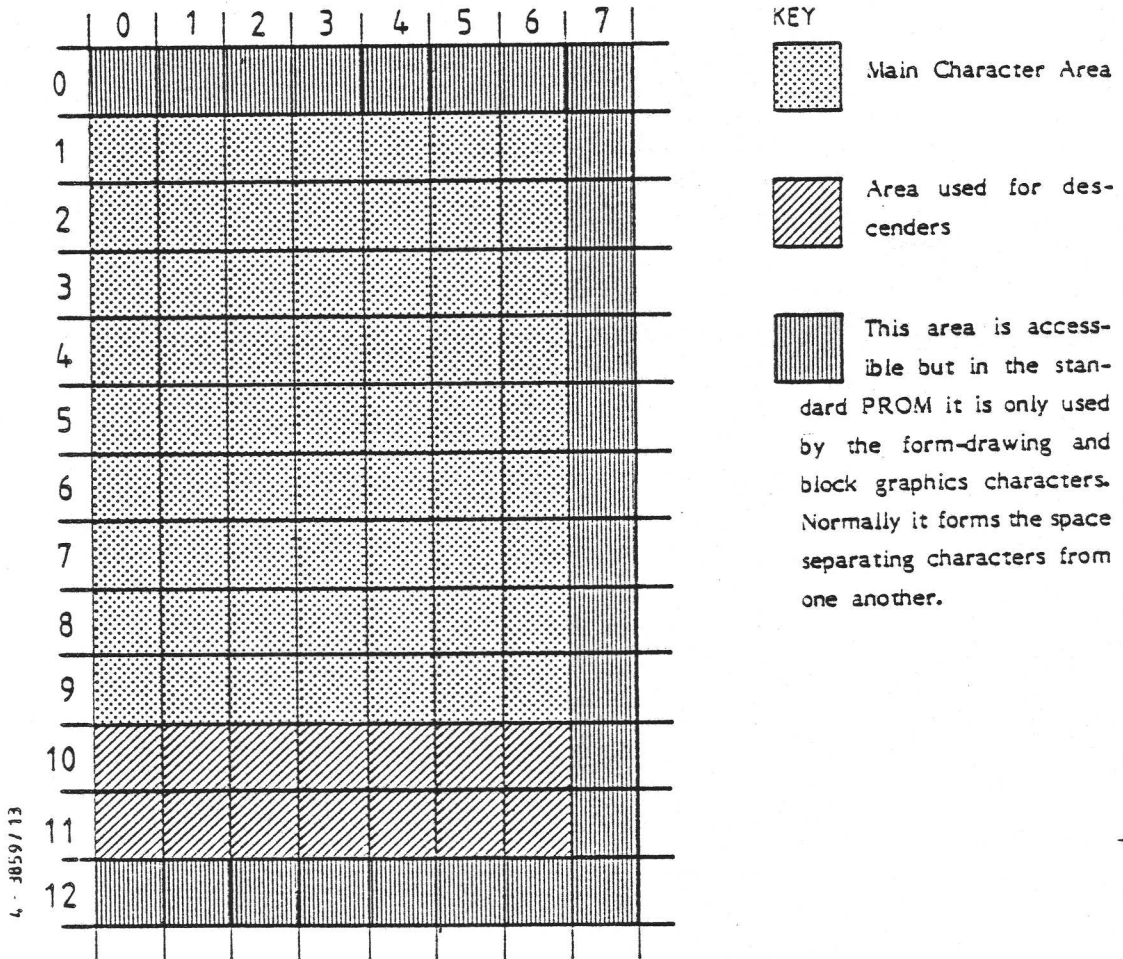
The seven bits PQRSTUV define which character this scan-line section is a part of. In most cases, these bits are the usual ASCII code for the character; the following table describes all cases:

<u>Bit X</u> <u>in PROM</u> <u>Address</u>	<u>Bits PQRSTUV</u> <u>in PROM</u> <u>Address</u>	<u>Characters addressed in standard PROM</u>
0	Hex 00 to 19	Those characters previously described as Group 4 (see page 51-27).
0	Hex 1A to 1F	Danish letters
0	Hex 20 to 7E	Standard ASCII characters 20 to 7E.
1	Hex 00 to 1F	Group 3 characters (special mode VT100 set) under the codes 5F to 7E inclusive. See page 51-26.
1	Hex 20 to 7E	Standard ASCII characters 20 to 7E.

**THE MEANING OF BITS 9 TO 3 IN THE PROM ADDRESS**



The dot matrix for a character is illustrated below:



**CHARACTER MATRIX**

The Underline-style cursor occupies all 8 pixels of scan-line 11, as does the "Underline" Character Attribute. The block cursor occupies the entire 8 x 13 pixel area.

The electron beam in the CRT scans from left to right along each scan line, note that the least significant bit of each PROM byte is displayed first as the scan goes across. This is why the number 4 has been drawn as a mirror image in the following illustration (so that the least significant bit appears in its normal place at the right on the diagram). This diagram gives an example of how a character on the screen is stored in the PROM.

SCAN LINE NUMBER

	7	6	5	4	3	2	1	0	← BIT NO. IN PROM DATA BYTE
0									
1									
2			█	█					
3			█		█				
4			█			█			
5			█				█		
6			█					█	
7		█	█	█	█	█	█	█	
8			█						
9			█						
10									
11									
12									

4-3859-1

AN EXAMPLE OF HOW A CHARACTER IS STORED IN PROM

From the information that has already been given, the reader may check for himself that the character "4" is stored in the standard PROM as defined over-leaf. Addresses and data are given in binary. Notice the mirror image of the "4" in the Data column of the table. The table describes the "4" in the VT100 set. Notice also the discontinuity in the address range halfway down the table.

<u>PROM address</u>	<u>Data Byte</u>
1001 1010 0000	00000000
1001 1010 0001	00100000
1001 1010 0010	00110000
1001 1010 0011	00101000
1001 1010 0100	00100100
1001 1010 0101	00100010
1001 1010 0110	00100001
1001 1010 0111	01111111
1101 1010 0000	00100000
1101 1010 0001	00100000
1101 1010 0010	00000000
1101 1010 0011	00000000
1101 1010 0100	00000000
1101 1010 0101	{ Wasted PROM area - never accessed }
1101 1010 0110	
1101 1010 0111	
1101 1010 0111	

**THE SAME EXAMPLE IN BINARY**

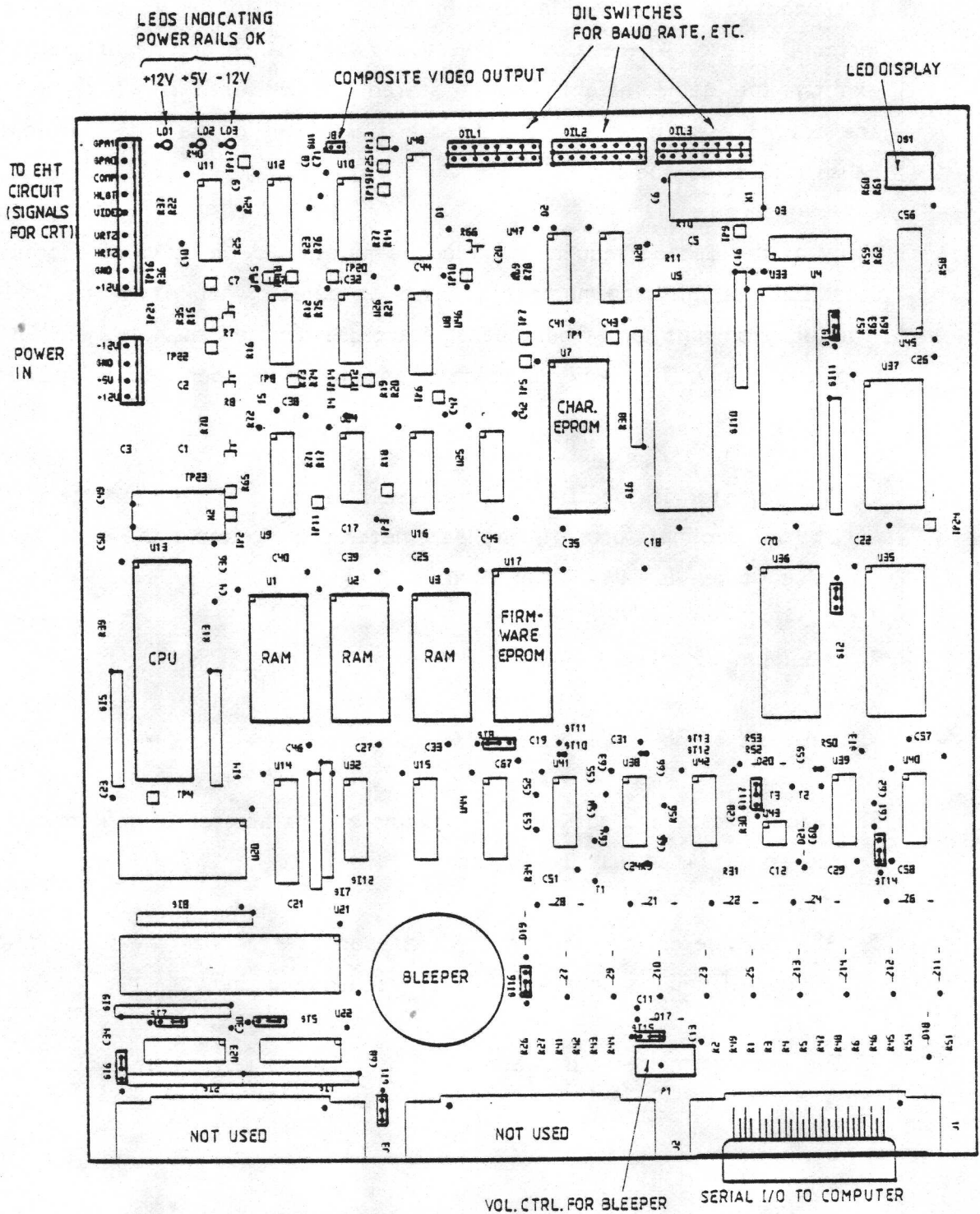
**How to gain physical access to the PROM**

1. Disconnect the CR7 from the mains.
2. Open the VDU cabinet as described on page 5-2.
3. Loosen the chassis securing bolts (no spanner required; see illustration on page 5-1).
4. Remove the entire rear panel (the panel in question is illustrated on page 51-4).
5. The edge of the video controller board may be seen behind where the panel was. Slide it slowly back, removing the EHT connector, then the power connector (power to Video controller board, that is, not power to CR7 which should have been removed at step 1).

The video controller board is illustrated below. Note that the top edge in the picture is the edge that you pull out.

- Finally the character PROM can be removed from the board. Take care not to bend the pins (legs). It is labelled CHAR. EPROM in the picture.

Installing a new PROM is the reverse of the above procedure.



VIDEO CONTROLLER BOARD

158C-3

#### 5.1.3.4 Note on Control and Escape Codes

Many functions of which the terminal is capable will not work when the relevant keys are pressed, this is because the operating system "filters out" some of them when it processes keyboard input. To use the functions, the correct code(s) must be passed to the video controller board via the user's program.

The codes are all given in Hex form, to avoid confusion between zeros and letter O's, etc. Where alternatives are given, either or any of them will have exactly the same effect (unless stated otherwise). All of the alternatives are not necessarily given, due to the flexibility in the way parameters may be specified (see below).

Many of the Escape sequences include a **parameter** i.e. a value supplied by the user (for example, the number of lines to delete when using the "delete lines from screen" function). These parameters are denoted as X, Y, etc. in the descriptions below. The way in which a parameter is specified is defined by the following rules:

1. A parameter is specified as the ASCII values for the characters that make up (the decimal form of) the parameter. For example the code to specify a value of ten is 31 30 (two Hexadecimal bytes).
2. Maximum of three ASCII values per parameter.
3. Minimum of no ASCII values per parameter.
4. Leading zeros are optional. For example a parameter of four can be expressed as 30 34 or just 34 (or, as 30 30 34).
5. Any parameter may be omitted (as per rule 3) but the default (assumed) value will depend upon the Escape sequence in hand.
6. The only permitted parameter separator is the semicolon (ASCII 3B).



### 5.1.3.5 Cursor Control

The CR7 supports full ANSI X3.64 standard cursor movements, addressing, and position reporting, plus some extra features.

The term "Active line" means "the line on which the cursor appears".

#### Move to first position in current line

Code: 0D

This code is generated on the keyboard by pressing ENTER (Numeric Mode only), or RETRN, or CTRL-M. Most operating systems will automatically add a LINE FEED (0A) when this code is received from the keyboard. The 0D code is conventionally (but not always) used in software to indicate the end of a line of user input at the keyboard.

#### Move one position down (same position across)

Code: 0A or 1B 44 or 1B 5B 42 or 1B 5B 30 42 or 1B 5B 31 42

This function, commonly known as Line Feed, is generated by the key of that name or by various Escape sequences. CP/M automatically adds a RETRN (0D) when this is received from the keyboard.

If the cursor is already at the bottom of the scrolling region (see pages 51-44a..44c) when 0A or 1B 44 is received, then the cursor will not move but the region will scroll up by one line, leaving the cursor on an empty line. However, if one of the other Escape sequences mentioned above were used instead, then nothing at all would happen, apart from a "bleep" being produced.

#### Move one position to the left

Code: 08 or 1B 5B 44 or 1B 5B 30 44 or 1B 5B 31 44

This is issued by BACKSPACE or CTRL-H or various Escape sequences specified

above. If the cursor is already in the leftmost screen position, nothing happens, apart from a "bleep".

**Move one line up (same position across)**

Code: 1B 4D or 1B 49 or 1B 5B 41 or 1B 5B 30 41 or 1B 5B 31 41

This function is generated by various Escape sequences. If the cursor already is at the top of the scrolling region (see pages 51-44a..44c) when 1B 4D or 1B 49 is received, then the cursor will not move but the region will scroll down by one line, leaving the cursor on an empty line. However, if one of the other Escape sequences mentioned above were used instead, then nothing at all would happen (apart from a "bleep" sound being generated).

**Move one position to the right**

Code: 1B 5B 43 or 1B 5B 30 43 or 1B 5B 31 43

All the Escape sequences above have an identical effect. If the cursor is already at the far right (column 80), then nothing happens apart from a "bleep". The cursor will automatically move one position to the right after displaying any character; thus by pressing the space bar the apparent effect will be merely to move the cursor one position to the right. However, what it is really doing is writing a blank character then moving to the right. Any character already on the screen in that position will disappear, having been replaced by the blank.

**Move one or more positions down**

Code: General case: 1B 5B X 42  
Examples: 1B 5B 32 42  
          1B 5B 32 30 42

Default value of parameter: 1 line.

The "X" above means that the user must insert the ASCII code(s) for the decimal

number of positions to be moved down. The examples above are for two lines and twenty lines down, respectively.

If the command specifies a movement to somewhere beyond the current scrolling region, then the cursor will just move to the bottom of the region, and a "bleep" will be heard.

**Move one or more positions to the left**

Code: General case: 1B 5B X 44

Examples: 1B 5B 32 44

1B 5B 32 30 44

Default value of parameter: 1 column.

The "X" above means that the user must insert the ASCII code(s) for the decimal number of positions to be moved left. The examples above are for two positions and twenty positions to the left, respectively.

If the command specifies a movement to somewhere beyond the screen then the cursor will just move to the first column, and a bleep will be heard.

**Move one or more positions up**

Code: General case: 1B 5B X 41

Examples: 1B 5B 32 41

1B 5B 32 30 41

Default value of parameter: 1 line

The "X" above means that the user must insert the ASCII code(s) for the decimal number of positions to be moved up. The examples above are for two lines and twenty lines up, respectively.

If the command specifies a movement to somewhere beyond the current scrolling region, then the cursor will just move to the top of the region, and a bleep will be heard.

**Move one or more positions to the right**

Code: General case: 1B 5B X 43

Examples: 1B 5B 32 43

1B 5B 32 30 43

Default value of parameter: 1 column.

The "X" above means that the user must insert the ASCII code(s) for the decimal number of positions to be moved right. The examples above are for two and twenty positions to the right, respectively.

If the command specifies a movement to somewhere beyond the screen then the cursor will just move to position 80 (i.e. rightmost column.), and a "bleep" will be heard.

**Move to top-left position in current partition or scrolling region**

Code: 1B 5B 48 or 1B 5B 3B 48 or 1B 5B 30 3B 30 48 or 1B 5B 31 3B 31 48

Any of the above sequences will send the cursor to the so called "Home" position.

If "Origin Mode" (see pages 51-44a..44c) is set, the cursor will move to the top left position in the Scrolling Region; if not, it will go to the top left position of the current Partition.

**Move one Tab position to the right**

Code: 09

Receipt of CTRL-I or TAB from the keyboard or Hex 09 from a program will send the cursor to the next horizontal tabulation position (except when the cursor is already in column 73, in which case the cursor will not move but a bleep will be heard). All this applies even if the cursor is already on a tab position. The tab positions are at column numbers 9, 17, 25, 33, 41, 49, 57, 65 and 73. There is no provision for altering the tab positions themselves.

**Move to the beginning of the next line**

Code: 1B 45

The cursor moves to column 1 of the next line down in the current partition. If it is already at the bottom, the partition scrolls up one line and the cursor sits in column 1 of a new blank line at the bottom of the partition.

The same effect could of course be achieved by combining the "Move to first position in current line" and "Move one position down" commands, for instance by pressing RETRN (which normally generates Line Feed as well as Return).

**Move to requested co-ordinates**

Code: In general: 1B 5B X 3B Y 48 or 1B 5B X 3B Y 66

Examples: 1B 5B 34 3B 37 30 48

1B 5B 35 48

Default values for parameters: 1 and 1.

The cursor is moved to the specified position within the current partition or scrolling region if that position exists. If it doesn't, it moves as far as it can go towards the specified co-ordinates and a bleep is heard. Note that line numbers are counted from the top of the Partition or Scrolling Region, neither of which is necessarily the top of the screen. For further details, see pages 51-44a..44c and 51-47..49.

The parameters X and Y are line number and column number, respectively. They are the ASCII codes for the decimal digit or digits that form the line or column number.

The first example above is a request to send the cursor to line 4, column 70.

The second example shows a special short form of the command where the parameter separator 3B is omitted, along with the second parameter. In such cases, the column number is set to the default value of 1; this example therefore is a command to send the cursor to line 5 column 1.



### Move to previously saved position

Code: 1B 38

This moves the cursor to where it was, the last time a "save position" was done (see below). This command also restores the Character Attributes to their settings when the "save position" was most recently done.

Note that this command will not work if either of the following things has been done since the "save position" was last done (since they erase the the memory areas where the cursor position etc. are stored):

1. Switching off
2. Issuing a Reset escape sequence (namely 1B 63)

### Save Position

Code: 1B 37

This stores the cursor co-ordinates in memory, for subsequent use by the 1B 38 command described above.

This command also stores the current settings of the character attributes.

### Report on Current Position

Code (program to terminal): 1B 5B 36 6E

Code (reply): In general: 1B 5B X 3B Y 52

Code (reply): Examples: 1B 5B 31 30 3B 37 36 52

1B 5B 30 32 3B 30 36 52

0 2 ; 0 6 R

The current cursor position relative to the start of the current partition is returned to the user. In the first example above, the cursor was at line 10 column 76 (decimal values) in the current partition. The second example shows line 2, column 6.

The line and column values are always returned as two-digit numbers (the first of which can be ASCII for zero, as in the second example above).

The returned escape sequence giving the cursor position is accessed by the programmer exactly as though he or she were reading characters in from the keyboard that were being typed in by a user.

In accordance with ANSI X3.64, if 8-bit data has been set on the DIL switches, then the reply sequence would start with hex 9B instead of 1B 5B.

#### Switch Cursor Off

Code: 1B 5B 31 76

Cursor disappears. This function only works on CR7s delivered after early November '83.

#### Switch Cursor On

Code: 1B 5B 30 76

Cursor reappears. This function only works on CR7s delivered after early November '83.

#### 5.1.3.4a Scrolling Region

The following 3 related functions are implemented in CR7s delivered after early November 1983.

The term "Scrolling" is explained on page 51-48.

The "Define Scrolling Region" function is used to restrict scrolling to a limited area of the screen. Note that Partitioning (pages 51-47..49) also does this; the Scrolling Region can be thought of as a "Sub-Partition", effecting some but not all of the cursor movements and screen editing functions. The Scrolling Region must lie within the current Partition.

The cursor can only be moved out of the Scrolling Region by issuing an appropriate absolute cursor movement command (either "Cursor to Home" or "Cursor

to requested co-ordinates" or "Restore cursor"). Furthermore, Origin Mode must be switched off for these to be effective outside the scrolling region. Cursor movements that are specified relative to its current position, such as "Move one or more positions up" will not allow the cursor to leave the scrolling region, irrespective of whether Origin Mode is On or Off.

The same restrictions apply to the screen editing commands; in other words, the only ones that can cross scrolling region boundaries are those to delete the top, bottom, or whole of the Partition. Origin Mode has no effects on screen editing.

Note that the scrolling region can be thought of as a "trap" for the cursor; if the cursor is outside the region and wanders in as a result of any of the cursor movement commands, then the only way it can get out is via one of the absolute movements mentioned above.

### Define Scrolling Region

Code: In general: 1B 5B X 3B Y 72

Example: 1B 5B 33 3B 31 37 72

Default values of parameters: The Scrolling Region becomes the whole of the current Partition.

The first parameter defines which line number within the current Partition is to be the top of the scrolling region. The second defines the bottom line of the scrolling region. The parameters are the ASCII values for the required decimal line numbers. The scrolling region must contain at least 2 lines (i.e. X must be less than Y).

In the example above, the scrolling region is set to lines 3 to 17 inclusive (relative to the top of the current Partition - the top line being no. 1).

This command also moves the cursor to the "Home" position. "Home" is the top-left corner of either the current Partition or the just-created scrolling region, depending on the setting of Origin mode (see below).

### Switch On Origin Mode

Code: 1B 5B 36 68 or 1B 5B 3F 36 68

This command sets the origin of screen co-ordinates to the top of the Scrolling Region. This means that it changes the action of the following two commands and no others:

Move cursor to Home

Move cursor to specified co-ordinates

If either of these is used subsequently, the specified cursor positions will be relative to the top line of the Scrolling Region as defined by the command outlined on page 51-44a.

The command also sends the cursor to the top left position in the Scrolling Region (the new "Home" position).

### Switch Off Origin Mode

Code: 1B 5B 36 6C or 1B 5B 3F 36 6C

This command sets the origin of screen co-ordinates to the top of the current Partition. This means that it changes the action of the following two commands and no others:

Move cursor to Home

Move cursor to specified co-ordinates

If either of these is used subsequently, the specified cursor positions will be relative to the top line of the current Partition. Partitioning is discussed on pages 51-47..49.

The command also sends the cursor to the top left position in the current Partition (the new "Home" position).

### 5.1.3.5 Screen Editing

Various functions are available for erasing characters from the screen or moving characters down to make room for new characters.

These functions work on the current Partition only, which is not necessarily the whole screen (see pages 51-47..49). Furthermore, if a Scrolling Region (see pages 51-44a..44b) has been set up, then most of these screen editing functions cannot cross out of (or, exceptionally, into) the scrolling region. The only exceptions to this are the 3 commands Delete top, bottom, and whole of Partition. These 3 delete the requested lines wherever they lie with respect to the Scrolling region.

None of these commands (in section 5.1.3.5) will affect the cursor position.

#### Delete right hand part of line and leave a gap

Code: 1B 5B 4B or 1B 5B 30 4B

All characters in the active line to the right of the cursor are removed. The character under the cursor is also removed. The cursor does not move. Nothing moves into the blank area thus created.

#### Delete left hand part of line and leave a gap

Code: 1B 5B 31 4B

All characters in the active line to the left of, and at the cursor position are removed. The cursor does not move. Nothing moves into the blank area thus created.

#### Delete line and leave a gap

Code: 1B 5B 32 4B

The active line is replaced by a blank line.



**Delete line and leave no gap**

Code: 1B 5B 4D or 1B 5B 30 4D or 1B 5B 31 4D

The active line disappears. The remaining lines in the partition or scrolling region are moved up, leaving one empty line at the bottom.

**Delete several lines and leave no gap**

Code: In general: 1B 5B X 4D

Example: 1B 5B 35 4D

Default value of parameter: 1 line.

