NCR

PC8 Owner's Manual

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April 1986

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FEDERAL COMMUNICATIONS COMMISSION (FCC) RADIO FREQUENCY INTERFERENCE STATEMENT

WARNING

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

Information to User

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

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

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful: "How to Identify and Resolve Radio-TV Interference Problems". This booklet is available from the U.S. Government Printing Office, Washington, DC 20402, Stock No. 004-000-00345-4.

The NCR Corporation (NCR) is not responsible for any radio or television interference caused by unauthorized modifications of this equipment or the substitution or attachment of connecting cables and equipment other than those specified by NCR. The correction of interferences caused by such unauthorized modification, substitution or attachment will be the responsibility of the user.

WARNING

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

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Declaration of Conformity

This device complies with Part 15 of FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

NCR PERSONAL COMPUTER PC8

CONTENTS

The next Steps

You have already set up your NCR Personal Computer, so now it is time to get to know how to make the most of your computer.

POSITIONING YOUR COMPUTER

Now that you are about to take the next steps on the road to computing proficiency, it is important to find a location for your computer where it can best serve you. Such a location should be

- free of vibration and dust
- away from extremes of temperature and humidity
- away from direct sunlight and heating
- where there is sufficient airflow to cool the main unit and video display
- within easy reach of an adequate number of grounded power sockets (for both computer and any additional units you may wish to attach), properly fused and with leakage protection
- a strong, level working surface, where power and signal cables can be organized in a tidy fashion
- on a separate power circuit from radio or TV receivers

DISKETTE CARE

Having located the computer, you are now probably wondering where to keep your diskettes. Obviously, it makes sense to store them within easy reach of your computer, but you should observe the following precautions:

- do not expose diskettes to dust or other small particles such as graphite from pencils
- keep diskettes away from other equipment that may have magnetized components. There are many possible magnetized items that may be in your computer environment: radios, charm bracelets, telephones, electric pencil sharpeners, etc
- as with the computer itself, you should keep diskettes away from excessive heat and humidity
- do not attempt to clean diskettes in any way

ONCE AROUND THE COMPUTER

Let us continue exploring the computer.

Figure 1-1 highlights parts of your NCR Personal Computer which, with exception of the lock, did not have to be considered when "Getting Started".

Open the front panel just as you did when "Getting Started".

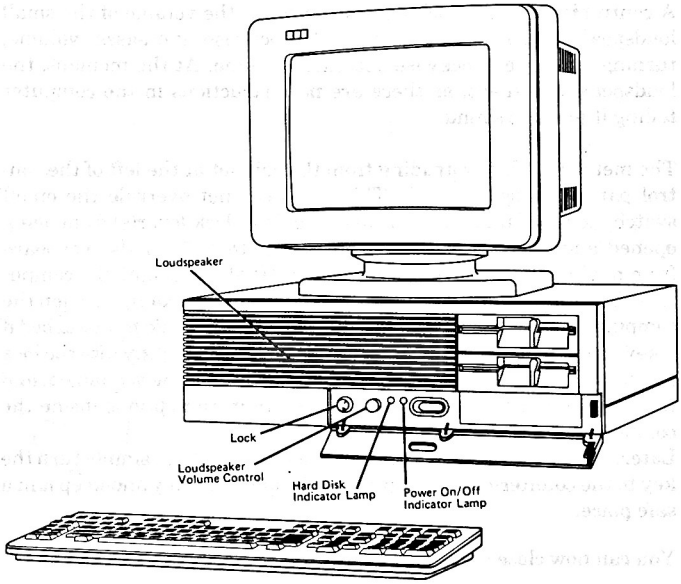

Loudspeaker
Lock
Loudspeaker Volume Control
Hard Disk Indicator Lamp
Power On/Off Indicator Lamp

Figure 1-1

The power on/off indicator lamp is illuminated while the main unit is switched on, so if your computer is still switched on from "Getting Started", the glow from this lamp will be visible.

The hard disk indicator lamp is illuminated while the hard disk unit, if one has been installed, is in action.