A number of lines, including and going down from the active line, are deleted. The remaining lines (if any) in the current partition or scrolling region are moved up to the top of the space thus created. Empty lines are added at the bottom to replace those removed. In the example above, 5 lines are deleted (the parameter value 35 being ASCII for 5).

**Delete top part of partition (and leave a gap)**

Code: 1B 5B 31 4A

All lines in the partition above the active line, plus all characters in the active line from column 1 up to and including the cursor position, are deleted. The area remains blank; nothing moves into it.

**Delete bottom part of partition (and leave a gap)**

Code: 1B 5B 4A or 1B 5B 30 4A

All lines in the partition below the active line, plus all characters in the active line to the right of the cursor, plus the character at the cursor are deleted. The area remains blank; nothing moves into it.

**Delete whole of partition**

Code: 1B 5B 32 4A

This is used at the beginning of a program to clear the previous program's junk off the screen. Cursor does not move.

**Insert one blank line**

Code: 1B 5B 4C or 1B 5B 30 4C or 1B 5B 31 4C

The active line and the following lines in the scrolling region or partition scroll down by one position (the bottom line disappears). The effect of this command is independent of the cursor's position within a line.

**Insert several blank lines**

Code: In general: 1B 5B X 4C  
Example: 1B 5B 31 36 4C

Default value of parameter: 1 line.

The active line and the following lines in the partition or Region scroll down by the requested number of positions. The same number of lines disappear. The effect of this command is independent of the cursor's position within a line.

**5.1.3.7 Screen Partitions**

The CR7 VDU has a "split-screen" capability, that is, the screen is divided into two sections, one above the other. These sections are called Partitions. All cursor movement and screen editing commands work on only one partition at a time - in fact the only commands that affect both partitions are the partitioning commands themselves, described in this section, and the Reset command (described on page 51-54).

The two partitions are called 0 and 1. Partition 0 is the upper one. By default

(i.e. at power-on), partition 0 is set to comprise all of the screen except the bottom line (no. 25). Thus one can normally ignore the partitions altogether, assume the screen has only 24 lines, and substitute the word "screen" for the word "current partition" in the descriptions of the various screen editing and cursor movement commands.

Note that scrolling, i.e. the moving upwards of text to make room for a new line, takes place within a partition rather than the screen as a whole. Thus it is possible, for example, just for the top half of the screen to scroll, while the bottom half remains steady. See also Scrolling Region, pages 51-44a..44c.

The commands to define where the screen is partitioned, and to select one or other of the partitions, are described below.

#### Define where the Screen is to be Partitioned

Code: In general: 1B 5B X 70  
Example: 1B 5B 31 30 70

Default value of parameter: 26

The parameter X is, as always, expressed as the ASCII values for the number in decimal. In this case the number referred to is that of the first line of the bottom partition. Thus in the example above, the parameter 31 30 means 10 (decimal). That is, partition 0 is to be the top 9 lines, and partition 1 is screen lines 10 to 25 inclusive.

There is one exception. If the parameter is omitted, then this means that the whole screen is to be partition 0. In other words, the parameter is interpreted as being 26 - the first line of partition 1 is the first line off the bottom of the screen.

Furthermore, a parameter of 1 or less is not permitted, since partition 0 must always contain at least one line (though partition 1 can be set to contain no lines, as described above).

So, to summarize, X can take any value between 2 and 25 inclusive, or may be omitted.

The following additional things happen when this command is used:

1. The screen is cleared
2. Partition 0 is selected
3. Cursor is moved "home" (line 1 column 1)
4. The character attributes and "Cursor position" values remain as they were before.

#### Select Partition 0

Code: 1B 5B 30 73 or 1B 5B 73

This means "until further notice, all commands (except Reset) refer to the upper screen partition".

The cursor will go to its final position of the last time partition 0 was in use (unless the terminal has been reset in the meantime). Character attributes are not restored.

#### Select Partition 1

Code: 1B 5B 31 73

This means "until further notice, all commands (except Reset) refer to the lower screen partition". The cursor will go to its final position of the last time partition 1 was in use (unless the terminal has been reset in the meantime). Character attributes are not restored.

If partition 1 contains no lines, then this command has no effect.

#### 5.1.3.8 Character Attributes

The CR7 supports four different ways of making selected characters stand out on the screen. These are known as Attributes, and they are: Reverse Video, Underlining, Highlight and Blink.

Reverse (or inverse) Video is where a character is displayed as dark writing on a light background instead of the normal light writing against a dark screen.

Underlined characters are drawn with a line underneath. The underline fills the whole of scan line 11 in the character matrix. See page 51-34.

The "Blink" attribute means that the affected characters appear and disappear (together) approximately 3 times every 2 seconds.

Characters having the "Highlight" attribute are displayed brighter than other characters. This attribute is a new feature added to CR7s delivered after early November '83.

The four attributes should be considered as four independent switches that are switched on or off by software. If one is switched on, then all characters that are sent to the screen thereafter are displayed in that mode until the attribute is switched off. The characters remain with the attribute but subsequently displayed characters will not have the attribute.

Due to hardware limitations, the Underline attribute is not available when Block-style cursor is set on the relevant DIL switch. In this case, a request for Underlining will be transformed by firmware to one for Blink instead.

The following commands describe how to change the attributes.

#### Set/Reset Attributes

Code: In general: 1B 5B W 3B X 3B Y 3B Z 6D  
or 1B 5B X 3B Y 3B Z 6D  
1B 5B X 3B Y 6D or 1B 5B X 6D

Examples: 1B 5B 30 6D or 1B 5B 6D  
1B 5B 35 3B 31 6D

Default values of parameters: 0 if all parameters omitted. Otherwise no default.

This command will set all the attributes specified, and reset (i.e. switch off) all the others.



The possible parameter values (in decimal form) to which the CR7 will respond are given below:

<u>Parameter</u>	<u>Attribute</u>
0	None, i.e. all attributes switched off
1	Highlight
4	Underline (or Blink it using block cursor)
5	Blink
7	Reverse video

The first two examples above both specify "switch all attributes off" i.e. set normal-style text. The third example specifies "switch on blinking and reverse video, and switch off underlining (if it was on)".

#### Save and Restore Character Attributes

The character attributes are saved and restored by the "Save & Restore cursor position" commands, outlined on pages 51-43..44.

#### 5.1.3.9 Application Mode

A glance at the illustration of the keyboard on page 3-5 will soon show you that most of the keys on the numeric keypad duplicate keys on the main keyboard. This redundancy has been put to good use in the design of the CR7. It is possible to switch the keyboard into an alternative mode of operation, wherein these redundant keys generate different codes from normal. These different codes can be "fielded" by an application program and used for special purposes. A commonly seen example is where a word processing program uses these buttons as text-handling commands instead of text input keys (since the digits 0 to 9 etc. may still be input from the main keyboard). This special mode of operation is known as Application Mode, and is called up by means of an Escape sequence.

The normal mode (non-application mode) which is in action when the CR7 is switched on, is called Numeric Mode. In this mode the numeric keys generate codes for the numbers, minus, comma, etc as printed on them. This mode is more

convenient for the rapid entry of lots of figures since the number keys are close together.

The actual Hex codes generated in the two modes are shown on pages 51-16..18. Notice that the buttons marked PF1, PF2, PF3 and PF4 do not change their output from one mode the the other, but all the other keys on the numeric pad do.

The commands to switch mode are given below.

#### **Enter Application Mode**

Code: 1B 3D

After sending this sequence, Application Mode will remain in operation until a "Reset to Numeric Mode" command is received, or the CR7 is switched off.

#### **Reset to Numeric Mode**

Code: 1B 3E

This will return the numeric keypad to its default mode of operation.

#### **5.1.3.10 Keyboard LEDs**

The 111-key keyboard illustrated on page 3-5 has a long row of LEDs between the main keyboard and the functions keys F1 to F19. These LEDs were discussed on pages 51-3..4.

#### **Switch Off LEDs**

Code: 1B 5B 71 or 1B 5B 30 71

All four programmable lights are switched off by this command. (To switch one or some of them off, they must all be switched off first, then the desired ones switched on again.)

### Switch On LED

Code: In general: 1B 5B X 71

Example: 1B 5B 32 71

Default value of parameter: 0 (switch off all LEDs)

A single LED is switched on by this command. Parameters in the range 1 to 4 are acceptable. In the example above, LED 2 is switched on.

#### 5.1.3.11 Transmission On/Off

It is possible to break or re-start the communication between the terminal (video controller board) and the processor board by sending certain control characters to the processor board. What this means is that the scrolling of text up the screen can be temporarily stopped while you get a chance to read it. Communication in both directions is affected, so if you turn transmission off, the keyboard is rendered "dead", until you type the one command that will start it again.

#### Transmission Off

Code: 13

Press S while holding down CTRL to generate this code. This will stop scrolling. The same effect can be obtained by pressing NO SCRL (or Scroll Lock), though no code is generated - this only applies to CR7s delivered after Nov. '83.

#### Transmission On

Code: 11

Press Q while holding down CTRL to generate this code. Scrolling will be resumed if there is still text waiting to be sent to the screen. The same effect can be obtained by pressing NO SCRL (or Scroll Lock) again, though no code is generated - this only applies to CR7s delivered after Nov. '83.

### 5.1.3.12 Various Noises

#### Bleep

Code: 07

This code, when received from a program will cause a short "bleep" sound to be generated by the terminal. It can be used as a warning in the event of program error.

It is also produced when an attempt is made to move the cursor off the current partition.

#### Click

All keys with the exceptions of CTRL, CAPS LOCK, and SHIFT causes an audible "click" to be generated when they are pressed. This is to confirm to the user that a code has been generated by the key. (the 3 exceptions do not click because they generate no codes by themselves - they only modify the outputs of other keys).

### 5.1.3.13 Terminal Reset

Code: 1B 63

The receipt of this escape sequence by the CR7 terminal resets it exactly as though it had been switched off and on again. This is not to be confused with an operating system reset or "boot". Terminal reset has no effect on the operating system.

The programmer should program a pause of a second or so after doing a terminal reset since the terminal will not react properly until it has completed its reset procedure.

The following things take place on receipt of the Terminal Reset:

1. Partition 0 is set to lines 1 to 24, partition 1 is line 25.
2. Partition 0 is selected as the current one.
3. Cursor goes to "home" position.
4. Character attributes are switched off - i.e. no blink, no underlining, no reverse video.
5. Screen is cleared.
6. "Save cursor position" locations are cleared.
7. All DIL switches are read. This implies that the G0 and G1 character sets are defined as those specified on the switches (not as may have been specified by Escape sequences).
8. G0 character set is selected.
9. The input and output buffers of the interface to the processor board are cleared.
10. Numeric Mode is selected (i.e. Numeric keypad goes out of Application Mode).

#### 5.1.3.14 SUMMARY of all codes that the CR7 terminal will respond to

The list below includes at least one code or code sequence for every command that the CR7 will respond to.

In many cases, several code sequences will produce identical effects on the terminal. In such cases, only the shortest code is listed here.

Where a part of the given code is variable (e.g. a parameter), it is listed after fixed bytes in the sequence as XX.

Remember that the terminal will not necessarily respond to all of these if they are typed in on the keyboard; they must be received from a program (or the keyboard must be short-circuited directly to the video controller instead of going through the processor board).

Note that Transmission QN and Off are not in the list because they are both sent by the terminal to the processor.



<u>Code in Hex</u>	<u>Code in Characters</u>	<u>Effect</u>	<u>Page No.</u>
1B 3D	ESC =	Application Mode, enter	51-52
1B 3E	ESC >	Application Mode, exit from	51-52
1B 5B 6D	ESC [ m	Attributes (Character), reset	51-50
1B 5B XX 6D	ESC [ P1 m	Attribute (Character), set one	51-50
1B 5B XX 3B XX 6D	ESC [ P1 ; P2 m	Attributes (Character), set two	51-50
		- etc. -	
1B 5B 35 6D	ESC [ 5 m	Attribute, set "Blink"	51-50
1B 5B 31 6D	ESC [ 1 m	Attribute, set "Highlight"	51-50
1B 5B 37 6D	ESC [ 7 m	Attribute, set "Reverse Video"	51-50
1B 5B 34 6D	ESC [ 4 m	Attribute, set "Underline"	51-50
07	CTRL-G	Bleep	51-54
08	CTRL-H	Cursor Backspace	51-39
1B 5B XX 42	ESC [ P1 B	Cursor down	51-40
1B 5B XX 44	ESC [ P1 D	Cursor left	51-41
1B 5B 44	ESC [ D	Cursor one column left	51-39
1B 5B 43	ESC [ C	Cursor one column right	51-40
1B 5B 42	ESC [ B	Cursor one line down if poss.	51-39
0A	CTRL-J or LINEFEED	Cursor one line down or scroll	51-39
1B 5B 41	ESC [ A	Cursor one line up if possible	51-40
1B 4D	ESC M	Cursor one line up or scroll	51-40
1B 5B 36 6E	ESC [ 6 n	Cursor position request	51-44
1B 5B 30 76	ESC [ 0 v	Cursor reappear	51-44a
1B 5B XX 43	ESC [ P1 C	Cursor right	51-42
09	CTRL-I	Cursor Tabulator (horizontal)	51-42
0D	CTRL-M or RETRN	Cursor to beginning of current line	51-39
1B 5B 48	ESC [ H	Cursor to "Home"	51-42
1B 5B XX 3B XX 48	ESC [ P1 ; P2 H	Cursor to specified position	51-43
1B 45	ESC E	Cursor to start of next line	51-43
1B 5B XX 41	ESC [ P1 A	Cursor up	51-41
1B 5B 31 76	ESC [ 1 v	Cursor vanish	51-44a

<u>Code in Hex</u>	<u>Code in Characters</u>	<u>Effect</u>	<u>Page No.</u>
1B 5B 4D	ESC [ M	Delete line	51-46
1B 5B XX 4D	ESC [ P1 M	Delete line(s)	51-46
1B 5B 31 4B	ESC [ 1 K	Delete line-segment to left of cursor	51-45
1B 5B 4B	ESC [ K	Delete line-segment to right of cursor	51-45
1B 5B 32 4A	ESC [ 2 J	Delete Partition	51-47
1B 5B 4A	ESC [ J	Delete Partition, bottom of	51-46
1B 5B 31 4A	ESC [ 1 J	Delete Partition, top of	51-46
1B 5B XX 74	ESC [ P1 t	Display a graphics character	51-27
XX (one byte)	Various between "Space" and ~	Display a specific character	51-23
0F	CTRL-O	G0 characters, select	51-20
1B 29 41	ESC ( A	G0 set to Normal	51-20
1B 29 30	ESC ( 0	G0 set to Special	51-20
0E	CTRL-N	G1 characters, select	51-20
1B 28 41	ESC ) A	G1 set to Normal	51-20
1B 28 30	ESC ) 0	G1 set to Special	51-20
1B 5B 4C	ESC [ L	Insert blank line	51-47
1B 5B XX 4C	ESC [ P1 L	Insert blank line(s)	51-47
1B 5B 71	ESC [ q	Keyboard LEDs off	51-52
1B 5B XX 71	ESC [ P1 q	Keyboard LED on	51-53
1B 5B 36 6C	ESC [ 6 l	Origin Mode off	51-44c
1B 5B 36 68	ESC [ 6 h	Origin Mode on	51-44c
1B 5B 73	ESC [ s	Partition 0, select	51-49
1B 5B 31 73	ESC [ 1 s	Partition 1, select	51-49
1B 5B XX 70	ESC [ P1 p	Partition screen	51-48
1B 5B 70	ESC [ p	Partition screen: all lines in Partition 0	51-48
1B 5B 32 4B	ESC [ 2 K	Replace line with blank line	51-45
1B 63	ESC c	Reset terminal	51-54
1B 38	ESC 8	Restore cursor and Attributes	51-44
1B 37	ESC 7	Save cursor and Attributes	51-44
1B 5B XX 3B XX 72	ESC [ P1 ; P2 r	Scrolling Region, define	51-44b
9B XX	ESC P1	same as 1B 5B XX	

5.1.3.15 SUMMARY of all codes generated by the CR7 terminal

The reader is referred to the tables on pages 51-14..19 which list all the codes generated by the pressing of keys. Note that these include some Escape sequences. In addition, there is one type of code sequence that is generated without any key being pressed, namely:

<u>Code in Hex</u>	<u>Code in Characters</u>	<u>Effect</u>	<u>Page No.</u>
1B 5B XX 3B XX 52			
or			
9B XX 3B XX 52	ESC P1 ; P2 R	Cursor position report	51-44

5.1.3.16 ASCII Codes

The following table is given for reference purposes only. It gives the standard symbols, which are not always those generated on the CR7's screen on receipt of the stated codes. See section 5.1.3.2 for details.

		M.S. 3 BITS								
Hex		0	1	2	3	4	5	6	7	
	Bin	000	001	010	011	100	101	110	111	
0	0000	NUL	DLE		0	@	P	'	p	
1	0001	SOH	DC1	!	1	A	Q	a	q	
2	0010	STX	DC2	"	2	B	R	b	r	
3	0011	ETX	DC3	#	3	C	S	c	s	
4	0100	EOT	DC4	\$	4	D	T	d	t	
5	0101	ENQ	NAK	%	5	E	U	e	u	
L.S. 4 BITS	6	0110	ACK	SYN	&	6	F	V	f	v
	7	0111	BEL	ETB	'	7	G	W	g	w
	8	1000	BS	CAN	(	8	H	X	h	x
	9	1001	HT	EM	)	9	I	Y	i	y
	A	1010	LF	SUB	*	:	J	Z	j	z
	B	1011	VT	ESC	+	;	K	[	k	{
	C	1100	FF	FS	,	<	L	\	l	
	D	1101	CR	GS	-	=	M	]	m	}
	E	1110	SO	RS	.	>	N	↑	n	~
	F	1111	SI	US	/	?	O	←	o	DEL

The codes specified above as mnemonics (NUL, SOH, etc.) are mentioned in the List of Abbreviations (section 6). They are mostly special codes used for controlling and synchronizing communications between computers and/or peripherals.







## 5.2 PROCESSOR BOARD

A brief outline of the features of the Processor Board in the CR7 was given on page 2-2. This section (5.2) describes how these features are implemented.

### 5.2.1 Overview of Structure & Function

The Processor Board is the central part of the CR7 computer system. Its position within the overall system is illustrated on page 2-1 (where it is labelled "CPU board").

The description is based on the block diagram, shown overleaf. It is assumed that the reader is familiar with the operation of the standard circuits mentioned such as the PIT, DMA, etc.; only exceptional usages are mentioned.

The physical layout of the components is shown on page 52-24.

#### CPU

The CPU is a Z80A 4MHz processor with 8 data lines and 16 address lines. The NMI function is not used.

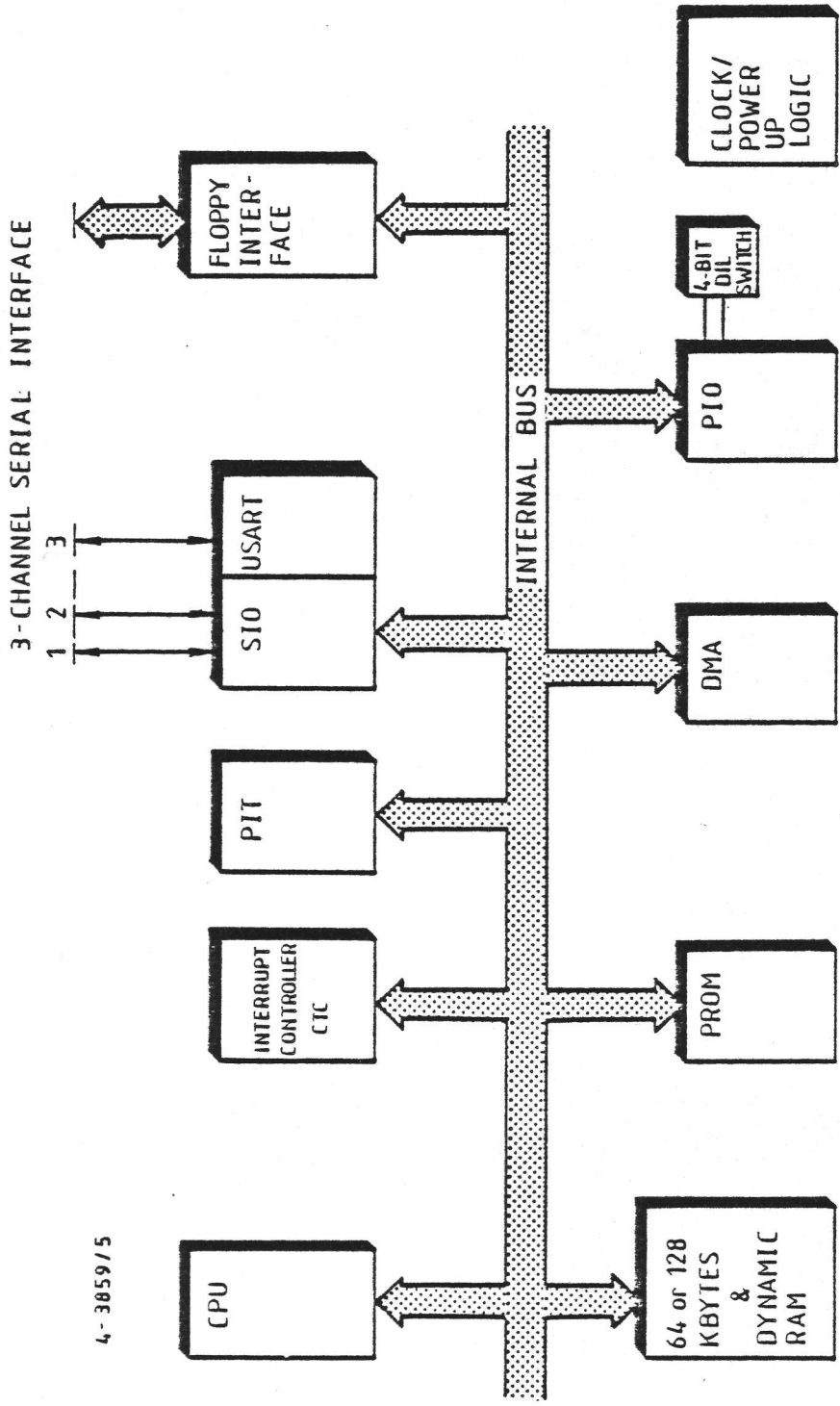
The DMA controller can request the CPU for use of the internal bus.

#### Serial Interface

The processor board provides three serial I/O channels. Two of them are controlled by an Intel Z80 SIO chip, the third by an 8251A chip.

The Z80 SIO can be used polled, used with interrupts, or with DMA channels (one for each SIO channel)

The 8251A USART chip cannot be accessed via DMA, but there is an interrupt (RX ready) output to channel 3 of the CTC interrupt controller.



PROCESSOR BOARD - BLOCK DIAGRAM

The three serial V24 interfaces have the following properties:

1. Channel A from the Z80 SIO is an extended DTE line interface to be used for communications devices such as the XTA board or other peripherals.
2. Channel <sup>C</sup>B from the Z80 SIO is a limited DCE line interface used for internal connection to the VDU section of the CR7.
3. Channel <sup>B</sup>C from the 8251A is a limited DTE line interface, generally used for a printer.

The Baud rate for the channels is provided by an 8253 PIT. Channel A uses output 1 from the PIT, channel B uses output 2 and channel C uses output 0.

The input frequency for the 8253A is 1.2 MHz.

Pin assignments and signal definitions for the three interfaces are given on pages 52-12..15.

The connection between the three channels and the rest of the CR7 is shown on page 50-3.

### Floppy Disk Controller

A standard floppy disk controller (WD 1793) has been implemented for accessing one to three double sided, double density 5.25" floppy disk drives.

The controller is connected to a DMA Channel and has an interrupt input from the interrupt controller (CTC).

See pages 52-10..11 for details of the interface provided by this 1793 chip and associated logic.

Software access to the controller is mentioned on page 52-21.

### Direct Memory Access Controller

The DMA used with the Z80A processor is the Am9517A chip (made by Advanced Micro Devices). It is configured with the following input:

CH0: Floppy disk controller  
CH1: Not used as input  
CH2: Z80-SIO channel A.  
CH3: Z80-SIO channel B.

CH0 and CH1 are also used during memory to memory transfers.