A control is present which allows you to set the volume of the small loudspeaker. Turning this control clockwise increases volume, turning it counter-clockwise decreases volume. At the moment, the loudspeaker is silent, as there are no instructions in the computer telling it to make sound.

The metal cylinder protruding from the cabinet at the left of the control panel is a system lock. This lock does not override the on/off switch, nor does it prevent the diskette drive lock lever(s) from being opened and closed. Instead, its purpose is to prevent the keyboard from having any effect on the computer. (It also prevents the computer cabinet from being removed.) This is useful, for example, when the computer is carrying out an important task which could be disturbed if a key were inadverdently depressed. Press the key lightly into the lock and turn it to its clockwise position. The keyboard is now enabled, and the cabinet can be removed if you wish to install options inside the computer (described in Chapter 2).
Later, whenever you have occasion to lock the system, simply turn the key to the counter-clockwise position. Remove the key and keep it in a safe place.

You can now close the front panel.

Looking at the main unit from the back (Figure 1-2), a number of connections and the voltage selection switch are already familiar to you.

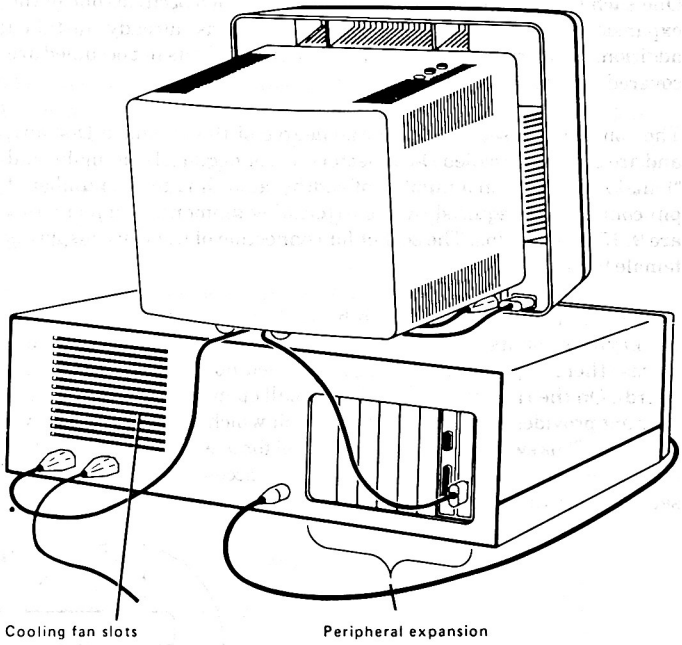


Figure 1-2

Figure 1-2 points out the position of the slots of the cooling fan. The cooling fan enables the computer to be switched on over long periods time without any damage resulting. It is important not to obstruct the air flow to these or any other cooling slots.

The peripheral expansion area is where sockets can be provided for the connection of equipment external to the main unit. Provision of

suitable sockets requires minor dismantling of the main unit and the installation of expansion boards. This procedure is explained in the Chapter "Installing Options" in this Manual.

One such piece of equipment is the display, which occupies one of the expansion slots available. If your dealer has already installed additional features, other slots may be occupied. Slots not occupied are covered by metal plates.

The connectors used are to a large degree of the standard D-shape, and are commonly called D-connectors. D-connectors, both "male" and "female", are used in a number of widths, according to the number of pin connections required by the external equipment. Common sizes are 9, 15, and 25 pins. The socket for connection of the video display is female 9-pin.

There remains one switch which has not yet been mentioned: stand the keyboard on its forward edge with the keyboard cable facing upwards (there is plenty of cable, so you need not disconnect the keyboard). On the right you will notice a small opening (Figure 1-3). This opening provides access to a slider switch which can be in one of two positions. This switch has already been set for use with your computer, so you will not normally have occasion to access it. The alternative setting is provided for use with other NCR equipment.