For correct timing of DMA transfers, the following conditions must be specified when programming the DMA controller:

1. Normal timing
2. Late write
3. DREQ active high
4. DACK active low.

### Programmable Interval Timer

The PIT used is an Intel 8253. Its outputs are as follows:

Channel 0: Used as Baud rate generator for V24 interface channel C.  
Channel 1: Baud rate generator for Channel A. (The fancy V24 interface).  
LST: Channel 2: Baud rate generator for Channel B. (The simpler V24 interface).

### Parallel Input Output and DIL Switches

The 8255 PIO is used for various things, including extending the availability of control lines on the SIO, and providing the facility to read a 4-bit DIL switch which is mounted on the board.

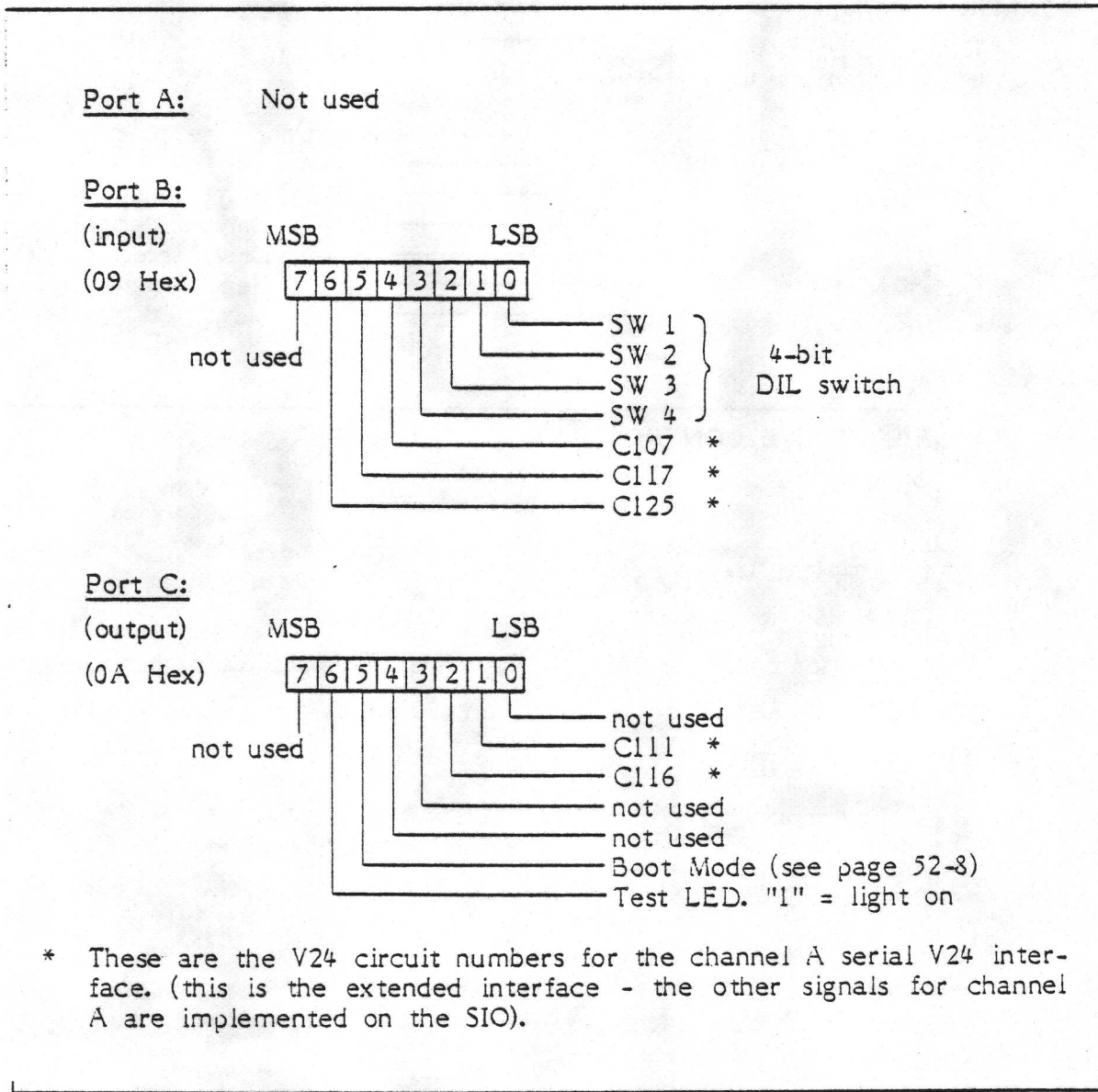
Only one of the four switches has been assigned a use by CR, namely:



Switch Closed: Boot an operating system including a Winchester driver  
no. 1: from the Winchester.

Open: Boot a floppy-only system from the floppy drive. Normally this is simply set depending on the presence or absence of a Winchester drive; however a Winchester/floppy system can be booted from the floppy (Switch 1 open) if for example the Winchester disk is unformatted. In such a case, though, the Winchester drive would not be recognized by the operating system.

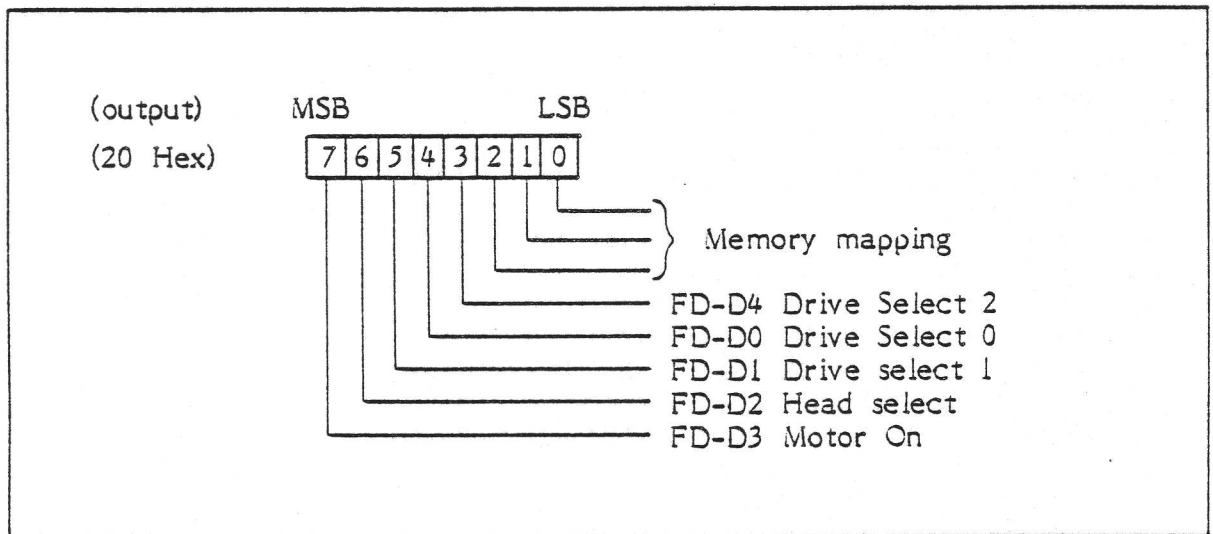
The exact usage of the PIO ports is outlined below:



PIO

### Floppy Drive Control and Map Register

A further I/O device has been implemented by means of a simple 8-bit register. It is used for controlling the Floppy Disk drives, and includes a Map Register. Note however that most of the processor's interaction with the floppy drives is via the floppy drive controller on I/O address 40 to 4F. The Map Register is only used when the extended RAM option (128 Kbytes total) is fitted. Further details of this appear on pages 52-17..19. The details of this simple 8-bit I/O device are shown below.



### FLOPPY DRIVE CONTROL AND MAP REGISTER

### RAM & PROM Memory

The processor board includes 64 Kbytes of dynamic Random Access Memory as standard. The RAM is controlled by an 8203-RAM controller. In some CR7 models, an extra 64 Kbytes is added - see pages 52-16..19.

The Boot PROM is covered in the Firmware section on page 52-8.

### Clock and Power up Logic

There is a single 24 MHz clock oscillator on the board. It is used directly by the RAM controller. The 24 MHz signal is converted into 8, 4, 1.2 and 1 MHz clocks by means of frequency divider circuitry.

The power-up logic provides the following 2 reset signals for use when initializing the other components on the board. A single-chip 7705 module supplies a reset (low) signal for the clock logic for the 40 msec following the point when the 5V power rail reaches 4.6V. At the end of this 40 msec, a monostable flip-flop provides a different reset signal for the rest of the board. This signal is held low for 100 msec, starting at the end of the previously mentioned clock reset signal.

### Interrupt Controller

The Timer-Circuit (Z80 CTC) is configured as a timer and interrupt controller as follows:

CH0: Interrupt from DMA meaning "End of Process"

CH1: Interrupt from Floppy Disk Controller.

CH2: Software timer

CH3: Interrupt from 8251A serial controller (USART), meaning "Receiver Ready".

The CTC and the SIO are connected together using a daisy chain scheme, the CTC having the higher interrupt priority.

The SIO and CTC share an interrupt line to the CPU. If either interrupts the CPU, it has to send some data afterwards to identify itself. This data is called an Interrupt Vector. It is a number which is set up in the SIO at boot time by the CPU. The same happens with the CTC, but the vector itself is of course different.

The interrupt channels 0, 1 & 3 from the list above come into the CTC on 3 interrupt lines. The main job of the CTC is to pass any interrupts on these 3 lines on to the CPU's single interrupt line, and to send the appropriate Interrupt Vector along to the CPU, to show whence the original interrupt came. Note that this "passing on" of interrupts is not the normal function of a CTC chip, all 4 channels were designed as timers. It is just that 3 of them may also take in external interrupts and these 3 are always set to "no time delay" in the CR7. This is just a way of converting non-Intel type interrupts into interrupts acceptable to the Z80.

The other channel on the CTC, channel 2, is used as a timer by software. It is possible to program it to send an interrupt to the CPU at any required time. The interrupt in this case will of course be accompanied by a unique Interrupt Vector. The software clock counts ticks from a 4 MHz crystal oscillator.

### **Firmware**

The following four items are shown on the board layout on page 52-24.

### **I/O Address Decoder**

The I/O address decoder is a 82S123 Bipolar PROM, inserted in socket IC5.

The PROM is enabled by an I/O request (either an I/O Read or an I/O Write), and the select signals are decoded from the address lines A3-A7 in accordance with the I/O address map shown on page 52-21.

When the DMA is in operation setting up direct transfers between the SIO and RAM, the I/O address decoder (i.e. the Bipolar PROM) must be (and is) disabled to prevent the creation of unwanted Chip Select signals. This is because both I/O and Memory control lines are set simultaneously during such a DMA transfer - the address on the address lines is a memory address not an I/O address. Thus only the memory address decoder can be allowed to operate at this time.

### **Boot Load PROM**

A standard 28-pin socket for a 2716, 2732, 2764 or 27128 PROM is implemented.

The CPU will start up in the PROM after a Power up sequence at address 0. At boot time, the lowest 32K of the memory area is decoded to PROM area and the rest (32K) of the memory address space is RAM. When the CPU has loaded the operating system into the RAM, a bit on the PIO is set low (= "1") and the 32K PROM area is replaced by a further 32 Kbytes of RAM area.

### **Boot PROM select and SIO/RAM synchronization**

Socket IC9 contains a 16R4 PAL (Programmable Array Logic) chip which has been programmed to provide the select signals for the Boot PROM and synchronization for the SIO.

The wait signal for the CPU or the DMA controller are made synchronous with the 4MHz clock. The wait line is normally low, and only when an addressed device is replying will the wait line go high. For all I/O devices except the SIO, it is the IORQ/ which brings the wait line high. For the RAM it is the SACK signal from the RAM controller which controls the wait line, and for the Boot PROM it is the Boot PROM Select signal.

The Boot PROM select signal is input to the PAL in order to create a wait state when the CPU accesses the PROM (thus fast or slow PROMs may be used).

The SIO select signal is necessary to control when the DMA is servicing the SIO channels because the SIO runs in synchrony with the 4MHz system clock and the RAM is an asynchronous (and much faster) device. So the RAM must be made to wait when moving data from SIO to RAM under DMA control.

### **Floppy Disk Data/Clock Separation**

This socket contains a 16R8 PAL which has been programmed to separate Data from Clock signals on the floppy disk interface. Data and Clock appear on the same lines but at different times.

## **5.2.2 Interface Specifications**

The processor board is interfaced via the pin connectors J1, J2, J3 and J4.

In the following sections all these interfaces will be specified in terms of both signals and electrical values.



**Floppy Disk interface**

This interface is wired to the 34-pin edge connector J4 on the processor board. It connects to one to three double-sided double-density 5.25" floppy diskette drives. All the drives can be connected to the same piece of 34-core ribbon cable.

Note that one Select output is used for the Motor Drive On signal (which is common to all drives, another Select output is used for Head-select, and one or two are for drive(s) select.

The signals on the edge connector are described below:

<u>Signal</u>	<u>Functional Description</u>
TR0/	<b>TRACK ZERO</b> This input indicates that the Read-Write Head is positioned over Track 00 when a logic low.
INDEX/	<b>INDEX HOLE</b> When input (low) for a minimum of 10 microseconds, this informs the controller when an index mark is encountered on the diskette.
WRPT/	<b>WRITE PROTECTED</b> This interface signal is provided by the drive to indicate to the system when a Write Protected Diskette is in use.
READ DATA	<b>READ DATA</b> The data input signal directly from the drive. This input takes the form of a pulse for each recorded flux transition (MFU code).
WRITE DATA/	<b>WRITE DATA</b> This interface line provides the data to be written on the diskette.
DIR/	<b>DIRECTION</b> This is a control signal which defines the direction of motion the R/W head will take when the step line is pulsed.
HLD/	<b>HEAD LOAD</b> The HDL output causes the Read-Write head to move into contact with the diskette.

**FLOPPY DISK INTERFACE SIGNALS**

<u>Signal</u>	<u>Functional Description</u>
WG/	<b>WRITE GATE</b> This output, when asserted, means that writing is to be performed on the diskette.
STEP/	<b>STEP</b> The step output contains a pulse for each step of the head's movement. The R/W head has to move with the direction of motion as defined by the Direction Select line (DIR).
DR0/ to DR2/	<b>DRIVE SELECT LINES</b> Activates, when active (low), one of three Floppy Disk Drives.
HEAD SELECT	<b>HEAD SELECT</b> Side select when using double sided Floppy Disk.
MOTOR ON/	<b>MOTOR ON</b> This output, when asserted, starts the motors in all connected drives.

**FLOPPY DISK INTERFACE SIGNALS (CONTINUED)**

8"	5 1/4"	Pin	Signal
		2 — 18 —	HLD/
		4 — 20 —	Not connected
		6 — NC —	Not connected
		8 — —	INDEX/
		10 — 26 —	DR0/
		12 — 28 —	DR1/ NC — [ stik på driv
		14 — 30 —	DR2/ NC —
		16 — NC —	MOTOR ON/ NC —
		18 — 34 —	DIR/
		20 — 36 —	STEP/
		22 — 38 —	WRITE DATA
		24 — 40 —	WG/
		26 — 42 —	TR0/
		28 — 44 —	WRPT/
		30 — 46 —	READ DATA
		32 — NC —	HEAD SELECT
		34 — NC —	Not connected

**PIN ASSIGNMENTS ON FLOPPY DISK INTERFACE**

The pins referred to in the table on the previous page (the even-numbered ones) are those furthest from the board. The odd-numbered pins (those closer to the board) are all wired to Earth.

<u>Signal Name</u>	<u>Receivers</u>	<u>Pullup resistance</u>	<u>Iil</u> (max)	<u>Vil</u> (max)
SEPC				
READY				
TRQ	TTL	150 ohms	-1.2mA	0.6V
INDEX	74LS244			
WRPT				
READ DATA				

**ELECTRICAL SPECIFICATIONS OF FLOPPY DISC INTERFACE (INPUTS)**

<u>Signal Name</u>	<u>Drivers</u>	<u>Iil</u> (max)	<u>Vil</u> (max)
WRITE DATA			
STEP			
HLD	TTL (OC) 7438		
WG		48mA	0.4V
DIR	TTL (OC) 7406		
HEAD SELECT			
DR0-DR2			
MOTOR ON			

**ELECTRICAL SPECIFICATIONS OF FLOPPY DISC INTERFACE (OUTPUTS)**

**Serial Line Interfaces**

There are three serial interfaces connected to the three 26-pin connectors J1-J3. The signals and their timing are according to the CCITT V24 recommendations. Their electrical properties are as defined by CCITT V28.

<u>V24</u> <u>Circuit No.</u>	<u>Driver or</u> <u>Receiver</u>	<u>Connection</u> <u>to/from</u>	<u>Description</u>
103	DRIVER	SIO	TRANSMITTED DATA
104	RECEIVER	SIO	RECEIVED DATA
105	DRIVER	SIO	REQUEST TO SEND
106	RECEIVER	SIO	CLEAR TO SEND
107	RECEIVER	PIO	DATA SET READY
108	DRIVER	SIO	DATA TERMINAL READY
109	RECEIVER	SIO	DATA CARRIER DETECT
111	DRIVER	PIO	DATA SIGNALLING RATE SELECT
113	DRIVER	TIMER (PIT)	TRANSMITTER CLOCK
114	RECEIVER	SIO	TRANSMITTER CLOCK
115	RECEIVER	SIO	RECEIVER CLOCK
116	DRIVER	PIO	SELECT STANDBY
117	RECEIVER	PIO	STANDBY INDICATOR
125	RECEIVER	PIO	CALL INDICATOR

#### CHANNEL A (CONNECTOR J1) - SIGNAL DEFINITIONS

Channel A is an extended line Communication Interface in accordance with the CCITT V24 recommendation for DTE devices.

This interface cannot be accessed under the standard CP/M operating system provided with the CR7. An appropriate driver program must be written for the SIO and PIT. This is described in Intel's documentation for their Z80 SIO chip and 8253 PIT. For complex applications such as auto-dial modems, the PIO will also need to be programmed.

This is the interface used by the XTA card (if fitted).

This interface uses channel A on the SIO (and some help from the PIO) and is accessed physically via the connector J1.

<u>V24</u> <u>Circuit No.</u>	<u>Driver or</u> <u>Receiver</u>	<u>Connection</u> <u>to/from</u>	<u>Description</u>
103	RECEIVER	SIO	RECEIVED DATA
104	DRIVER	SIO	TRANSMITTED DATA
105	RECEIVER	SIO	CLEAR TO SEND
106	DRIVER	SIO	REQUEST TO SEND
108	RECEIVER	SIO	DATA CARRIER DETECT
109	DRIVER	SIO	DATA TERMINAL READY
113	RECEIVER	SIO	RECEIVER CLOCK
115	DRIVER	TIMER (PIT)	TRANSMITTER CLOCK

### CHANNEL B (CONNECTOR J2) - SIGNAL DEFINITIONS

Channel B is a limited line Communication interface in accordance with the CCITT V24 recommendation for DCE devices. It is accessed as the user's console or terminal under CP/M. It is connected internally to the video controller board in the integrated workstation CR7 (i.e. the CR7 with the processor board built into a VDU). The interface is implemented by channel B of the SIO and comes out of the board via connector J2.

<u>V24</u> <u>Circuit No.</u>		<u>Driver or</u> <u>Receiver</u>	<u>Connection</u> <u>to/from</u>	<u>Description</u>
103	2	DRIVER	8251A	TRANSMITTED DATA
104	3	RECEIVER	8251A	RECEIVED DATA
105	4	DRIVER	8251A	REQUEST TO SEND
106	5	RECEIVER	8251A	CLEAR TO SEND
108	20	DRIVER	8251A	DATA TERMINAL READY
109	8	RECEIVER	8251A	DATA CARRIER DETECT
113		DRIVER	TIMER	TRANSMITTER CLOCK
115		RECEIVER	8251A	RECEIVER CLOCK

### CHANNEL C (CONNECTOR J3) - SIGNAL DEFINITIONS (Printer)

This is a limited line communication interface in accordance with the CCITT V24 recommendation for DTE devices. It is accessed as the system printer under CP/M. It is implemented by the USART device, and is connected via J3.



CR7 USER MANUAL - PROCESSOR BOARD

		CANNON CONNECTOR					
V24 SIGNAL ("A" PINS ON BOARD)		BOARD PIN CONNECTOR				V24 SIGNAL ("B" PINS ON BOARD)	
<i>SIO = 10H-1F</i> Channel A (from SIO)	C-103	1	A1	B1	14		
	C-104	2	A2	B2	15	C-114	Connector J1
	C-105	3	A3	B3	16	C-115	
	C-106	4	A4	B4	17		
	C-107	5	A5	B5	18		
	C-102	6	A6	B6	19		
	C-109	7	A7	B7	20	C-108	
		8	A8	B8	21		
		9	A9	B9	22	C-125	
		10	A10	B10	23		
	C-111	11	A11	B11	24	C-116	
		12	A12	B12	25	C-117	
		13	A13	B13			
<i>video board</i> Channel B (from SIO)	C-103	1	A1	B1	14		
	A-104	2	A2	B2	15	C-113	
	C-105	3	A3	B3	16		
	C-106	4	A4	B4	17	C-115	
		5	A5	B5	18		
		6	A6	B6	19		
	C-102	7	A7	B7	20	C-108	
	C-109	8	A8	B8	21		
		9	A9	B9	22		
		10	A10	B10	23		
		11	A11	B11	24		
		12	A12	B12	25		
		13	A13	B13			
<i>8251 = EO<sub>H</sub>-EF</i> Channel C (from 8251A)	C-103	1	A1	B1	14		Connector J3
	C-104	2	A2	B2	15	C-113	
	C-105	3	A3	B3	16		
	C-106	4	A4	B4	17	C-115	
		5	A5	B5	18		
		6	A6	B6	19		
	C-102	7	A7	B7	20	C-108	
	C-109	8	A8	B8	21		
		9	A9	B9	22		
		10	A10	B10	23		
		11	A11	B11	24		
		12	A12	B12	25		
		13	A13	B13			

PIN ASSIGNMENTS ON PROCESSOR BOARD AND CANNON CONNECTORS FOR THE THREE LINE INTERFACES

### 5.2.3 Extending the System

Although the processor board is a self-contained computer system (apart from power supply and peripherals), there are various ways of expanding the capabilities of the board.

One of these is the specific case of adding 64 Kbytes of extra RAM; the CR7 may be purchased with this option installed. All the other proven possibilities are subsumed under the title "PROM socket extension" - it is entirely up to the interested user/designer what extra components are added. It could be a larger PROM than the one supplied, or it could be some other device altogether. The user may of course have his own ideas for system expansion; the only other help provided on the board is in the provision of jumpers SR11 and SR12 - see page 52-23.

#### 5.2.3.1 RAM extension to 128 Kbytes

This extension is required where the CP/M+ operating system is in use. Although in theory the Z80 can only address 64 Kbytes of memory, CP/M+ is able to switch between different "Banks" of memory whose total size exceeds 64 Kbytes. The extra 64 Kbytes is installed on a small "piggy-back" card on the processor board. This extra board also houses the RAM controller and a PROM used in the mapping in and out of the different areas of memory.

The extension board is connected to the processor board via the original RAM controller socket (IC 11) and the data latch socket (IC 12). The RAM controller is transferred to a socket on the extension board. The data latch is discarded since one is already fitted to the extension card. There are also some minor changes to be made to some resistors on the processor board when the RAM is extended. Finally, the three control signals described below are fed to the extension board from IC 57 on the main board. Pin assignments on the 3-pin connector on the extension board are given overleaf.

<u>Pin Nearest to Jumper SR1</u>	<u>Middle pin</u>	<u>Pin furthest from SR1</u>
IC 57 pin 6	IC 57 pin 2	IC 57 pin 5

#### SOURCE OF CONTROL SIGNALS TO EXTENSION BOARD

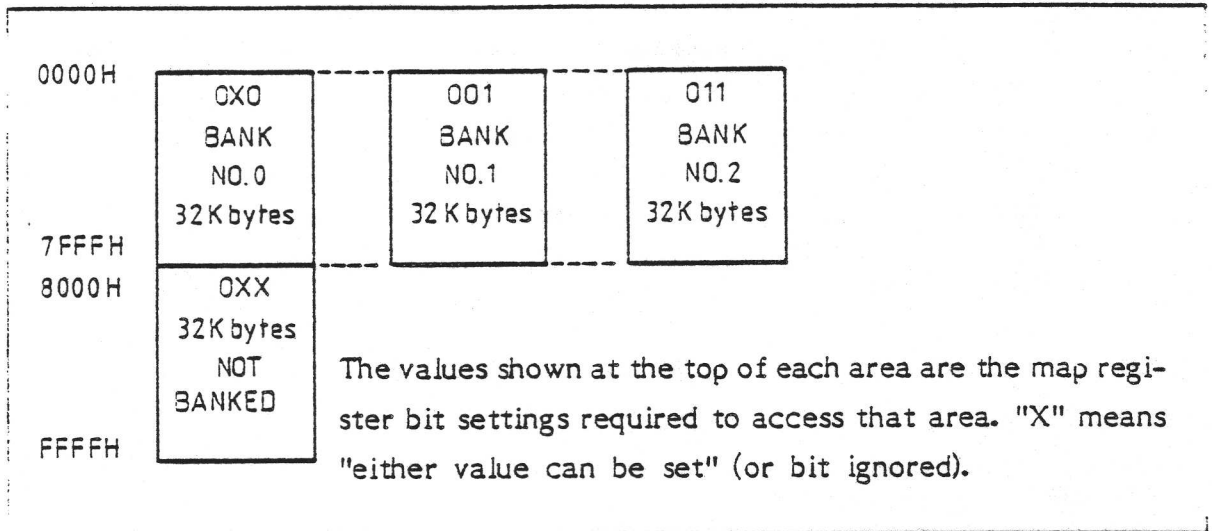
##### How the different areas of RAM are addressed

The 128 Kbytes of memory is divided into areas, some of which are called Banks; not all the memory comes into the Banking System. The term "Bank" is a CP/M concept; the user should refer to Digital Research's documentation for full details. There are two possible memory banking schemes available on the CR7; the choice as to which scheme applies is made by means of the jumper SR1 on the RAM extension board.

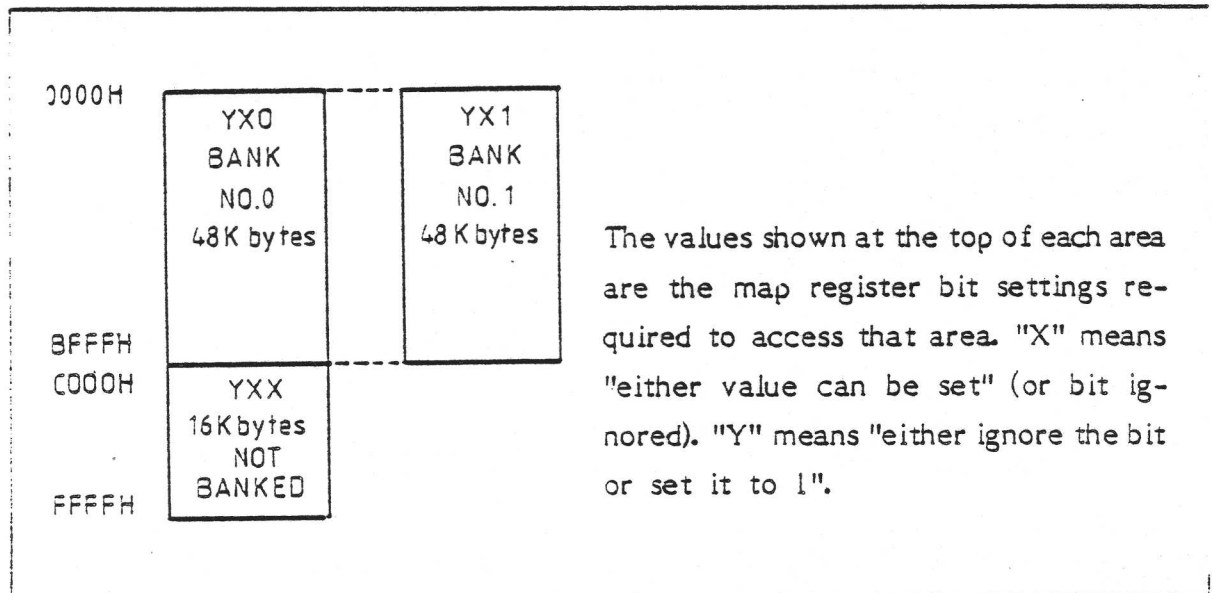
SR1: Select memory banking scheme. Mounted: 3 Banks of 32 Kbytes each Not mounted: 2 Banks of 48 Kbytes each. * Factory setting.
----------------------------------------------------------------------------------------------------------------------------------------

#### RAM EXTENSION CARD JUMPER SPECIFICATION

Furthermore, this jumper setting can be overridden by software (bit 2 of the map register, described below). The bit values shown in the address maps overleaf assume that the jumper is not mounted.



**MEMORY ADDRESS MAPPING FOR 32 K BANKS**



**MEMORY ADDRESS MAPPING FOR 48K BANKS**

The two mapping schemes are shown above. The mapping bits that decide which bank is in use are of course controllable by software. They are at the least significant end of the Floppy Drive Control/Map Register device, which is at I/O address 20 (Hex) on the processor board.

<u>Bit</u>	<u>If set to "0"</u>	<u>If set to "1"</u>	<u>Comments</u>
0 (ls)	No mapping. Bank "0" selected.	Memory banking in operation. Bank 1 or 2 selected.	This is the only bit that is actually used by standard software.
1	Bank "1" selected (32K banks).	Bank "2" selected (32K banks).	This bit is only used when the 32 K bank size is selected. CP/M+, as supplied with the CR7 never uses it.
2	32 K bank-size selected.	48K banks selected	If this bit is <u>not</u> written to, then the bank-size is defined by jumper. CP/M+, as supplied with the CR7, <u>always</u> uses 48K banks, so never uses this bit (since the value is defined by the jumper).

#### MAPPING BITS ON I/O REGISTER AT ADDRESS 20 HEX

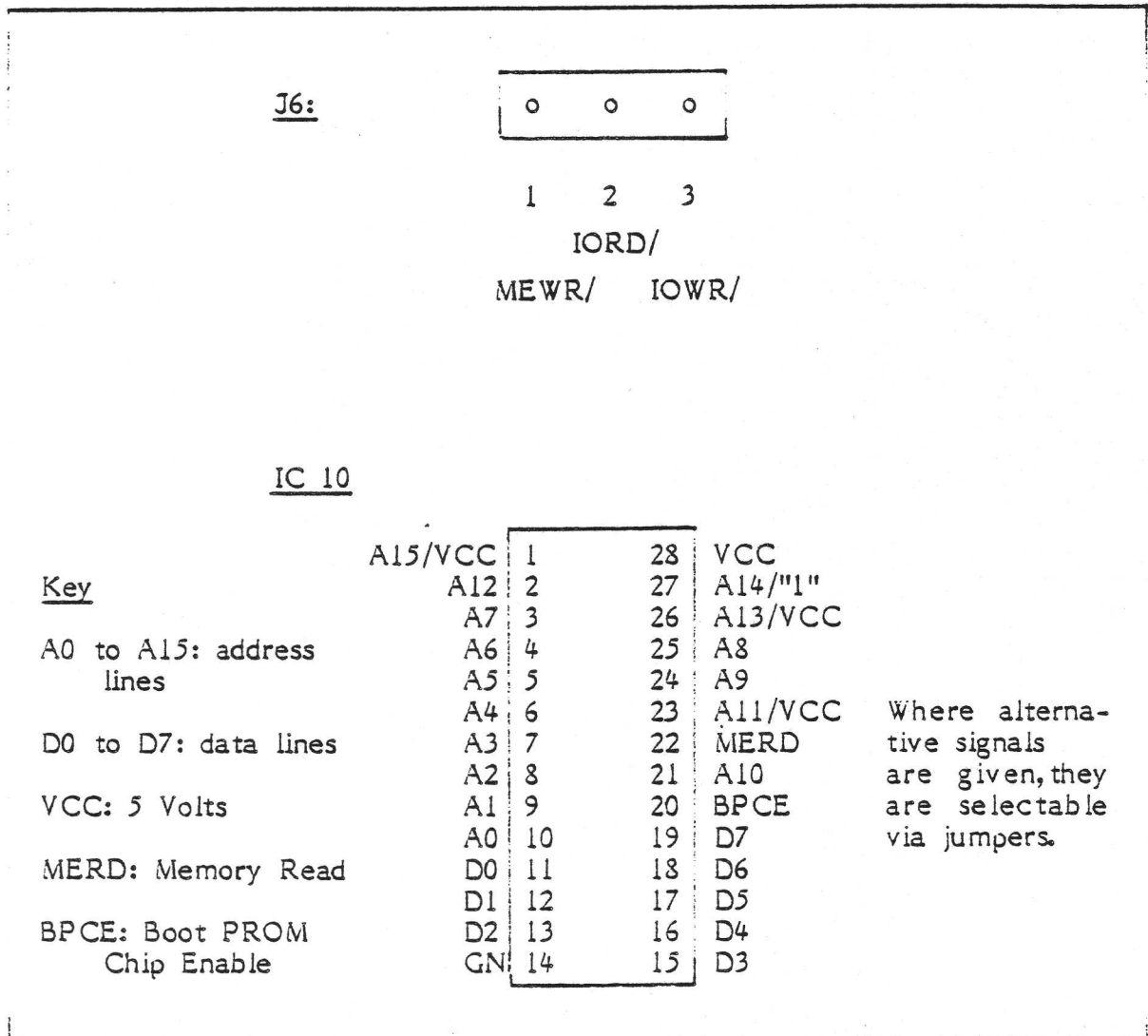
##### 5.2.3.2 PROM Socket Extension

Access to the entire system bus is available via the PROM socket, plus the 3-pin connector J6. This comprises 16 address lines, 8 data lines and 4 control lines (Memory Read, Memory Write, I/O Read and I/O Write.) Of course if the PROM socket is used in this way, it will be necessary to install a suitably programmed PROM as part of whatever extension is added, if the computer is still to have the capability of booting itself.

The SASI interface card (i.e. the card through which a Winchester controller may be attached to the processor board) is a good example of the use of this PROM socket extension technique. Furthermore, the SASI card itself also provides scope for system extensions. The card is described on pages 53-1..10.



The pin assignments of the PROM socket IC 10 and the socket J6 are given below. For their positions on the board, see the illustration on page 52-24.



**PIN ASSIGNMENTS FOR PROM SOCKET AND J6 CONNECTOR**

**5.2.4 Operation**

At power-up, the CPU is initially set to "Boot Load Mode" wherein the lowest 32 Kbytes of its address space access the PROM area, while the upper 32 Kbytes access the upper 32 Kbytes of RAM.

When bit 5 in port C of the PIO is set low ("0") then the lower 32 Kbytes of address space access the lower part of RAM instead, and the PROM is ignored. This is summarized overleaf.

<u>Memory type</u>	<u>Mode of Operation</u>	<u>Addresses (Hex)</u>
PROM RAM	Boot Load Mode	0000 to 7FFF 8000 to FFFF
PROM RAM	Normal Mode	Inaccessible 0000 to FFFF

**MEMORY ADDRESS MAP**

The I/O addresses are shown below. Addresses not mentioned are not used. Details of the use of the various I/O devices were given in section 5.2.1.

<u>Device</u>	<u>I/O Addresses (Hex)</u>
CTC	00 to 07
PIO	08 to 0F
SIO	10 to 1F
Floppy Drive control & Map register	20 to 2F
DMA	30 to 3F
Floppy disk controller	40 to 4F
SASI interface	5A, 5B, 5F
8253 PIT	D0 to DF
8251A	E0 to EF

**I/O ADDRESS MAP ON THE CR7**

**Jumper Specifications**

The normal (factory) settings are marked with an asterisk. The position of the jumpers are shown on page 52-24.

SR1: AD15 or VCC can be strapped into pin 1 of the Boot Load PROM socket.

A - VCC (5 volts)

\* B - AD15 (address line 15)

## CR7 USER MANUAL - PROCESSOR BOARD

- SR2: AD14 or a logical high can be strapped into pin 27 of the Boot Load PROM socket.  
A - "1"  
\* B - AD15
- SR3: AD13 or VCC can be strapped into pin 26 on the Boot Load PROM socket.  
\* A - VCC  
B - AD13
- SR4: ADD11 or VCC can be strapped into pin 23 on the Boot Load PROM socket.  
\* A - AD11  
B - VCC
- SR5: When this jumper is mounted, the CLK 1 signal of serial interface channel A is connected, via a driver, to circuit C114 of the interface.  
\* Not mounted.
- SR6: Select either external or internal clock as the receiver Baud rate clock on serial interface Channel A.  
A - external clock C115  
\* B - internal CLK 1 from PIT
- SR7: Select either external or internal clock as Transmitter Baud Rate clock on serial interface Channel A.  
A - external clock C114  
\* B - internal clock CLK 1
- SR8: Select external or internal Baud rate clock for serial interface channel B.  
A - external CLK  
\* B - internal CLK 2 from PIT
- SR9: Select external or internal Baud rate clock for serial interface channel C.  
\* A - internal clock (clock 0 from PIT)  
B - external clock

SR10: The 24 MHz system clock can be disconnected (for test purposes) by removing jumper SR10.

\* Mounted.

SR11: Address line AD3 can be strapped on to IC50 pin 13. This could be useful if attempting some expansion of the system via the PIO socket. This jumper must not be mounted if PIO (IC50) is mounted.

\* Not mounted.

SR12: Address line AD2 can be strapped into IC50 pin 17. This jumper must not be mounted if the PIO is mounted. See SR11 above.

\* Not mounted.

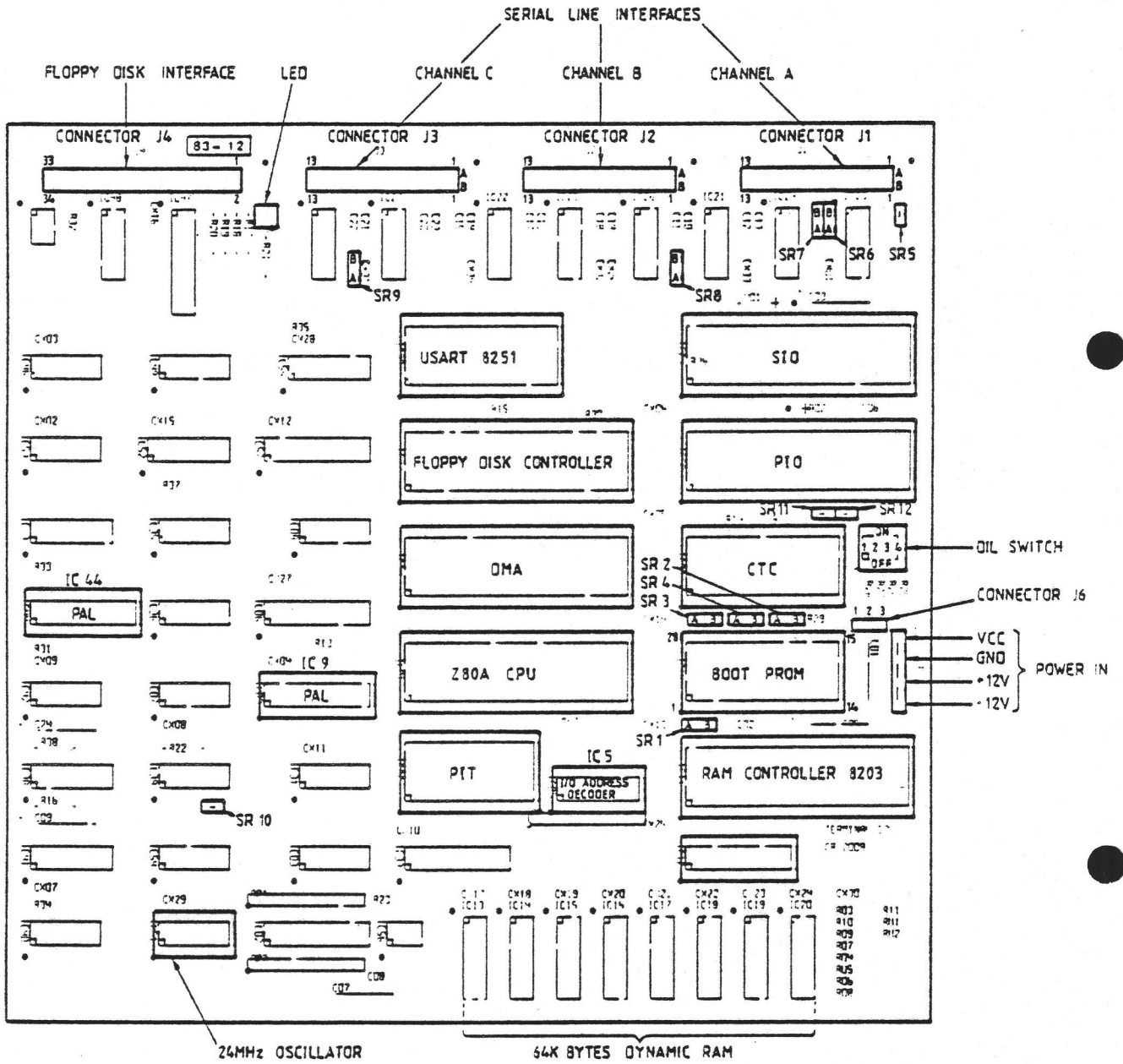
### Power Requirements

Power for the Processor Board is supplied by the power supply described on pages 51-12..13. It is "piped" to the board via the connector shown in the board layout overleaf.

The requirements of the board are:

1.5 ± 0.2 A at +5V and  
<100mA at +12V and  
<100mA at -12V

Typical overall power dissipation is 9 Watts.

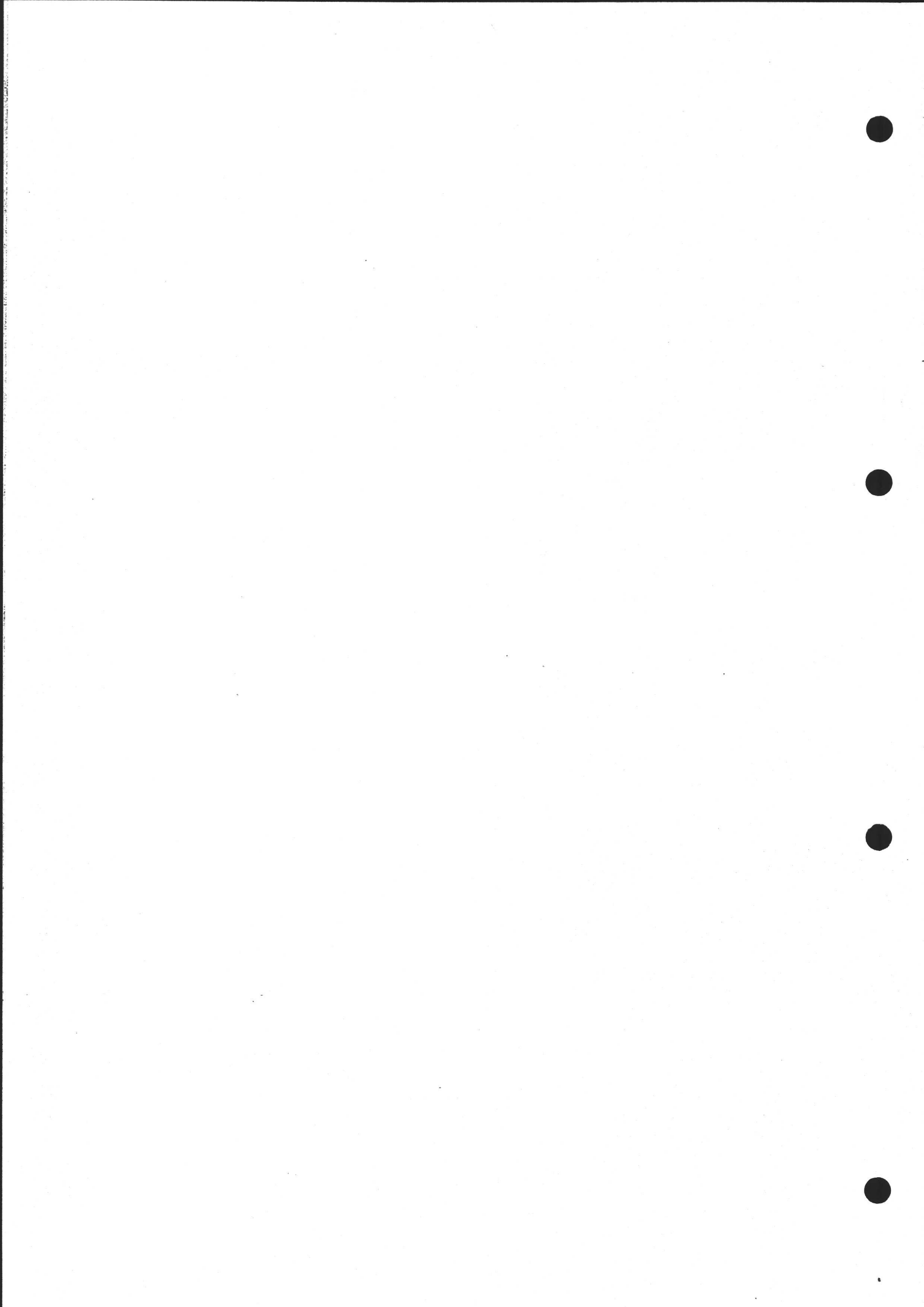


3-4075

PROCESSOR BOARD - COMPONENT LAYOUT







### 5.3 THE WINCHESTER DISK AND ITS INTERFACE

It can be seen from the block diagram on page 2-1 that the interface between the CPU board and the Winchester drive consists in fact of two boards - the SASI interface and the Winchester controller.

#### 5.3.1 The SASI interface Board

##### 5.3.1.1 Purpose of

The Disk Controller board that is used in the CR7 is an "off-the shelf" item, not made by CR. In consequence, its communication with the processor board is, and rightly so, in accordance with a standard interface. This standard interface is known as SASI (Shugart Associates System Interface) and is in turn a subset of ANSI X3T9.2/82-2 SCSI (American National Standards Institute's Small Computer System Interface). However, the CR7 processor board was originally intended to be used only with floppy disk drives, for which a built-in (non-SASI) interface is provided. It therefore became necessary to implement the SASI interface on a separate board.

#### System Expansion

Note that the SASI interface can connect to up to 8 target devices in total. This therefore provides an extra avenue for system expansion over and above those mentioned for the processor board itself (pages 52-16..20). However, it must be stressed that the board was designed purely for use with the Winchester controller, it has never been tested in conjunction with any other Target device. Thus the connection of a user's own SASI-compatible device would be at his own risk. It would of course also be necessary to write a device driver for the new device.

##### 5.3.1.2 Description of the SASI Interface

A summary of the Interface only is given here since this is a standard interface. The full SCSI is described in detail (over 100 pages) by ANSI - their reference number being X3T9.2/82-2.

As mentioned earlier, SASI is only a subset of SCSI. The main differences between the two are listed below - that is, things not implemented on the CR7 that are defined in the ANSI standard.

1. There is no Parity line on the CR7 SASI.
2. There is no ATN line on the CR7 SASI.
3. The processor board is always the Initiator on the CR7 (it cannot take the role of Target as is possible in SCSI). By the same token, the Winchester Controller is always the Target on the CR7.
4. The CR7 SASI has no Arbitration or Reselection Phases.
5. The only possible Message on the CR7 SASI is 00 (Command Complete).

The interface takes the form of a negative logic, bidirectional 8-bit data bus with no parity. Electrically the bus is of "open collector" type, terminated on each end by a 220/330 ohm resistor network. The interface also includes 8 control lines though commands are also sent on the data lines.

The bus has one "Initiator" device (the processor board in the case of the CR7 configuration) and up to 8 "Target" devices (normally, on the CR7, only one: the Winchester controller).

### Sequence of operations

#### 1. Checking out the SASI bus status

Before data can be sent to or from the Target, it is necessary to read the Status register in the SASI interface card, to assure us that the Bus is not busy or in some error state.

N.B. This has nothing to do with the Status Phase described in the SCSI document. (The Status Phase is concerned with the status of a device attached to the bus, not the bus itself.)

The SASI bus status register is read by doing a Read at CR7 I/O address 5A (Hex). The returned byte is set out as follows:

<u>Bit no.</u>	<u>Name</u>	<u>Explanation</u>
7 (m.s.)		Not used.
6		Not used.
5		Not used.
4	REQ	A "0" means that the Target device has made a transfer request to the processor board which has not yet been serviced. The thing to be transferred, and in which direction, depends on the I/O, C/D and MSG bits described below.
3	MSG	When set to "0", a Message is about to be sent by the Target, on the data lines, to the initiator. The only valid Message on the CR7 SASI is "0", meaning "Command Complete".
2	I/O	"0" means that the Target has data for the processor (reading the disk). A "1" means a request for data from the processor ("Ready to write to disk").
1	C/D	"0" means a request for a Command, "1" is a request for Data.
0 (l.s.)	BSY	"0" (Busy) means that a Target has been selected.