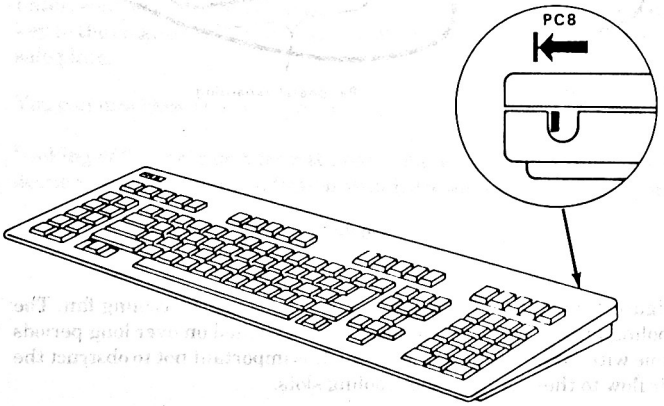


Figure 1-3

MASTERING YOUR KEYBOARD

You will soon realize that this is the part of your computer that you will use the most. Other parts of the computer will be working for you, but you will be telling the computer what to do by using the keyboard.

The keyboard is used to enter or "input" information into your NCR Personal Computer. The keys are used in different ways for different programs, and not all keys are used in each program. In other words, some keys are "application dependent." Their functions vary according to criteria established by the program in use. The manual for a specific program will explain which keys will be used, and for what functions.

At a first glance your keyboard may seem to be a little complicated, but spend a little time studying this description and you will soon see how logically the keys are arranged, and how easy it is to use. Knowledge about the keyboard gained now will prove invaluable when you are ready to use programs.

Look at your keyboard, the first thing you will notice is that the keys are for the most part arranged in four groups. Looking from the left to the right, we will call these groups:

- Programmable function key pad
- Alphanumeric key pad
- Cursor positioning and word processing key pad
- Numeric key pad and alternative cursor pad

In addition to these groups, four strips each of five keys are situated along the top of the keyboard. These keys are dedicated to enhanced keyboard functions, described separately at the end of this description of the keyboard.

THE PROGRAMMABLE FUNCTION KEYPAD

These keys may be programmed to suit your own requirements. Typically they may be used for

- providing additional text processing functions
- providing one-key entry of instructions you frequently issue to the computer

What each one does depends on the individual program being run. The description belonging to a program explains which programmable function keys (if any) to use and how to use them.

You can also give these keys a meaning determined by you: for example, if you are using your computer for your day-to-day correspondence, you will probably find it convenient to make one of these programmable function keys write out the current date, thus saving you a considerable number of typing strokes.

THE ALPHANUMERIC KEYPAD

Alphanumeric Keys

These keys are like those on normal typewriters: they include the alphabetic keys (a to z), the numeric keys (0 to 9), and a few keys for punctuation (period, comma etc.).

When you press any of these keys, the screen on your computer displays the lowercase character of the alphabetic key pressed, or what is shown on the lower part of the numeric and symbol keytips. To get an, uppercase character or one of the special symbols that are engraved on the upper part of the keytips you must use either the Shift Key or the Caps Lock Key.

Caps Lock

Press this key once to set it into the active (capital) position, note in the active mode the small red LED within the keytip is lit.

When it is in the active mode and you press any of the alphabetic keys you enter uppercase (capital) letters.

Pressing the Caps Lock Key a second time restores the key to the inactive position (lowercase letters).

Shift

These keys, when used with the alphabetic keys, function in a similar way to the Caps Lock Key: when you are holding a Shift Key down and you press an alphabetic key, then the screen displays an uppercase character. You must also use a Shift Key whenever you want any of the special symbols that are shown on the upper part of non-alphabetic keys.

For ease of operation two identical Shift Keys are provided on your keyboard. There are two things you should remember when using a Shift Key:

- These keys do not latch down, they must be held down while you press another key.
- The Shift Keys have an effect on the Caps Lock Key function: if the Caps Lock Key is in the active mode and you now press a Shift Key and an alphabetic key, then the CRT screen displays a lower-case character.

Normally the CAPS LOCK key should be in the inactive position (LED not lit) when loading application programs.

Enter

Whenever you have finished telling the computer to do something (entering a command), or when you have finished entering some data, then you must tell the computer to respond to your instructions. To do this , press the Enter Key.