N.B. This Status register is merely a way of reading the state of the 5 control lines of the same names in the SASI bus. A hardware "Low" logic state is equivalent to a "0" in this register.

So, before doing any I/O on the bus, its current software status or hardware state (the former is a subset of the latter, since only 5 of the 8 control lines may be read from software) is determined. Hopefully, a value of 1F (Hex) will be returned. Basically this value means that the bus is not Busy and there are no errors, i.e. it is in the "Bus Free" phase described by ANSI SCSI.



If the status was not 1F, it will be necessary to do a SASI bus Reset. This is achieved by doing a Write to CR7 I/O address 5F (hex). The status can now be re-read as described above.

## 2. The "Select" Phase

The Initiator (in our case the Processor board) wants to communicate with the Winchester controller. The first thing it does in stage 2 of our sequence of operations is to put the Device I.D. of the Winchester Controller (the number 1) on the data lines, then it asserts SEL. In the CR7 there will only be one target device (the Winchester Controller) but it still has to be selected. Of course if the user has connected other devices, then the bus has to select which one to talk to.

Then the Target will recognise its own ID on the data lines and will reply by asserting BSY. This is to tell the Initiator that it is alive and well and that the Selection phase is over (from the Target's point of view). The status register is again checked as described previously. If BSY had not been asserted by the Target, it means that the Target was not there or had some sort of fault. In this case, as before a Reset would have to be issued to the SASI and we would start again at the very beginning of stage 1.

On the other hand, if all was well (i.e. BSY was asserted), then the Initiator will deassert SEL, thus completing the Selection phase.

## 3. Sending the Read or Write Command.

From now on, the Target acts as Master on the Bus. In other words, instead of the Processor saying to the Disk drive "Here are some numbers. Store them." the Disk Drive says "OK, Processor, I gather you want me to do something. What?" To re-state this in a more electrical way, the Target asserts REQ (indicating a request of some sort) and sets the C/D line to C (indicating a request for a command). The Target also sets the I/O line to Output, since it is asking for a command to be output from the Processor to itself. The Target also de-asserts MSG since this is not a Message.

At this stage, software reads the SASI status register again, to check that the Target has set the control lines properly as stated above. If they are incorrect an error will be reported.

Then the Processor duly sends it the first byte of the command on the 8 data lines, accompanied by ACK, to show that the command is ready. The Target de-activates REQ to indicate that it has got the command. The Processor completes the handshake procedure by de-activating ACK.

Now, if the Target is the Winchester disk controller, it will expect a further 5 control bytes in order to define what exactly it is to do. A user's own device may well have different requirements. For the Winchester controller, then, step 3 is repeated a total of 6 times.

#### 4. Sending the Data.

The Target now knows how much data it is about to receive or send, and where within itself to get it from or write it to. So it continues to act as a Master on the bus. It requests each byte in much the same way as it requested the 6 command bytes, the only difference being that the C/D line is of course set to Data instead of Command, and the direction of transfer (I/O line) may be different.

#### 5. Finishing off.

When all the data has been sent, the Target device initiates two final transfers of a byte each, which again follow the general pattern of events as described in stage 3.

The first is a Status byte. This is the Status Phase alluded to in our stage 1, and is nothing to do with the SASI status register. The control lines are set up as a "Reversed Command", in other words as described in step 3 except that the I/O line is set to Input to the processor instead of output from it. The format of this byte is:

<u>Bit no.</u>	<u>Name</u>	<u>Explanation</u>
7(M.S.)		Not used, = 0
6		Not used, = 0
5	DRIVE	This is the Drive number: "0" if only one drive is fitted.
4		Not used, = 0
3		Not used, = 0
2		Not used, = 0
1	ERR	"1" = Error, "0" = OK
0		Not used, = 0

If an error is indicated, then when this entire 5-stage cycle is over, and the bus is no longer Busy, then a new cycle is performed to find out what the error was. The command used is called a Sense Status Command. Four bytes are returned, one of which is the error code and the others define exactly where on the disk the error occurred. This is the mechanism by which the error codes listed on pages 4-11..13 are generated.

To return to the "Finishing Off" stage, the final transfer is of a byte called a Message byte. This byte and the data lines always contains the value 0 on the CR7 SASI (though other values are specified by SCSI). The purpose of the Message, which goes from the Target to the processor board, is to indicate that the command cycle is complete. Again, the procedure is similar to that described for step 3, except that all three lines: Message, I/O, and C/D are asserted.

The Message byte must be read by the processor. The normal REQ/ACK handshaking procedure is followed by the de-assertion of the BSY line by the Target device; thus the bus enters the "Free" (idle) state once again.

Note that the transfer of these two final bytes, Status and Message, takes place whatever the Target might be.

A summary of the control line settings for the five possible types of transfer are given below. The Bus Free condition is added, for reference. Note that "High" = Logic "1" (= De-asserted where that is meaningful). The Hex equivalents when reading the SASI status register are also given.

<u>REQ</u>	<u>MSG</u>	<u>I/O</u>	<u>C/D</u>	<u>BSY</u>	<u>Hex</u>	<u>Meaning</u>
0	1	1	0	0	0C	Target receives command
0	1	1	1	0	0E	Target receives data
0	1	0	1	0	0A	Target sends data
0	1	0	0	0	08	Target sends Status
0	0	0	0	0	00	Target sends Message
1	1	1	1	1	1F	Bus Free

**SASI CONTROL LINES**

**Signal Definitions**

<u>Name</u>	<u>Description</u>
I/O	<b>Input/Output</b> Low = Input to processor
C/D	<b>Command/Data</b> Low = command, high=data
BSY/	<b>Interface Busy</b> This line is set low when a Target device has been selected.
MSG/	<b>Message</b> Low = completion of command sequence
REQ/	<b>Request</b> Part of handshake procedure

**SASI SIGNALS DRIVEN BY TARGET DEVICES**

These were described in more detail on page 53-3.

<u>Name</u>	<u>Description</u>
SEL/	<b>Select</b> Indicates that the required Target's ID has been put on the data bus (as preparation for the sending of a command).
ACK/	<b>Acknowledge</b> This is the response by the initiator to a REQ/ signal from the Target. It indicates that the data lines have now been set up or read, as required.
RST/	<b>Reset</b> This signal causes a Reset. See I/O address table, below.

**SASI SIGNALS DRIVEN BY INITIATOR DEVICE**

**I/O Addresses**

Seen from the processor, the SASI contains two read/write ports and a write-only port. The addresses are shown below.

<u>Hex I/O Address</u>	<u>R/W</u>	<u>Function</u>
5A	Read	Status register (i.e. settings of the control lines which are driven by the Target).
5A	Write	Select a Target. By writing the value 1 to this address the Winchester controller is selected (and the SEL line is asserted. It will be de-asserted later by hardware).
5B	Read	Read a byte from the Target device.
5B	Write	Write a byte to the Target device.
5F	Write	All Targets, and the SASI interface itself are reset to a known starting condition. All control lines (apart from RST itself) are set high - 7 in all.

**SASI INTERFACE - I/O ADDRESSES**



## Electrical Connections

The SASI board is connected to the processor board via the latter's boot PROM socket, as described on pages 52-19..20. Its position can be seen in the CR7 Internal View illustration on page 50-2. The PROM (that would have been in the PROM socket) is mounted on the connector board itself.

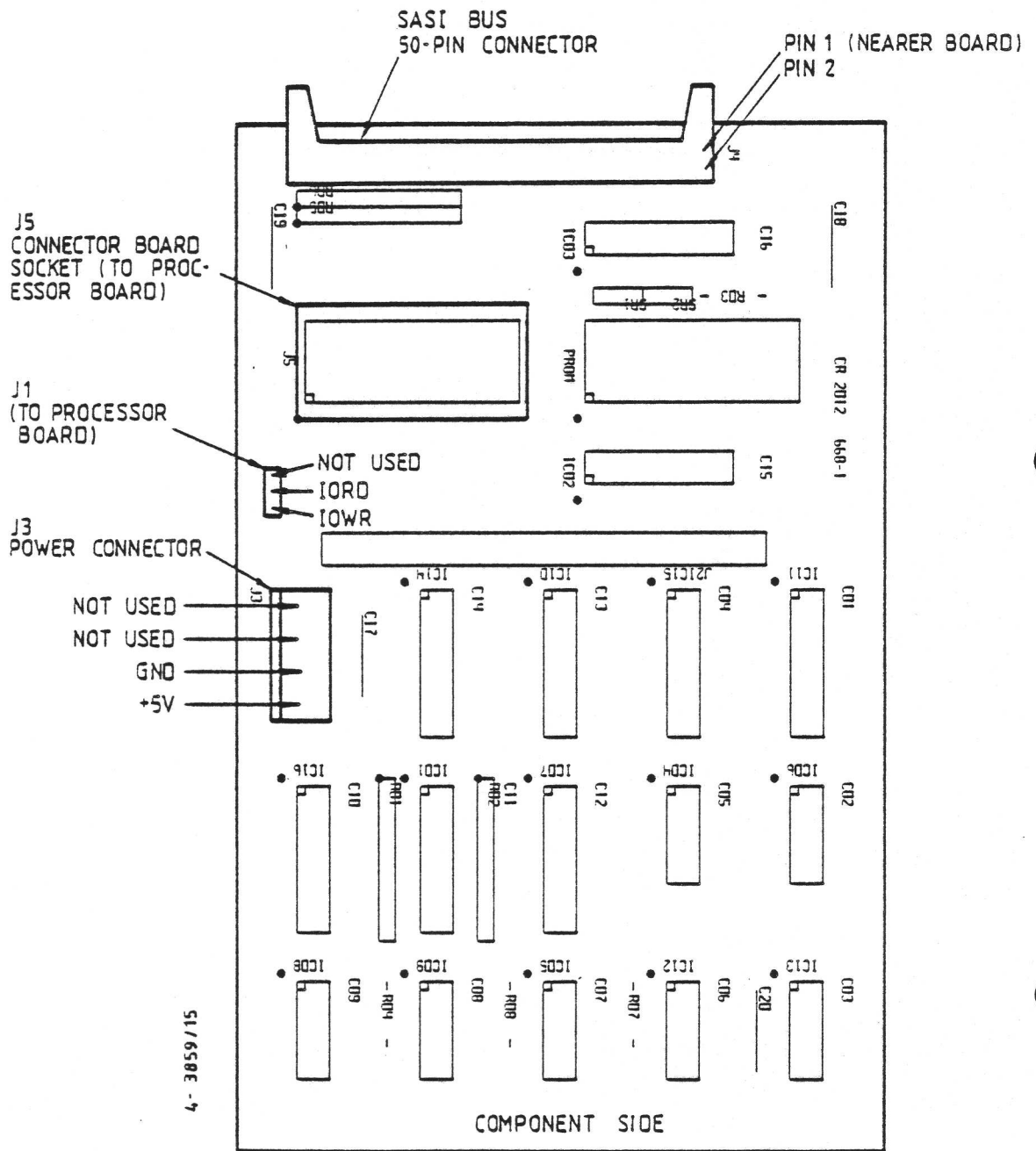
An additional connector, J1, is required for signals IORD and IOWR to the SASI board.

Power is connected via J3. Only +5V is used.

The output from the SASI board, i.e. the SASI bus itself, is a 50-pole flat cable. The pin numbering for this is given below, followed by an illustration showing the pin locations.

<u>Signal</u>	<u>Pin</u>	<u>Pin</u>	<u>Signal</u>
GND	1	2	DB0
GND	3	4	DB1
GND	5	6	DB2
GND	7	8	DB3
GND	9	10	DB4
GND	11	12	DB5
GND	13	14	DB6
GND	15	16	DB7
GND	17	18	Not connected
GND	19	20	GND
GND	21	22	GND
GND	23	24	GND
GND	25	26	GND
GND	27	28	GND
GND	29	30	GND
GND	31	32	Not connected
GND	33	34	GND
GND	35	36	/BSY
GND	37	38	/ACK
GND	39	40	/RST
GND	41	42	/MSG
GND	43	44	/SEL
GND	45	46	C/D
GND	47	48	/REQ
GND	49	50	I/O

SASI INTERFACE CARD - PIN ASSIGNMENTS



SASI INTERFACE CARD

### 5.3.2 Winchester Controller

The Winchester Controller board supplied with the CR7 can handle up to two 5.25" Winchester drives. Any drive which is compatible with Seagate Technology's ST-506 drive may be used.

The positioning of the controller board within the CR7 is shown in the illustration on page 50-2.

Communication between the controller board and the host is in accordance with the SASI (Shugart Associates System Interface) standard. A separate CPU Adaptor board implements this interface. This was described in the previous section.

The controller board is the DTC-510A, made by Data Technology Corporation. An outline of some of its design features are given below.

- o Automatic seek verify. Whenever a "seek" is done, the cylinder is verified; every data transfer implies a seek.
- o Simple multiple block transfers. One command can specify the transfer of several blocks; furthermore, the controller automatically selects the next track and/or cylinder when required during such a transfer.
- o Sector buffer. A buffer that can hold a whole sector (512 bytes) is provided on the board. This eliminates a cause of possible lost data during a transfer.
- o Programmable sector interleaving. An interleave factor of up to 16 is possible. CR software uses the default value of 0.
- o Logical Unit Numbers. All accesses are specified by means of LUNs as a means of attaining device independence.
- o Programmable disk drive parameters. Characteristics of destination drive are defined by software, not by jumpers.

- o Alternate track addressing. The host processor can define an alternate track if a track becomes defective. Subsequent accesses to the bad track will be diverted to an alternate track.
- o Data error sensing and correction. Uses the normal ECC codes.
- o Error detection. There is a wide variety of error codes, thus any code is very specific. This greatly speeds up hardware fault finding. Furthermore, error codes are displayed in LEDs on the board.
- o Power requirement: 2.6 amps (max.) at 5 volts.

The Winchester Controller board layout is shown opposite, followed by a brief description of the pin assignments and error codes.

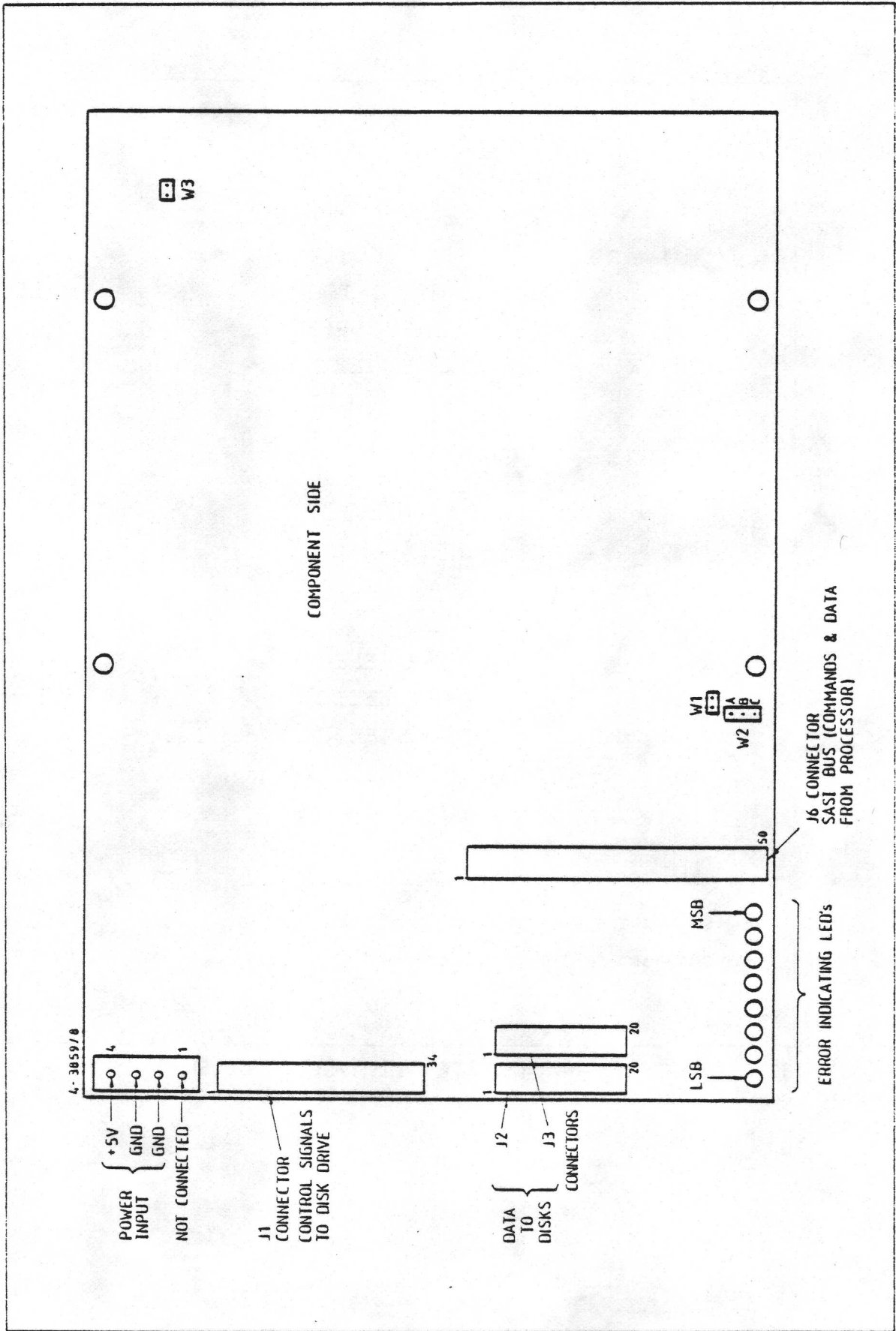
#### Jumpers - Winchester Controller Board

The board has only three jumpers.

<u>Jumper</u>	<u>Description</u>
W1	Sector size    Installed: 512 bytes (18 sectors per track) * Removed: 256 bytes (33 sectors per track)
W2	Parity            A to B: Enabled B to C: No parity *
W3	Always installed *

\* = Factory settings

#### JUMPERS



WINCHESTER CONTROLLER BOARD LAYOUT

## Pin Assignments on the Winchester Controller board

<u>Pin</u>	<u>Signal Name</u>	<u>To or From Controller</u>
2	REDUCED WRITE CURRENT	from
4	HEAD SELECT bit 2 *	from
6	WRITE GATE	from
8	SEEK COMPLETE	to
10	TRACK ZERO	to
12	WRITE FAULT	to
14	HEAD SELECT bit 0 *	from
16	Reserved	
18	HEAD SELECT bit 1 *	from
20	INDEX	to
22	READY	to
24	STEP	from
26	DRIVE SELECT 1	from
28	DRIVE SELECT 2	from
30	DRIVE SELECT 3 (not used)	from
32	DRIVE SELECT 4 (not used)	from
34	DIRECTION IN	from

\* Up to 8 heads may be selected by this 3-bit number.  
All signals are asserted when negative.  
All odd-numbered pins are connected to ground.

## J1 CONNECTOR - WINCHESTER DISK CONTROL SIGNALS



<u>Pin</u>	<u>Signal Name</u>	<u>To or From Controller</u>
1	DRIVE SELECTED	to
2	GND	both
3	Reserved	
4	GND	both
5	Reserved	
6	GND	both
7	Reserved	
8	GND	both
9	Reserved	
10	Reserved	
11	GND	both
12	GND	both
13	+MFM WRITE DATA	from
14	-MFM WRITE DATA	from
15	GND	both
16	GND	both
17	+MFM READ DATA	to
18	-MFM READ DATA	to
19	GND	both
20	Reserved	

**J2 CONNECTOR - WINCHESTER DISK DATA SIGNALS**

Connector J3 would be used for a second Winchester drive, if fitted (i.e. normally J3 is not used). The pin assignments for J6, the SASI bus, were described on page 53-9.

**Error Codes**

The error codes which can be sent by the SASI interface are listed on pages 4-12..15. In addition to these, there are 33 possible codes which may be displayed on the LEDs on the card itself (though some are the same as the codes sent to the screen via the SASI).

The LED codes are listed below. Note that the LED at the corner of the board is the least significant bit of the code, and that the LEDs are labelled 1 to 8 on the board, rather than 0 to 7.

<u>Hex</u>	<u>Binary (LED) Values</u>								<u>Description</u>
<u>Error</u>									
<u>Code</u>									
								↙ LED at corner of board	
00	0	0	0	0	0	0	0	0	No error condition, normal operation
01	0	0	0	0	0	0	0	1	No Index pulse from drive
02	0	0	0	0	0	0	1	0	No Track 0 from drive after restore
03	0	0	0	0	0	0	1	1	Sector address beyond maximum
04	0	0	0	0	0	1	0	0	Winchester drive not selected
05	0	0	0	0	0	1	0	1	No Seek Complete from drive
06	0	0	0	0	0	1	1	0	No ID Address Mark received
07	0	0	0	0	0	1	1	1	No Data Address Mark received
08	0	0	0	0	1	0	0	0	Seek Error, cylinder or head wrong
09	0	0	0	0	1	0	0	1	Sector not found
0A	0	0	0	0	1	0	1	0	ECC error in ID field
0C	0	0	0	0	1	1	0	0	Invalid command received
0D	0	0	0	0	1	1	0	1	Incorrect Data Mark
0E	0	0	0	0	1	1	1	0	Incorrect ID Mark
0F	0	0	0	0	1	1	1	1	Incorrect Cylinder Address from drive
10	0	0	0	1	0	0	0	0	Incorrect Sector Address from drive
11	0	0	0	1	0	0	0	1	Incorrect Head Address from drive
12	0	0	0	1	0	0	1	0	Uncorrectable data error
13	0	0	0	1	0	0	1	1	Correctable data error
14	0	0	0	1	0	1	0	0	Drive not ready
15	0	0	0	1	0	1	0	1	Write fault condition
17	0	0	0	1	0	1	1	1	Drive is write protected
18	0	0	0	1	1	0	0	0	RAM diagnostic error
1F	0	0	0	1	1	1	1	1	Unable to read alternate track
20	0	0	1	0	0	0	0	0	Host adaptor has parity circuit fault
21	0	0	1	0	0	0	0	1	Bad block detected from drive
22	0	0	1	0	0	0	1	0	Invalid function for drive type
32	0	0	1	1	0	0	1	0	Seek in progress
33	0	0	1	1	0	0	1	1	Volume overflow
40	0	1	0	0	0	0	0	0	Idle condition
81	1	0	0	0	0	0	0	1	Multiple LUNs selected, fatal error
82	1	0	0	0	0	0	1	0	Sequence time-out during disk transfers
C0	1	1	0	0	0	0	0	0	Controller selected

A "1" in this table indicates a lit LED.  
Values not listed are not used.

LED DISPLAY ERROR & STATUS CODES

## Formatting

The Winchester disk is "soft sectored", which means that sectors are identified from specially recorded signals placed there by a formatting program. Normally the Winchester disk will not need formatting, but the process is described below in case a hardware error has disrupted the disk. Note that the operating system is configured to treat the Winchester drive as two separate drives (see page 4-16), which cannot be formatted independently. Formatting is carried out by the controller on receipt of a single, simple command. This command can be called up via the Installation Floppy menu program, which was described on page 4-9..10.

### 5.3.3 The Winchester Disk Drive

The Winchester drive fitted to CR7s is compatible electrically with the Seagate ST506 / 412 models. Like the floppy drive, it is of half-height, so that a floppy drive and a Winchester may be fitted into the standard sized aperture for one 5.25" disk drive.

It is very probable that CR's choice of Winchester drive for the CR7 will change regularly since the market place in this field is very fluid; newer and better drives are constantly being brought out. For this reason, very few details of a particular drive are given here since the information would soon become obsolete.

Those details that do follow apply to the SyQuest SQ306F drive, which was the current choice in August '83.

Capacity	6.38 Mbyte unformatted, 5.0 Mbyte formatted
Transfer rate	5.0 Mbits/sec
Access time	70 ms average, 3ms track to track, 185 ms maximum
Average latency	8.46 ms
Recording density	12000 bpi maximum
Track density	435 tpi
No. of tracks	306 on each side
no. of R/W heads	2
No. of platters	1
MTBF	11000 power-on hours, typical
Heat dissipation	15 watts, maximum
Power requirement	12 V $\pm$ 5% at 0.7 amps 5 V $\pm$ 5% at 0.9 amps
Error rates	as for Teac Floppy drive (see page 54-1)

#### WINCHESTER DRIVE SPECIFICATION

The drive employs a buffered seek mode for faster access.

The disk itself has a glass-like coating over the magnetic layer which protects it against dust and smoke particles; the disk is claimed by its manufacturer to be impervious to head crashes.

The red light on the drive is lit when the drive is selected (i.e. when a read or write is in progress.)







## 5.4 FLOPPY DISK DRIVE

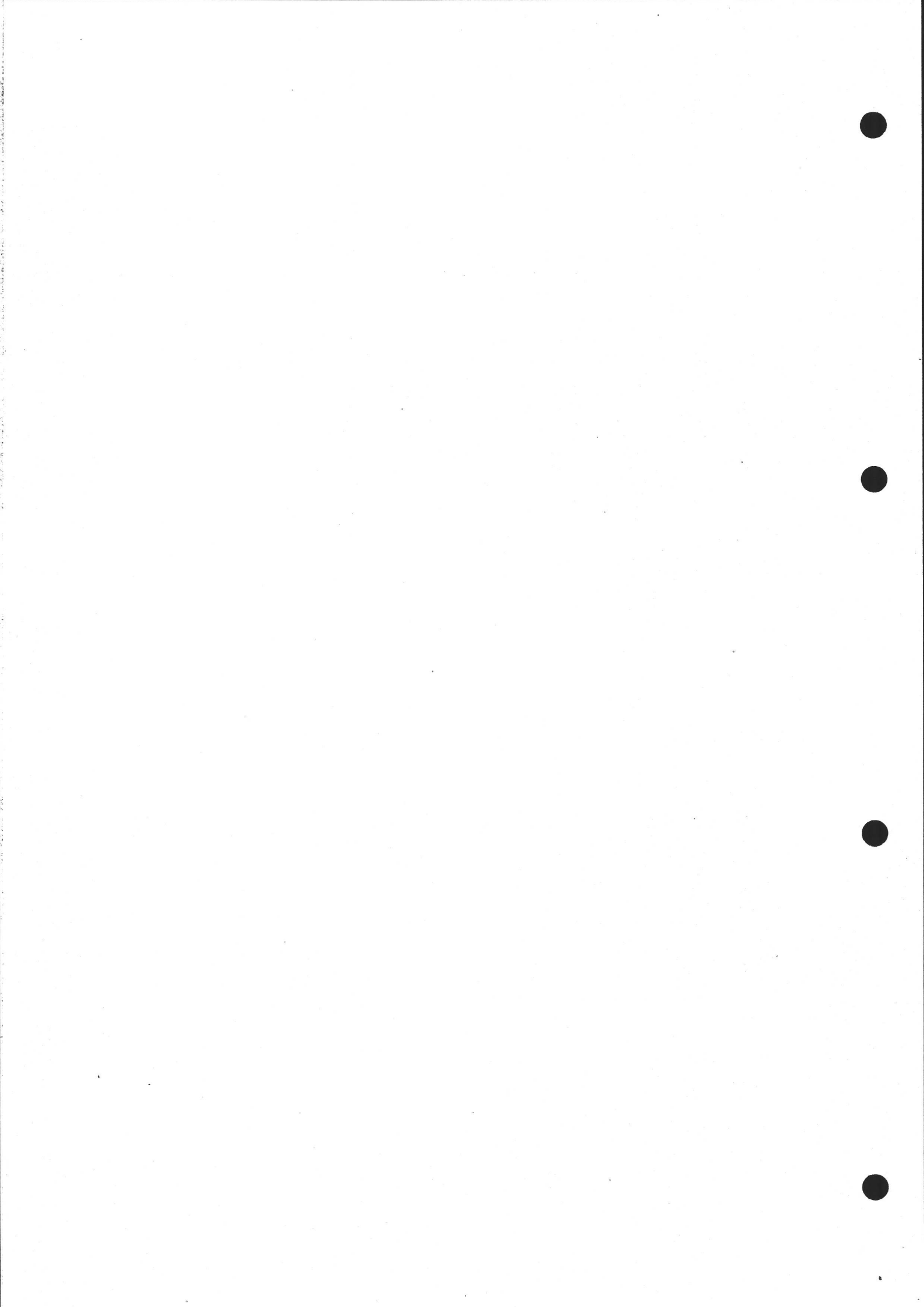
The specification of the Teac FD-55F floppy disk drive used in the CR7 are as follows:

Recording method	MFM
Data transfer rate	250 Kbits/sec
Tracks/disk	160
Maximum data density	5922 bits per inch
Data capacity	1000 Kbytes per diskette (unformatted) 655.36 Kbytes (formatted)
Motor speed	300 rpm
Average latency	100 msec
Track density	96 tpi
Number of cylinders	80
Recording medium	Industry standard 5.25" floppy diskettes
Error rates:	
soft read	1 in $10^9$ bits (up to 2 retries)
hard read	1 in $10^{12}$ bits
Seek error	1 in $10^6$ seeks

The unit has just one control and one indicator light. The disk is inserted through the slot (see page 3-14). The red light will be illuminated only while data is being read from or written to the drive.

Note that the floppy drive controller forms part of the processor board, so was described in section 5.2 (see Index for page numbers).

The floppy disk is accessed by various Drive Letters; page 4-16 gives details.



## 5.5 X-NET TERMINAL ADAPTOR, XTA

The XTA is an optional extra for the CR7. It is a separate computer within the CR7 with a special function.

### 5.5.1 X-Net

X-Net is CR's local area network system, which is used for connecting various computing resources within, say, a factory or university campus. X-Net will connect to any manufacturer's equipment. If using non-CR equipment, the connection is made through an XTA in its own small cabinet. However if using the CR7 Diplomat-X microcomputer, or the CR7 Comfort-X or CR5 Compass-X terminals, then the XTA is built-in.

### 5.5.2 The Role of the XTA within X-Net

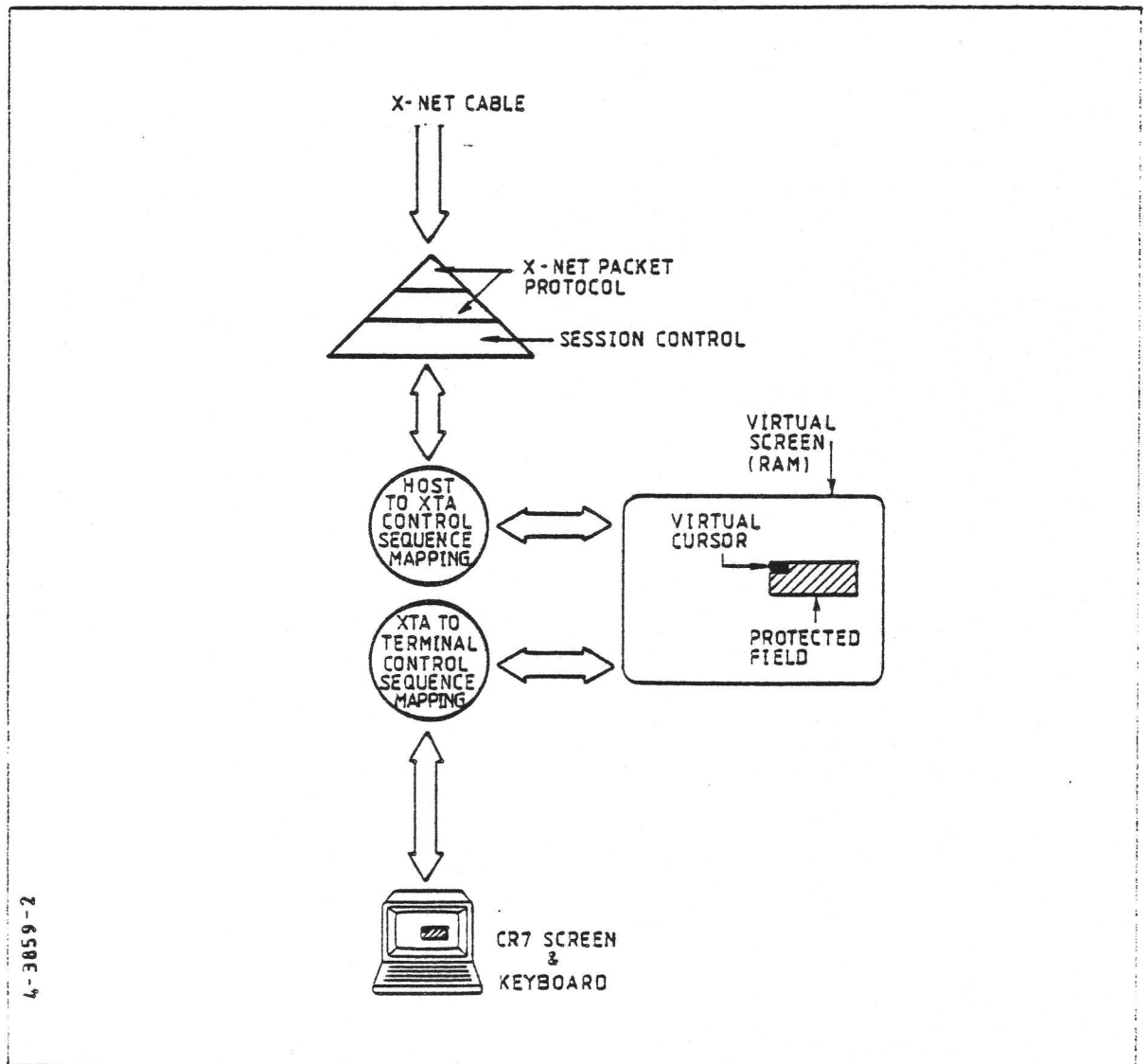
The main function of the XTA is to convert between a V24 terminal protocol and the X-Net frame protocol. The throughput of the board is up to 9.6 Kbits sec.

The XTA performs the additional function of terminal emulation. The rest of this section deals with that issue.

Unfortunately, terminals made by different manufacturers vary not only in the physical layout of the keys, and the presence or absence of some of the keys, but even in the meanings of certain keys and sequences of key-strokes. Obviously, X-Net can do nothing about the physical layout of keys, but it can and does provide the facility to translate the codes generated by the keyboard so that the terminal of one manufacturer "looks like" that of another. To be more precise, the terminal can be made to respond like that of another vendor. Put another way, a given terminal can be made to appear to an IBM processor as an IBM terminal, then on another occasion the same terminal can appear to a PDP-11 as, say, a VT100 (PDP-11) terminal. This facility comes to the fore when using full-screen editors and the like since the commonest form of discrepancy between terminals occurs with cursor functions.

X-Net's software can emulate virtually any host or terminal. This includes

the emulation of protected fields on the screen where required, by using a map in memory of the VDU screen. This process is illustrated below.



**TERMINAL EMULATION**

The process illustrated above is handled within the XTA; the host end of the emulation is done elsewhere (at the X-Net Port).

**5.5.3 XTA Hardware Overview**

The terminal adapters and the controller between them comprise the basic intelligence of the X-Net. In other words, the XTA converts between the terminal protocol and the frame protocol required by X-Net.

It is the terminal adapter which is addressed by X-Net users. There can be up

to 254 of them on a single X-Net.

The purposes of the various components shown in the Block Diagram are outlined below.

### Description of XTA Components

8-bit and 4-bit Switches. These switches are read by the XTA board. Details appear on page 55-7.

EPROM. This is the boot PROM for the board. When the CR7 is first switched on, the program in this PROM automatically starts to execute in the XTA's CPU. This program informs the X-Net Controller (via the network itself) that it has been switched on. The Controller responds by downloading the program to run in the XTA from its (the Controller's) own disk.

RAM. The 32 Kbytes of RAM are used to contain the program which is downloaded at boot time from the Controller.

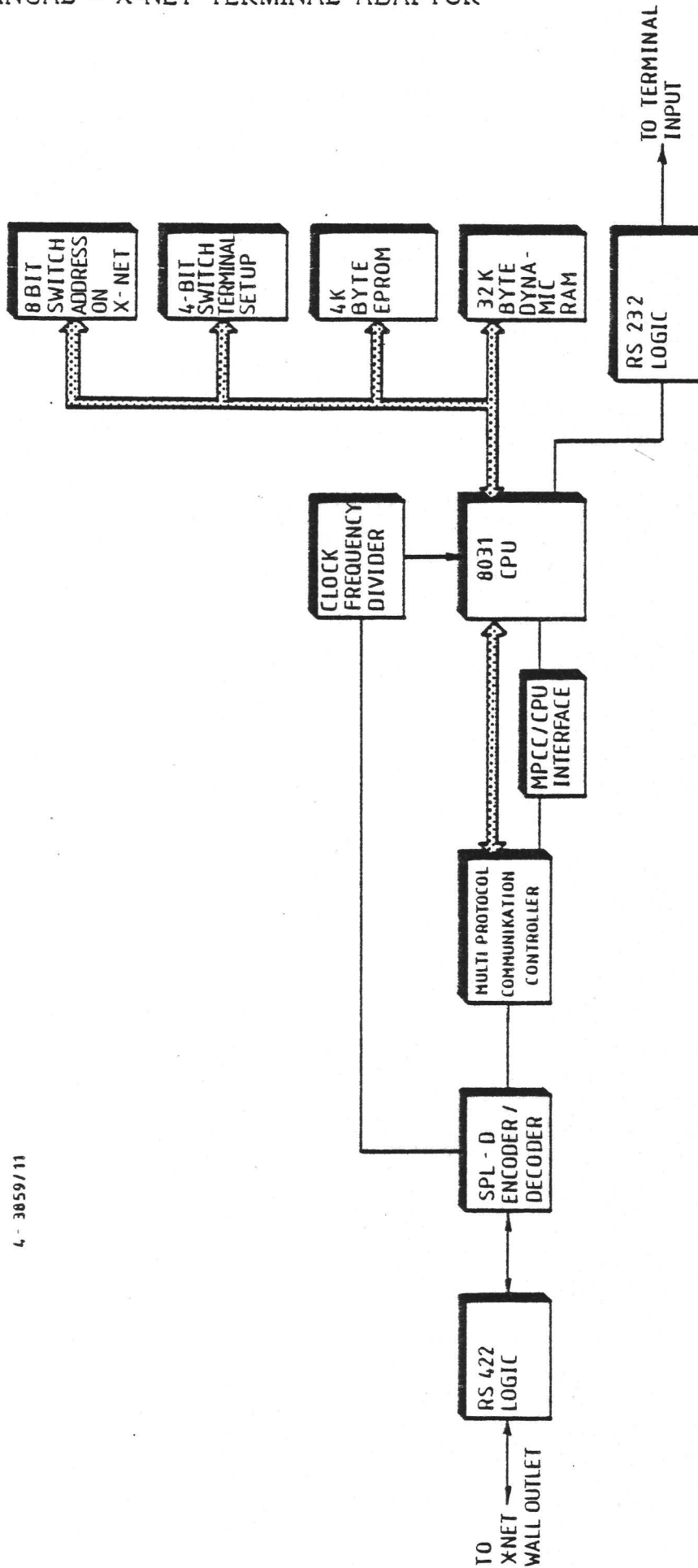
CPU. The CPU on the XTA board is an Intel 8031. It here that the protocol conversion and terminal emulation software runs.

The 8031 chip also includes the serial interface between the XTA and the CR7 Video Controller board (or an external terminal, if so desired). The interface has the following characteristics:

- o Asynchronous V24 DTE
- o Full or half duplex
- o Local or remote echo
- o Speeds of from 50 to 19200 Kbit/sec
- o Character mode: 7 bits/char., even parity, 1 stop bit.

The speed (Baudrate) and Character mode may be altered by software as required. Details of the assignment of signals to pins on this interface are given on pages 55-10 and 52-13.

The CPU chip also contains an interrupt controller and timers.



4 - 3859/11

XTA BLOCK DIAGRAM



Multi-Protocol Communication Controller (MPCC). This is a single chip which converts both ways between the simple stream of bytes required by the CPU, and the HDLC frame format required by X-Net.

SPL-D Encoder/Decoder. The HDLC code referred to above goes through a further stage of conversion, to (or from) a code called SPL-D. SPL-D is a means of combining data and clock signals into one signal. This has two advantages. One is to reduce the numbers of wires needed in the X-Net bus (i.e. the cable that forms the network itself); the other is to ensure that clock and data pulses remain in perfect synchrony. If they were in two separate wires, the wires could have different characteristics and could cause timing problems when long distances were involved.

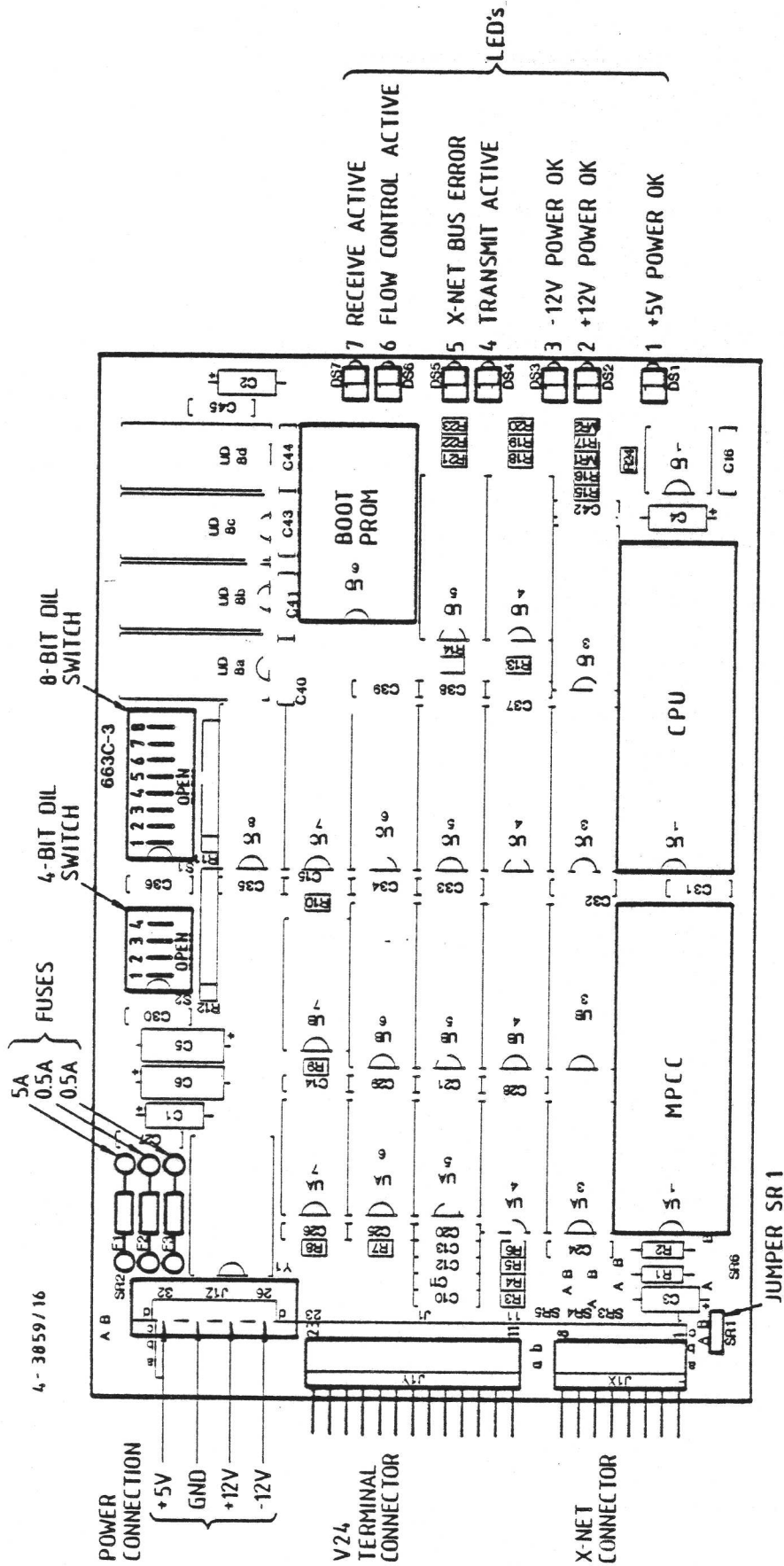
Clock Frequency Divider. The clock output from the SPL-D module (which originated from the X-Net Controller) is divided by 6 and used as input for Baud rate generation by the serial interface section of the CPU.

RS422 and RS232 Logic. These two modules serve similar functions, namely to change the voltage levels of signals going through them, in accordance with the levels defined by RS422 and RS232.

12 MHz Oscillator. This co-ordinates the activities of the board, in particular the execution of instructions in the CPU. It is not used for Baud rate generation since it is not at a frequency which can be conveniently divided to the required Baud rates.

### **Board Layout**

The XTA board is illustrated overleaf, followed by some practical details of some of the items illustrated.



XTA BOARD LAYOUT

### Integration into X-Net

The XTA installed within the CR7 is identical to the separate XTA box (the version using dynamic RAM) which is used for connecting other manufacturers' terminals to X-Net - thus the installation procedure is essentially the same. However, to gain access to the DIL switches on the XTA it is of course necessary to look inside the CR7 instead of in a separate small unit. The position of the XTA is shown in the illustration on page 50-2. Full details of the installation of a microcomputer or terminal into X-Net are given in section 5.3 of the document "X-NET/RFM/0004 X-Net Installation Guide". This includes the DIL switch settings. However, summary tables are given below. See also pages 50-3 and 55-9 of this manual (XTA cable connections).

### DIL Switch Settings

<u>Switch Number:</u>	8	7	6	5	4	3	2	1	
<u>Bit No. in X-Net Address:</u>	7	6	5	4	3	2	1	0	
1 = Open    0 = Closed	MSB								LSB

8-bit DIL switch - X-Net Address

<u>Baud Rate</u> (bits/sec)	<u>Switch No.</u>			
	<u>1</u>	<u>2</u>	<u>3</u>	
19200	1	1	1	1 = Open 0 = Closed
9600	0	0	0	
4800	1	0	0	
2400	0	1	0	
1200	1	1	0	
600	0	0	1	
300	1	0	1	
50	0	1	1	

Switch 4:    Closed: Normal operation  
                  Open: "Command Mode" text not displayed

4-bit DIL switch

PUSH SWITCHES DOWN AT THE END MARKED "OPEN" TO SET A "1"

Note that it is possible to override the Baud rate switch setting via software downloaded from the Controller.

### Jumper settings on the XTA

There are 6 jumpers on the board. They should all be set to the "A" position. The only one a user might possibly want to move is no. SR1.

SR1    A:    V24 circuit 101. Cable shield (Protect) connected to ground.  
          Factory setting.

          B:    Circuit 101 Signal connected to ground.

### Fuses

Three fuses are soldered onto the PCB.

<u>Position</u>	<u>Rating</u>	<u>Protected Circuit</u>
Nearest to edge of board	5A	+5V
Middle	0.5A	+12V
Nearest to centre of board	0.5A	-12V

### LEDs

The board is supplied with 7 LEDs that show the current status of the board (see page 55-6). In normal use, LEDs 1, 2, and 3 will be on, and 4 and 7 will flash briefly every 3 seconds or so. Light number 6 will glow if transmission to and from the destination device on X-Net has been temporarily halted by the destination device. For example, a slow printer could signal that its input buffer is full and that the CR7 must wait until the printer is ready for more data.

### Cable Connections

As can be seen from the illustration on page 55-6, the XTA has 3 cable connectors. The power input is wired as shown in the illustration. The other two are described below.

Note that the cabling is different on the different varieties of CR7; an overview diagram appears on page 50-3. The terminal-only version with an XTA is remarkable in that an external cable must be connected between sockets A and B at the back. This is so that the XTA can be used independently if so desired (i.e. it can be connected between another terminal which has no XTA of its own, and the X-Net Wall Outlet.)

<u>Pin Numbers on CR7 Con- nector to the Outside World</u>	<u>Signal Names</u>	<u>XTA Board Connector Pin Nos.</u>
No pin	Not connected	8a
1	DIS+	8b
9	DIS-	7a
2	TXD-	7b
10	TXD+	6a
3	RXD+	6b
11	GND	5a
4	RXD-	5b
12	GND	4a
5	GND	4b
13	VCC	3a
6	VCC	3b
14	GND	2a
7	VCC	2b
15	VCC	1a
8	GND	1b

### X-NET CONNECTORS - PIN ASSIGNMENTS

<u>Signal Name</u>	<u>Description</u>
DIS+ and DIS-	Enable signal to X-Net Wall Outlet
TXD+ and TXD-	Transmitted data. The Upper Bus on X-Net
RXD+ and RXD-	Received data. The Lower Bus on X-Net
VCC	+5V power to Wall Outlet
GND	Ground (earth) for VCC

**X-NET CONNECTOR - SIGNAL DESCRIPTIONS**

The signal descriptions for the V24 interface were given on page 52-13, apart from SIG.GND and PROT.GND which are Ground for Signal and Protected Ground respectively.

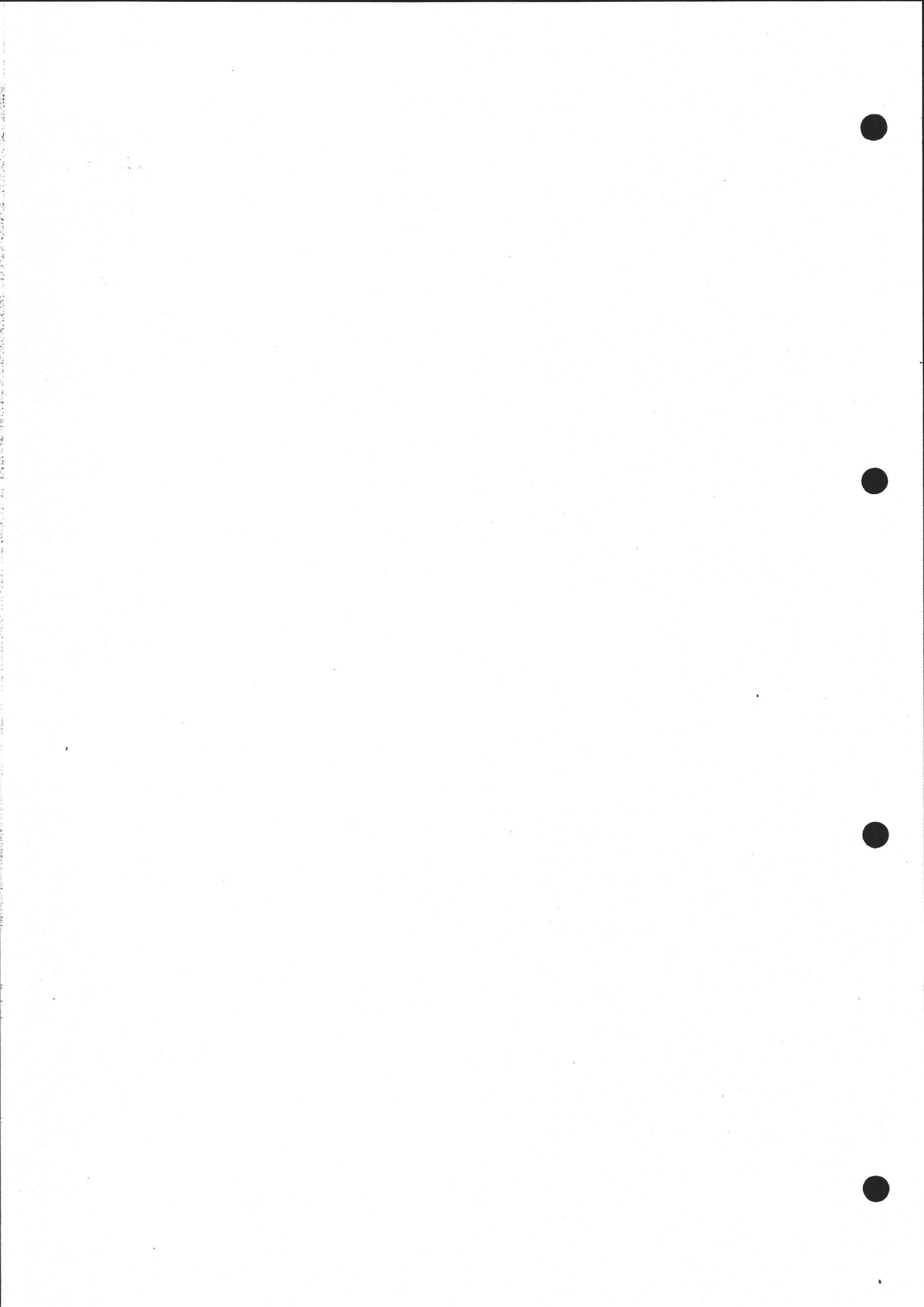
**V24 CONNECTOR - SIGNAL DESCRIPTIONS**



<u>CR7 Diplomat-X Microcomputer Pin Numbers on Processor Board Connec- tor J1</u>	<u>CR7 Comfort-X Terminal Pin Numbers on Rear Connector "A"</u>	<u>Signal Name (V24 Circuit Number)</u>	<u>XTA Board Connector Pin Numbers</u>
	No pin	Not connected	23a
A13 to A9	13,25,12,24,11,	Not connected	23b,22a,22b,21a,21b,
B13 to B8	23,10,22,9,21	Not connected	20a,20b,19a,19b,18a
A8	8	109 DCD	18b
B7	20	108 DTR	17a
A7	7	102 SIG.GND	17b
B6	19	Not connected	16a
A6	6	107 DSR	16b
B5	18	Not connected	15a
A5	5	106 CTS	15b
B4	17	Not connected	14a
A4	4	105 RTS	14b
B3	16	Not connected	13a
A3	3	104 RXD	13b
B2	15	Not connected	12a
A2	2	103 TXD	12b
B1	14	Not connected	11a
A1	1	101 PROT.GND	11b

The two connectors are joined inside the CR7 by a flat cable from the XTA to either the processor or rear connector "A". The table above lists the wires in the order that they appear across the cable.

V24 CONNECTORS - PIN ASSIGNMENTS



## 5.6 SYSTEM BOOTING

When power is switched on to the processor board, two Reset signals are asserted as described on page 52-7.

Then the software in the Boot PROM starts to run. One of the first things it does is to switch on the red LED on the board. Then various self-test procedures are carried out. If the testing fails, the LED will remain lit and one of the following messages will appear on the screen:

Z80 MEM. ERR. WRITE = xx READ = yy

or

NO CTC INTERRUPTS

The sequence of events for bringing up the system after a reset will depend upon the operating system in use. Please refer to the appropriate section below. Note also "selecting the Boot Source" on page 3-33.

### 5.6.1 CP/M 2.2

1. The system PROM executes memory and other hardware tests.
2. CP/M is read in from the two reserved "System" tracks on disk drive B (Winchester) or drive A in the dual floppy system.
3. CP/M is entered at its entry point in the BIOS code (Basic I/O System).
4. A start-up message is output to the screen:

CR7 BOOTLOADER Vers. 5.0

CHRISTIAN ROVSING A/S 64K CP/M VER 2.2 07-15-82  
DUAL SIDED 96 TPI 5 1/4 MINI FLOPPY BIOS, VER. 2.1  
A>

and the system is ready for use.

The above procedure is known as a "Cold Boot". A subset of this may be carried out by pressing CTRL-C on the keyboard. This is known as a "Warm Boot". In this case, the procedure starts within step 3. Only the BDOS (Basic Disk Operating System and CCP (Command Console Processor) are read in - the BIOS is assumed to be still there. The warm start is used after using certain utilities such as the debugger which overwrite the CCP code.

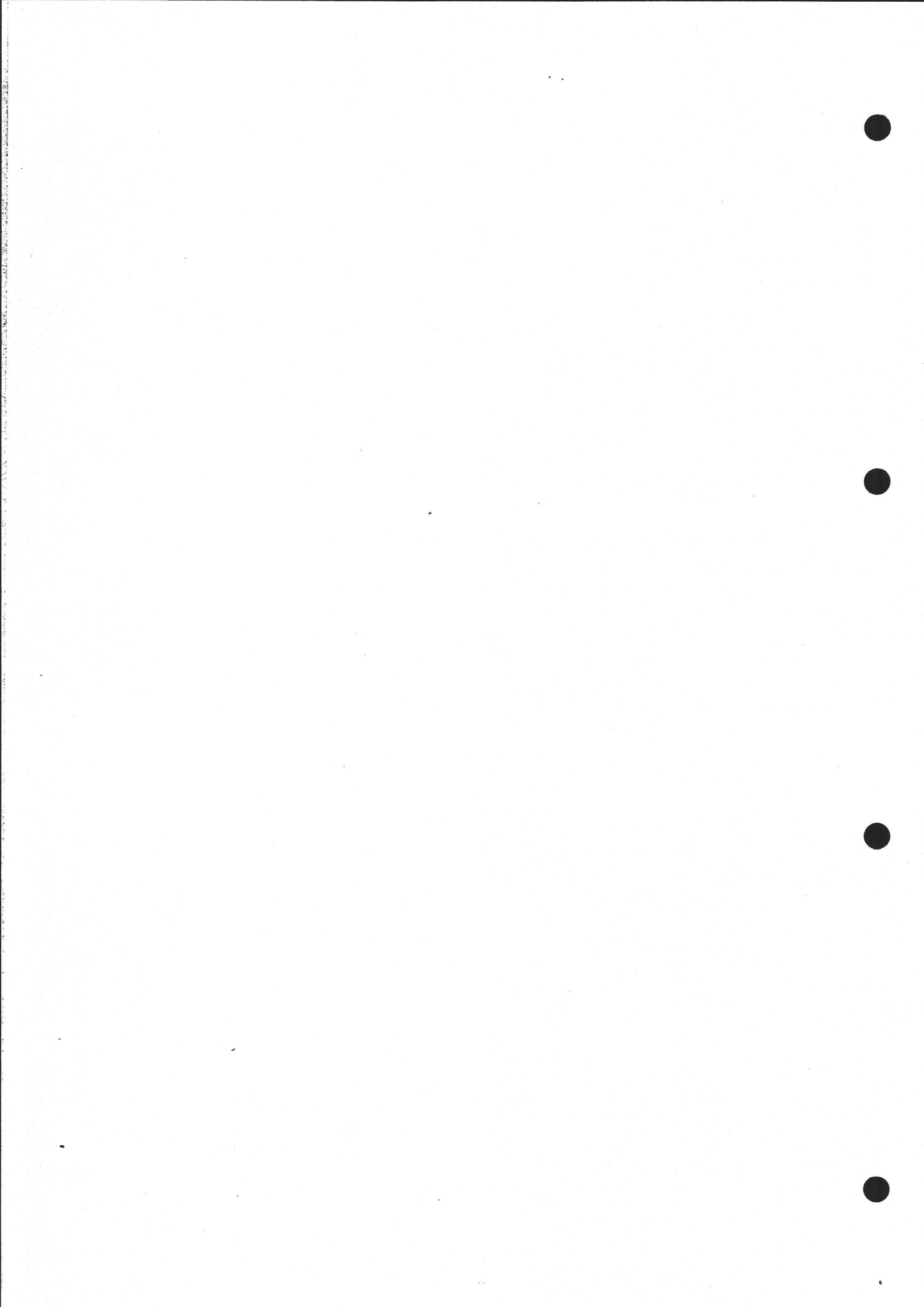
### 5.6.2 CP/M Plus

1. The system PROM contains the Primary bootloader program. This executes memory and hardware tests, then it reads the Secondary bootloader from the system tracks on the disk into RAM. The Primary bootloader announces itself as the "CR7 Bootloader Version 6.0".
2. The Secondary bootloader now starts to run. It announces itself on the as such on the screen. It loads the file CONFIG.SYS into memory. This file tells it what to load next, and where to put it in memory. The file that it loads is itself yet another loader, namely the CP/M Loader - otherwise known as the "Z80 File".
3. The CP/M loader, as its name suggests, loads CP/M+ itself, finally, into memory from the file CPM.SYS.
4. CP/M is entered at its entry point in the BIOS code (Basic I/O System). Then it announces itself, and reads the default directory into memory. There is a short pause while this happens.
5. CP/M+ looks for a file on the default disk (normally drive A) called PROFILE.SUB. If it exists, it runs it. The user can put whatever commands he likes into this file, and they will be executed automatically every time the CR7 is switched on.

The system is now ready for use.

The above procedure is known as a "Cold Boot". A subset of this may be carried out by pressing CTRL-C on the keyboard. This is known as a "Warm Boot". In this case, the procedure starts within step 4. Only the BDOS (Basic Disk Operating System and CCP (Command Console Processor) are read in - the BIOS is assumed

to be still there. The warm start is used after using certain utilities such as the debugger which overwrite the CCP code.





6. LIST OF ABBREVIATIONS

ACK	Acknowledge (affirmative)
BCD	Binary Coded Decimal
BEL	Bell or bleep
BIOS	Basic Input/Output System
BS	Back Space
BSC	Binary Synchronous Communications (a set of rules for data transmission)
CAN	Cancel
CCITT	International Telegraph and Telegram Consultative Committee
CCP	Console Command Processor
COBOL	COMmon Business Oriented Language
CP/M	Control Program/Microcomputer. Operating system used in the CR7
CPU	Central Processor Unit
CR	Christian Roving A/S, manufacturers of the CR7. Also: Carriage Return
CR8	CR8/16 microcomputer. Similar to the CR7, but more sophisticated.
CR80	A minicomputer manufactured by CR (q.v.), often used as a front-end processor
CRT	Cathode Ray Tube (the front of which is the screen on a VDU)
CTC	Control and Timer Circuit
CTRL	Control
DC1	Data Control character no. 1; also known as XON (q.v.)
DC2	Data Control character no. 2; also known as XOFF (q.v.)
DC3	Data Control character no. 3
DC4	Data Control character no. 4
DCE	Data Circuit terminating Equipment
DDT	Dynamic Debugging Tool
DEL	Delete previous character
DIL	Dual In-Line
DLE	Data Link Escape (part of BSC)
DMA	Direct Memory Access
DTE	Data Terminal Equipment
DTR	Data Terminal Ready
EHT	Extra High Tension
EM	End of Media (part of BSC)
ENQ	Enquiry (part of BSC)
EPROM	Erasable Programmable Read Only Memory
ESC	Escape (part of BSC)

## CR7 USER MANUAL - ABBREVIATIONS

ETB	End of Transmission Block (part of BSC)
FF	Form Feed
FS	File Separator (part of BSC)
GS	Group Separator (part of BSC)
HDLC	High Level Data Link Control
HT	Horizontal Tabulator
I/F	Interface
I/O	Input-Output
JCL	Job Control Language used with IBM mainframes
LED	Light-Emitting Diode
LF	Line Feed
LSB	Least Significant Bit
LUN	Logical Unit Number
MFM	Modified Frequency Modulation
MPCC	Multi-Protocol Communications Controller
MSB	Most Significant Bit
MTBF	Mean Time Between Failures
NAK	Negative Acknowledge (part of BSC)
NMI	Non-Maskable Interrupt
NUL	the Null character
OC	Open Collector
OEM	Original Equipment Manufacturer
PAL	Programmable Array Logic
PAM	Process Addressable Monitor (a CR product)
PCB	Printed Circuit Board
PCI	Programmable Communications Interface
PIO	Programmable Input-Output device
PIP	Peripheral Interchange Program
PIT	Programmable Interval Timer
PROM	Programmable Read-Only Memory
RAM	Random Access Memory
ROM	Read-Only Memory
SASI	Shugart Associates System Interface
SDLC	Synchronous Data Link Control
SI	Shift In
SIO	Serial Input-Output device
SO	Shift Out
SOH	Start of Heading (part of BSC)
SPP	Speed Programming Package

STX	Start of TeXt (part of BSC)
SUB	Substitute (part of BSC)
SYN	Synchronous idle (part of BSC)
TOF	Top Of Form
US	Unit Separator (part of BSC)
USART	Universal Synchronous/Asynchronous Receiver/Transmitter
VDU	Visual Display Unit (a terminal that has a screen)
VT	Vertical Tabulator
VT100	a VDU (q.v.) manufactured by Digital Equipment Corp.
XOFF	Transmit off
XON	Transmit on
XTA	X-Net Terminal Adaptor
XWO	X-Net Wall Outlet

7. INDEX

Some notes on the use of this Index

1. The first page number(s) mentioned for each topic refers to the main entry (if any) for that topic.
2. The notation (for example) 5-66..68 means that the reference starts on page 5-66 and continues through to page 5-68. On the other hand, 5-66, 5-67, 5-68 means that there are one or more separate references to the topic on each of these three pages.
3. Please note the different uses of the semicolon and comma. When listing references to other subject names in the index, whole entries are separated by semicolons, while subsections are specified by commas. For example, the entry:

file names - see directory; specifying files

means that there are two references, one under "directory" and one under "specifying files". However, the entry:

file names - see directory, specifying files

means that there is only one reference, and it is the "specifying files" subsection of the entry for "directory".

? - see ambiguous file specification  
 \* - see ambiguous file specification  
 > - see system prompt  
 1713 - see floppy disk controller  
 7705 chip 52-7  
 825123 Bipolar PROM - see I/O address decoder  
 8080 assembler - see ASM assembler  
 8251A - see processor board, USART

**A**

A> - see system prompt  
 abbreviations (list of) 6-1..2  
 access - see internal access  
 ACK 6-1  
 active  
   disk - see Current disk  
   line 51-39

address decoder - see I/O address decoder  
 addressing  
   ,character PROM 51-32..33  
   ,I/O 52-21  
     - see also: I/O address decoder  
   (mailing program) - see mailing program  
   ,memory 2-2, 52-17..19, 52-20..21  
   ,SASI 53-8  
 adjustment  
   ,Baud rate - see Baud rate setting  
   ,tilt - see tilt control  
   ,voltage - see voltage setting  
 ALERT light (42A printer) 3-11  
 ALT key 3-7  
 altering text - see editing; editor  
 alternate character sets - see character set(s)  
 Am9517A - see DMA  
 ambiguous file specification 4-5..6

ANSI X3.64 51-1  
 Application Mode - see keyboard Application Mode  
 applications  
   ,files used in different 4-1  
   packages 1-3, 2-4..11, 1-10..13  
 application software - see applications packages  
 arithmetic - see spreadsheet program  
 arrow keys 3-7, 3-8  
 ASCII codes (table of) 51-58  
 ASM assembler 2-11, 4-7  
 assembler language  
   ,ASM - see ASM  
   ,macro - see macro assembler  
 Attributes - see character attributes  
 Auto and Manual operation of Menus  
   - see MENU MAN program  
 auto-repeat keys - see repeat

## B

back panel 50-3, 51-4  
 BACK SPACE key 3-7  
 backup - see copying; incremental disk backup  
 banking (of memory) 52-16..19  
 BASIC 2-13  
 Basic I/O System - see BIOS  
 Baud rate  
   clock 51-11, 52-9, 52-22  
   setting 51-7..8, 3-9, 4-8  
 BCD 6-1  
 Bdos Err 3-26  
 BEL 6-1  
 bell - see noises  
 BIOS 56-1, 56-2, 6-1  
 bleep - see noises  
 bleeper 51-37  
   ,volume control for 51-37  
 blink - see character attributes; cursor blink  
 Block cursor - see cursor shape  
 block diagram  
   ,processor board 52-2  
   showing differences between models 50-3  
   ,whole system 2-1  
   ,XTA 55-4  
 boot - see system reset  
   load PROM 52-8..9, 52-21, 52-22, 52-24  
 brand-new diskette - see formatting of disks  
 BREAK key 3-7  
 brightness and contrast 51-6, 3-4, 51-4  
 BS 6-1  
 BSC 2-2, 6-1  
 built-in commands 4-3  
 bus - see processor board, bus on; SASI bus reset

## C

Cabinet models - see CR7 Cabinet models  
 cabling 50-3, - see also entries under the various modules to be connected  
 calculation and financial planning program  
   - see spreadsheet program  
 CAN 6-1  
 Cannon connector 52-15  
 capacity  
   of diskette 54-1  
   of Winchester 53-18  
 CAPS LOCK key 3-6  
 card index (feature of word processor) 2-8

care and storage of diskettes  
   - see diskettes, care of  
 carriage return - see RETRN key  
 catalogue  
   of books in a library 2-10  
   of files on a disk - see DIR command;  
   LIST FILE NAMES command  
 CB80 - see Basic  
 CBASIC - see Basic  
 CCITT 2-2, 52-12, 6-1  
 CCP 56-2  
 changing  
   diskettes - see diskettes, inserting; SET DISKETTE "WRITE-ENABLED" command  
   name of file - see REN command  
   text - see editing; editor  
 channel A - see serial interface  
 channel B - see serial interface  
 channel C - see serial interface  
 character(s)  
   ,accessing particular 51-23..30  
   attributes 51-49..51, 51-9, 51-55  
   matrix 51-34..36, 51-31  
 character set(s) 51-20..37  
   ,CR 51-24..25, 51-27,  
   - see also: character set, selecting  
   ,ESC sequence access to 51-27..28  
   ,Normal Mode 51-24  
   ,personalized 51-31..37  
   PROM 51-31..37  
   ,selecting 51-20..23, 51-8, 51-9  
   ,Special Mode 51-25..26  
   supplied with CR7 51-20..30  
   ,VT100 51-24, 51-26, 51-28,  
   - see also: character set, selecting  
 CHOOSE CURRENT DISK DRIVE command  
   - see Current Disk  
 clock - see Baud rate clock; XTA clock frequency divider  
   and power-up logic 52-6  
 COBOL 2-14, 2-10, 6-1  
 COGEN 2-14  
 cold boot 56-2  
 .COM file type 3-33  
 command files  
   under CP/M 3-33, - see also: SUBMIT command  
   under dBaseII 2-11  
 command line 4-2..4, 2-3,  
   - see also: specifying files; SUBMIT command  
 commands  
   ,built-in - see built-in commands  
   ,special - see special CR7 commands  
   - see also: CP/M commands; Menu system  
 command tail 4-3  
 communications software 2-3, 1-11  
 compilers - see Basic; Cobol; Fortran; Pascal  
 component layout - see location of components  
 composite video output 51-37  
 configuration options - see options  
 connections - see plugging in  
 connectors 2-1  
 contrast - see brightness and contrast  
 Control - see CTRL  
 control and timer circuit - see CTC  
 COPY FILES command 3-26, 3-36  
 copying 3-17..19  
   complete diskette 3-18, 3-30, 3-36  
   - file-by-file 3-18..19,  
   - see also: COPY FILES command  
   to system tracks of disk  
   - see system generation



# CR7 USER MANUAL - INDEX

cost planning - see project management;  
spreadsheet program  
CP/M 52-13, 52-14, 6-1  
  BIOS - see BIOS  
  commands 4-6..7  
  loader 56-2  
  ,relationship between CP/M and Menu system  
    3-19, 3-36  
  ,running a program under 3-33  
  - see also: operating system  
CP/M + - see CP/M Plus  
CP/M 2.2 1-10, 2-2, 56-1  
CP/M 3.0 - see CP/M Plus  
CP/M Plus 1-10, 2-2, 2-3, 52-16, 56-2..3  
CPU 2-1, 52-1, 6-1,  
  on video controller board 51-37  
  on XTA - see XTA, CPU  
  - see also: processor board  
CR 6-1  
CR3 Compass terminal 51-1, 55-1  
CR7  
  Cabinet models 51-1  
  Comfort 1-4  
  Comfort-X 1-4  
  ,differences between models 1-4..5, 50-3,  
    51-1  
  Diplomat 1-4..5  
  ,installation of - see installation of CR7  
  ,operation of - see operation of CR7  
CR8 6-1  
CR80 6-1  
CR character set - see character set(s), CR  
critical path analysis 1-11, 2-10  
CR logo 51-30  
  key 3-9  
CRT 2-1, 6-1  
CTC 52-7, 52-1, 52-3, 52-21, 52-24, 6-1  
CTRL codes 51-38, 51-14, 6-1,  
  - see also particular codes listed below  
CTRL key 3-6, 4-4  
CTRL-N 51-9, 51-22, 51-23  
CTRL-O 51-9, 51-22, 51-23  
CTRL-P 4-7, 4-6  
CTRL-Q (transmission on) 51-4  
CTRL-S (transmission off) 51-4  
Current disk 3-25, 4-1  
cursor 3-3  
  blink 51-8  
  ,Block - see cursor shape  
  control commands 51-56, 51-39..44, 51-55  
  shape 51-8, 51-9  
  ,Underline - see cursor shape  
customer base 2-10  
cut and paste 2-4

## D

daisy-wheel printer - see printer, daisy wheel  
Danish  
  character set - see character set, CR  
  keyboard - see keyboard type  
  ,software for use by Danish speakers 1-12  
data  
  base system - see dBaseII  
  length 51-8, 51-9..10  
  management system - see dBaseII  
dBaseII 2-10..11, 1-11  
DC1 6-1  
DC2 6-1  
DC3 6-1  
DC4 6-1  
DCE 6-1  
DDT command 4-7, 6-1

debugging - see DDT command; SPP  
default disk - see Current disk  
default drive - see Current disk  
delete areas of screen 51-57  
DELETE FILES command 3-27  
DEL key 3-7  
DIL switches  
  ,processor board 52-4, 52-2, 52-5, 52-24  
  ,terminal - see terminal characteristics  
    (setting of)  
  ,XTA 55-7  
DIR command 4-6  
  - see also: LIST FILE NAMES command  
DIRECTION signal 52-10  
direct memory access controller - see DMA  
directory 4-1  
disk(s)  
  access error codes - see error codes  
    (disk)  
  backup - see copying; incremental disk  
    backup  
  controller - see floppy disk controller;  
    Winchester disk controller board  
  ,copying - see copying disks  
  drive 1-2, 1-6, 50-2,  
  drive letter 4-16, 3-25, 4-4  
  drive name - see drive letter  
  drive select lines 52-11  
  - see also: floppy disk drive;  
    Winchester disk  
  files - see file  
  ,floppy - see diskettes  
  ,formatting of - see formatting  
  ,hard - see Winchester disk  
  ,initializing - see formatting  
  ,operation of - see operation of disks  
  ,purpose of 1-2  
  sectors 4-1  
  space - see STAT command  
  status - see STAT command  
  ,system tracks on - see system tracks  
  - see also: diskettes  
diskette(s)  
  ,care of 3-15  
  ,changing - see diskettes, inserting  
  ,copying - see copying disks  
  ,formatting - see formatting  
  ,illustration of 3-13  
  ,inserting 3-14, 3-25  
  ,Installation - see Installation Floppy  
  ,Menu - see Menu diskette  
  ,new - see new diskette  
  ,purpose of - see disks, purpose of  
  ,storage of - see diskettes, care of  
  ,use of 3-13..15  
  ,write-permit notch on - see write-permit  
    notch  
dismantling - see internal access  
display contents of file - see DUMP command;  
  TYPE command  
DLE 6-1  
DMA 52-4, 52-1, 52-2, 52-3, 52-8, 52-9, 52-21,  
  52-24, 6-1  
dot-matrix  
  printer - see printer, dot-matrix  
  used to form characters on screen  
  - see character matrix  
double sheet feeder - see sheet feeder  
drive - see disk drive  
DTC-510A - see Winchester controller  
DTE 2-2, 6-1  
DTR 51-8, 6-1  
DUMP command 4-7



## E

ED command 4-7  
 editing  
   ,command line 4-3..4  
   the screen display 51-45..47  
 editor  
   ,CP/M - see ED command  
   for use with Pascal - see SPP  
   - see also: word processing  
 EHT card 2-1, 50-2, 51-37, 6-1  
 EM 6-1  
 emulation - see IBM 2780 emulation; terminal emulation  
 END key 3-8  
 English  
   character set - see character set, VT100  
   keyboard - see keyboard type  
 ENQ 6-1  
 entering text - see editing; editor  
 ENTER key 3-8  
 EPROM 6-1, - see PROM  
 ERA command 4-7  
   - see also: DELETE FILES command  
 erasing files - see DELETE FILES command;  
   ERA command  
 error  
   at boot time 56-1  
   ,Bdos - see Bdos error  
   codes (disk) 4-12..15  
   ,command line (while typing in)  
     - see editing, command line  
   ,hardware 3-16  
   situations - see printer not working;  
     "stuck" programs  
   when switching on 56-1  
 escaping from the Menu system  
   - see CP/M, relationship  
 ESC codes 51-38, - see also: character sets,  
   ESC sequence method  
 ESC key 3-6, 6-1  
 ETB 6-2  
 extending the system  
   RAM 52-16..19  
   via PROM socket 52-19..20  
   via SASI 53-1

## F

F1 to F19 keys 3-6  
 FCOPY - see copying complete diskette  
 FF 6-2  
 file  
   attributes 4-1  
   copying - see copying file-by-file  
   deleting - see DELETE FILES command;  
     ERA command  
   ,description and explanation of the term:  
     1-2, 4-1..2  
   erasing - see DELETE FILES command;  
     ERA command  
   extension - see file type  
   merging - see merging  
   names - see DIR command; directory;  
     LIST FILE NAMES command;  
     RENAME FILE command; REN command;  
     specifying files  
   printing - see printing out a file  
   security - see security  
   type - see directory; specifying files  
 financial  
   modelling - see spreadsheet program  
   planning - see spreadsheet program

## firmware

  on processor board 52-8..9, 52-2  
   on video controller board 51-11, 51-13,  
     51-37  
 floppy disk - see diskette  
   controller 52-3, 1-1, 1-6, 2-1, 2-2, 52-6,  
     52-9, 52-9, 52-21, 52-24, - see also:  
     floppy disk interface  
   control & map register 52-6, 52-18, 52-21  
   drive 54-1, 1-2, 1-7, 2-1, 51-2, 51-3,  
     52-5  
   interface 52-9..12, 52-24  
 formatting  
   of disks 3-16..17, 3-35, 53-17  
   of text (in word processing) 2-5, 2-6  
 form-drawing - see graphics  
 FORTRAN 2-13  
 FS 6-2  
 function keys - see F1 to F19 keys;  
   PF0 to PF4 keys  
 fuse(s)  
   for whole CR7 51-4, 51-5  
   on XTA - see XTA, fuses

## G

graphics 51-8, 51-29  
   ,block 51-30  
   ,form-drawing 51-29  
   ,G0 and G1 51-8, 51-9, 51-20, 51-22, 51-55  
   ,high resolution 51-29  
 GS 6-2

## H

hard disk - see Winchester  
 hardware 50-1..55-11, 1-4..10, 1-1..3, 2-1..2  
 HDLC 2-2, 55-5, 6-2  
 HEAD LOAD signal 52-10  
 HEAD SELECT signal 52-11  
 Help Menu 3-23..33  
 HOME 3-7, 3-8, 51-42  
 HT 6-2

## I

IBM 2780 emulation 2-3  
 IBM mode - see Keyboard IBM mode  
 I/F 6-2  
 illustrations - see location of components  
 incremental disk backup 2-12  
 index hole 3-13  
 INDEX HOLE signal 52-10  
 indicator light - see LED(s)  
 information 1-2  
 initializing  
   ,CR7 - see system reset  
   disks - see formatting  
   terminal - see terminal reset  
 inserting diskettes - see diskettes, inserting  
 INS key 3-9  
 Installation Floppy 4-9..11  
 installation of CR7 3-1..4  
 Intel 8080 - see ASM assembler  
 interface  
   ,floppy disk - see floppy disk interface  
   ,serial - see serial interface  
   to processor board 51-10, - see also:  
     serial interface  
 internal access 50-1..2  
   to character PROM 51-36

interpreter 2-13  
 interrupt  
   controller - see CTC  
   vectors 52-7  
 inverse video - see reverse video  
 I/O 6-2  
   address decoder 52-8, 52-24

## J

JCL 2-3, 6-2  
 jumper settings  
   on processor board 52-21..24  
   on RAM extension card 52-17  
   on video controller (terminal) 51-10..11,  
   51-7, 51-37  
   on Winchester controller 53-12, 53-13  
   on XTA 55-8, 55-6  
   - see also: DIL switches

## K

keyboard 3-4..9, 1-2, 2-1, 51-2, 51-3  
 Application Mode 51-51..52, 51-3, 51-55  
 connection 3-1, 51-2, 51-3, 51-4, 51-6  
 ,Danish - see keyboard type  
 ,English - see keyboard type  
 IBM mode 51-19  
 LEDs 51-52..53, 51-2, 51-3..4  
 ,numeric keypad on 51-2, 51-3,  
   - see also: keyboard Application Mode  
 output (codes) 51-14..19  
 programming 51-20  
 type (Danish or English) 51-18..19, 51-8  
 key click - see noises

## L

layout of components - see location of  
 components  
 LED(s) 6-2  
   ,keyboard - see keyboard LEDs  
   ,processor board 52-24, 56-1  
   ,Winchester controller 53-13, 53-15..16  
   ,XTA - see XTA LEDs  
 LF 6-2  
 light - see LED(s)  
 LINE FEED 3-8, 51-39  
 lineprinter - see printer  
 LIST FILE NAMES command 3-24..25, 3-35,  
   - see also: DIR command  
 local - see off-line  
 location of components (illustrations)  
   in general (workstation models) 50-2,  
   51-2, 51-4  
   on processor board 52-24  
   on SASI 53-10  
   on video controller board 51-37  
   on Winchester controller 53-13  
   on XTA card 55-6  
 logged disk - see Current disk  
 logical  
   drive - see disk drive letter  
   unit number - see LUN  
 logo - see CR logo  
 LPBAUD - see Baud rate setting  
 LSB 6-2  
 LUN 53-11, 6-2

## M

macro assembler  
   - see assembler language, macro  
 mailing program 1-11  
 Main Menu 3-21..23  
 MAIN MENU command 3-33  
 mains - see power; voltage  
 malfunction - see error  
 manpower 2-9..10  
 Manual and Auto operation of Menus  
   - see MENU MAN program  
 map register 52-6  
 mathematical functions 2-8  
 matrix - see character matrix; dot-matrix  
 printer  
 memory - see addressing, memory; banking (of  
   memory); PROM; RAM  
 Menu diskette 3-2, 3-20  
 MENU MAN program 3-30..32  
 MENU OFF 3-30  
 MENU ON? 3-3  
 Menu system 2-3, 3-19..33  
   Auto and Manual operation of  
   - see MENU MAN program  
   Help menu - see Help Menu  
   Main menu - see Main Menu  
   ,relationship with CP/M  
   - see CP/M, relationship  
   ,running a program under the 3-33  
 merging 2-7  
 MFM 6-2  
 MODE key 3-8  
 modem 52-3  
   connector 51-4, 51-5, - see also: serial  
   interface  
 moving files - see copying  
 MPCC - see XTA, MPCC  
 MSB 6-2  
 MTBF 53-18, 6-2

## N

NAK 6-2  
 new diskette - see formatting of disks  
 NMI 52-1, 6-2  
 noises 51-54  
 NO SCRL key 3-7  
 NUL 6-2  
 numeric keypad - see keyboard, numeric keypad

## O

OC 6-2  
 OEM 6-2  
 off-line 51-8  
 on-line 51-8  
 operating system 1-3, 4-1..16, 1-10  
 operation of  
   CR7 3-1..38  
   disks 3-13..19  
   keyboard - see keyboard  
   Menu system - see Menu system  
   printers 3-10..12, 3-36..37  
   programs - see running a program  
   terminal 3-4..9  
 options  
   ,hardware 1-3..10, 1-2  
   ,software 1-10..12  
 Origin Mode 51-44a..44c  
 oscillator 52-6, 52-24, 55-5  
 OTHER COMMANDS command 3-29..32

## P

PAL 52-9, 52-24, 6-2  
 PAM 6-2  
 parameter 3-29, 4-7, 51-38  
 parity 51-8, 51-10, 53-12  
 partitions (of screen) - see screen partitions  
 Pascal/MT+ 2-12  
 patching the operating system - see system generation  
 PCB 6-2  
 PCI 6-2  
 PF0 key 3-6  
 PF1 key 3-8  
 PF2 key 3-8  
 PF3 key 3-8  
 PF4 key 3-8  
 PG DN key 3-9  
 PG UP key 3-9  
 PIO 52-4..5, 52-2, 52-13, 52-21, 52-23, 52-24  
 PIP command 3-18, 4-7, 4-8, 6-2  
 PIT 52-4, 52-3, 52-13, 52-21, 52-22, 52-24, 6-2  
 pixel 51-31  
 planning - see planning and report generation; project management; spreadsheet program  
 planning  
   and report generation 2-9, 1-11  
   tool - see planning and report generation  
 plastic software - see applications packages  
 plugging in 3-1..2, 50-3  
 power  
   off 3-3..4, 3-37  
   on 3-2..3, 3-35, 51-3, 51-4, 51-5, 52-2, 52-6..7, 52-8  
   requirements (processor board) 52-23  
   requirements (Winchester controller) 53-12  
   socket 51-5, 51-4, 52-24  
   supply 51-12..13, 2-1, 50-2  
     - see also: voltage setting  
   switch - see power on  
   up - see power on  
 primary bootloader 56-2  
 printer  
   connection 3-2, 51-4, 51-6  
     - see also: serial interface  
   ,daisy wheel 3-11..12, 1-9..10  
   ,dot-matrix 3-10..11, 1-7..8  
   not working 3-36..37  
   operation - see operation of printers  
   ,types of 1-5..6, 1-7..10,  
     - see also: printer, daisy wheel;  
     printer, dot-matrix  
 PRINT FILES command 3-28..29  
 printing out a file  
   using CP/M - see CTRL-P; PIP command  
   using Menu system  
     - see PRINT FILES command  
   using word processor 2-6  
 processor board 52-1..24, 1-1, 1-2, 2-1, 2-2  
   ,block diagram of 52-2  
   ,bus on 52-2  
   ,CPU on 52-1, 52-2, 52-24  
   CTC - see CTC  
   DIL switch - see DIL switch  
   DMA - see DMA  
   ,illustration of 52-4, 50-2  
   ,internal bus on 52-2  
   LED - see LED(s), processor board  
   PAL - see PAL  
   PIO - see PIO  
   PIT - see PIT  
   PROM - see firmware on processor board  
   RAM - see RAM

processor board (continued)  
   self test 56-1, 56-2  
   SIO - see SIO  
   USART 52-3; 52-2, 52-7, 52-14, 52-21, 52-24, 6-3  
 programmable interval timer - see PIT  
 programming  
   aid - see SPP  
   ,keyboard - see keyboard programming  
   languages 2-11..14, 1-11  
   ,terminal 51-13..58  
 programs - see software; "stuck" programs  
 project management 2-9..10, 1-11  
 PROM 6-2, - see boot load PROM; character set PROM; extending the system via PROM socket; firmware; XTA, EPROM  
 prompt - see system prompt  
 protection - see security; write-permit notch  
 PRT SC key 3-8

## R

RAM 1-1, 1-2, 1-7, 1-10, 2-1, 2-2, 52-2, 52-6, 52-8, 52-9, 52-24, 6-2  
   addressing 52-21, 52-18  
   controller 52-6, 52-16, 52-24  
   extension 52-16  
   on video controller board 51-37  
   on XTA - see XTA, RAM  
 READ DATA signal 52-10  
 real-time applications 2-12  
 rear panel - see back panel  
 RENAME FILE command 3-28  
 REN command 4-7,  
   - see also: RENAME FILE command  
 repeat  
   ,how to make a key-stroke 3-4, 51-14  
 report generation  
   using Cobol - see COGEN  
   using dBaseII 2-11  
   using planning and report generation package - see planning and report generation package  
   using project management package 2-10  
   using spreadsheet program 2-7..8  
 reserved tracks on system disk - see system tracks on disk  
 reset - see system reset; terminal reset  
 RETRN key 3-7  
 returning to the Menu system - see CP/M, relationship  
 RETURN key - see RETRN key  
 reverse video 51-31,  
   - see also: character attributes  
 RM/COBOL - see Cobol  
 robot 2-6  
 ROM 6-2,  
   - see also: PROM  
 RS232 - see serial interface; XTA RS422 & RS232 logic  
 RS442 - see serial interface; XTA RS422 & RS232 logic  
 "rubbing over" files - see DELETE FILES command  
 running a program 3-33..34, 1-1

## S

SASI 53-1..10, 52-19, 52-21, 6-2  
   ACK signal (status register) 53-8, 53-5, 53-6, 53-9

- SASI (continued)
- BSY signal (status register) 53-3, 53-4, 53-7, 53-9
  - bus Reset 53-4
  - C/D signal (status register) 53-3, 53-4, 53-5, 53-6, 53-7, 53-9
  - checking bus status 53-2..4
    - electrical connections 53-9, 53-10
    - error 53-6
    - finishing off 53-5..6
    - Initiator device 53-2
    - illustration of 53-10, 50-2
    - I/O addresses 53-8
    - I/O signal (status register) 53-3, 53-5, 53-6, 53-7, 53-9
    - Message byte 53-6
    - MSG signal (status register) 53-3, 53-4, 53-7, 53-9
    - pin assignments - see SASI, electrical connections
    - purpose of 53-1
    - REQ signal (status register) 53-3, 53-4, 53-5, 53-6, 53-7, 53-9
    - RST signal (status register) 53-8, 53-9
    - Select phase 53-4
    - SEL signal (status register) 53-8, 53-4, 53-9
    - sending Data 53-5
    - sending Read or Write command 53-4
    - sequence of operations in 53-2..7
    - signals 53-7..8
    - Status phase 53-2, 53-5
    - Target device 53-1, 53-2, 53-4
  - schematic diagrams - see block diagrams
  - screen 51-3, 51-2
    - editing 51-45..47 (details in Contents pgs. 9..10)
    - partitions 51-47..49
    - scrolling 51-48,
      - Region 51-44a..44c
  - SCROLL LOCK key - see NO SCRL key
  - SCSI 53-1..2
  - SDLC 2-2, 6-2
  - secondary boot loader 56-2
  - sector
    - map 4-1
    - size (Winchester) 53-12
  - security 3-27
  - self test 56-1, 56-2
  - selecting the boot source 3-34
  - serial interface (V24) 52-12..15, 1-1, 2-2, 50-3, 51-37, 52-1..3, 52-4, 52-24
    - on X-Net 55-10..11
  - serial I/O chip - see SIO
  - SET DISKETTE "WRITE-ENABLED" command 3-25..26
  - setting the Baud rate - see Baud rate setting
  - SET UP key 3-6
  - sheet feeder 1-9, 1-6
  - SHIFT key 3-7, 3-8
  - single sheet feeder - see sheet feeder
  - SI 6-2
  - SIO 52-9, 52-1, 52-3, 52-8, 52-9, 52-13, 52-21, 52-24, 6-2
  - skill types 2-9..11
  - SO 6-2
  - SOH 6-2
  - software 1-3
    - applications - see applications packages
    - communications
      - see communications software
    - list of 1-12
      - see also: operating system; programming languages
  - space on disk - see STAT command
  - special CR7 commands 4-7..10
  - special function keys - see F1 to F19 keys; PF0 to PF4 keys
  - specifying files 4-4..6
    - Summary Table 3-38
  - speed
    - serial interfaces - see Baud rate setting
  - Speed Programming Package - see SPP
  - spelling checker
    - in Pascal's SPP 2-12
    - in word processor 1-11
  - SPL-D - see XTA, SPL-D
  - split screen - see screen partitions
  - SPP 2-12, 6-2
  - spreadsheet program (for calculation and financial planning) 2-7..9, 1-11,
    - see also: planning and report generation
  - startup - see power off, on
  - STAT command 4-6
    - status of disk - see STAT command
  - STEP signal 52-11
  - stock control 2-10
  - stop bits 51-8
  - storage - see disk drive; diskettes, care of RAM
  - "stuck" programs 3-33..34, 3-36
  - STX 6-3
  - SUB 6-3
  - SUBMIT command 4-7
  - summary
    - of codes generated by terminal 51-57
    - of codes that terminal responds to 51-55..57
    - of how to specify files 3-38
    - of operational procedures 3-35..36
    - of startup procedures 3-35
  - switches - see DIL switches; power off, on
  - switching on and off - see power off, on
  - SYN 6-3
  - SYSGENF 4-8..9
    - see also: Baud rate setting
  - system
    - boot - see system reset
    - commands - see CP/M commands
    - expansion - see extending the system
    - file 4-1
    - generation 4-8..11
    - prompt 4-2, 3-3, 4-4
    - reset 56-1..3, 3-33, 3-34..35, 52-5
      - see also: boot load PROM; power on
    - tracks on disk 3-19, 4-8, 56-1, 56-2
- T
- TAB 3-6, 51-42
  - tailor-made character sets - see character sets, personalized
  - Technical Overview 50-1..56-2
  - terminal 51-1..58
    - characteristics (setting of) 51-6..10, 3-9, 51-4, 51-37, 51-55
    - components 51-2..13
    - controls 51-2..6
    - emulation 55-1..2
      - features of 51-1..2
    - operation of - see operation of terminal
    - programming - see programming, terminal
    - purpose of 1-2..3
      - relation to the rest of the CR7 50-3, 51-1
    - reset 51-54..55
  - Text Master - see word processing



text processing - see word processing  
 tilt control 3-1  
 timer - see CTC; clock  
 TOF 3-10, 3-12, 6-3  
 Toolbox 4-10..11  
 TRACK ZERO signal 52-10  
 tractor feed mechanism 1-7, 1-5, 1-6, 1-9  
 transmission on/off 51-53, 55-8,  
 - see also: CTRL-Q; CTRL-S  
 trouble - see error  
 TYPE command 4-6

## U

Underline character attribute - see character attributes  
 Underline cursor - see cursor shape  
 US 6-3  
 USART - see processor board, USART  
 USER command 4-6  
 user number 4-1..2, 4-6  
 utilities - see commands

## V

V24  
 interface - see serial interface  
 protocol 55-1  
 V28 52-12  
 VDU 6-3, - see also: terminal  
 video controller card 2-1  
 firmware - see firmware on video controller card  
 ,illustration of 51-37, 50-2  
 visual display unit - see VDU  
 voltage setting 3-1  
 VT 6-3  
 VT100 6-3  
 character set - see character set(s), VT100

## W

warm boot 56-2  
 WD1793 - see floppy disk controller  
 wildcard characters - see ambiguous file specifications  
 Winchester controller 53-11..17, 1-3, 1-6, 2-1  
 electrical connections 53-13..15  
 error codes 53-15..16, 53-13  
 ,illustration of 53-13, 50-2  
 jumpers - see jumpers, Winchester controller  
 pin assignments 53-14..15  
 ,SASI (interface) to - see SASI  
 Winchester disk 53-17..18, 1-2, 2-1, 51-2, 51-3, 52-5  
 controller board - see Winchester controller; SASI  
 formatting 53-17  
 ,illustration of 1-7  
 specification 53-18  
 ,use of 3-15  
 wiring of modules to back panel 50-3  
 word processing 2-4..7, 1-10  
 workstation - see terminal  
 WRITE DATA signal 52-10  
 WRITE GATE signal 52-10  
 write-permit notch 3-13  
 WRITE PROTECTED signal 52-10  
 writing on disk 3-25

## X

X-Net 1-6, 55-1  
 connector 51-4, 51-5, 55-6  
 Controller 55-8  
 frame protocol 55-1, 55-2  
 interface board - see XTA  
 packet protocol 55-2  
 Port 55-2  
 Terminal Adaptor - see XTA  
 Wall Outlet - see XWO  
 XON/XOFF 51-8, 6-1, 6-3  
 XTA 55-1..11, 1-3, 1-6, 2-1, 2-2, 52-13, 6-3  
 address 55-7  
 Baud rate 55-3, 55-7  
 block diagram 55-4  
 cable connection 55-9..11, 50-3, 52-13,  
 - see also: X-Net connector  
 character mode 55-3  
 clock frequency divider 55-5, 55-4  
 CPU 55-3, 55-4, 55-6  
 EPROM 55-3, 55-4, 55-6  
 fuses 55-8, 55-6  
 ,illustration of 55-6, 50-2  
 ,integration of into X-Net 55-7  
 jumper settings 55-8, 55-6  
 LEDs 55-8, 55-6  
 MPCC 55-5, 55-4, 55-6, 6-2  
 oscillator 55-4  
 RAM 55-3, 55-4  
 ,role of 55-1..2  
 RS422 & RS232 logic 55-5, 55-4  
 serial interface 55-4, 55-6, - see also:  
 XTA, RS422 & RS232 logic  
 signal descriptions 55-10  
 SPL-D encoder/decoder 55-5, 55-4  
 switches 55-7, 55-3, 55-4, 55-6  
 ,use of for terminal emulation - see terminal emulation  
 XWO 2-1, 51-5, 6-3

## Z

Z80A 1-1, 2-2, 52-1, 52-4, - see also:  
 processor board, CPU on  
 Z80 file - see CP/M loader

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