Whenever this key is pressed the cursor moves to the beginning of the next line on the screen.

NOTE: In some of the documentation that you will be reading you will encounter other names for this key: such as "Return", "Carriage Return", or "New Line". Often, when the computer is telling you to press this key, you will see on the screen (CR).

Spacebar

To enter a space between characters press the Spacebar, the cursor moves one column to the right and leaves a space on the screen.

Backspace

Pressing this key moves the cursor one column to the left each time it is pressed.

Control

Used alone the Control Key has no function. The Control Key is used to change other keys into application dependent special function keys. When used, the Control Key must always be pressed first and held down while the other key is pressed.

Alternate Key

Like the Control Key, this key allows you to perform special operations.

Tabulator Key

Use of this key is application dependent. In word-processing programs, it is used in much the same way as the tabulator on a conventional typewriter.

Print Screen

When used without a Shift Key this key is used to produce an asterisk (*).

This key can also be used together with the Shift and Control keys (see "Useful Combinations" below).

Insert

This key is application dependent, usually being used to determine whether typing in a line overwrites existing characters or displaces them.

Press this key once to set it into the active mode. When active, characters may be entered at the current cursor position. Characters that were already on the line are moved to the right to make room for the inserted characters.

Pressing the key once again de-activates the insert mode.

THE CURSOR POSITIONING AND WORD PROCESSING KEYPAD

Cursor Positioning Keys

These five keys are arranged in form of a cross, with the Home key at the center. With the help of a suitable application, they help you to quickly position the cursor to any place on the screen.

Pressing the Home Key moves the cursor to the top left corner of the screen (column 1, line 1).

The remaining four cursor positioning keys have arrows pointing to the left, right, up, and down: they move the cursor one column to the left, one column to the right, one line up, and one line down, respectively.

End

This key is sometimes used by applications to move the cursor from its present position to the last character in the same line.

Page Up

An application dependent key, usually used to display the previous screen page.

Page Down

An application dependent key, usually used to display the next screen page.

Delete

An application dependent key, usually used to delete the character at which the cursor is positioned. Characters to the right then move one position to the left.

Control

The keyboard has two identical Control Keys, see the "Alphanumeric Keypad" description for the function of this key.

NUMERIC KEYPAD

You may consider this keypad as two separate keypads:

- a word processing keypad, or
- a numeric keypad

When you first switch the computer on, this keypad automatically assumes the word processing mode, and remains in this mode until you wish to change it to the numeric mode. Changing mode is accomplished by using Numeric Lock Key (Num Lock).

The functions of the Home, Page Up, Page Down, End and the five cursor positioning keys are in the word processing mode identical to those keys in the Cursor Positioning and Wordprocessing Keypad: look to the description of this keypad for the function of these keys. (These duplicate cursor and wordprocessing keys are provided for those operators who are already accustomed to this type of keyboard arrangement.)

In the numeric keypad mode, these keys produce the numbers printed on the keytips.

The following keys are always active regardless of the setting of the Numeric Lock Key:

- Scroll Lock
- Minus
- Plus
- Enter

Numeric Lock

This key (Num Lock) acts as a toggle: press the key to change the keypad to the numeric mode. The keypad now remains in the numeric mode until the Numeric Lock Key is pressed a second time. The small red LED within the keytip is lit when in the numeric mode.

The Num Lock Key should be in the inactive position (LED not lit) when loading application programs.

Scroll Lock

This key is usually used in combination with the Control Key (see "Useful Combinations" below).

Escape

The use of this key is application dependent.

System Request

SysReq is generally given privileged significance by applications.

Numeric Keys

These keys (0 to 9) are conveniently grouped together to allow the high speed entry of numeric data.

Decimal Point Key

This key allows you to enter a decimal point, at the required place, in a string of digits.

Plus and Minus Keys

The Plus (+) and Minus (−) Keys generate the signs commonly associated with the simple mathematical operations of addition and subtraction. The achievement of such mathematical operations is application dependent.

USEFUL COMBINATIONS

This section describes five useful multi-key actions which are usually available, independent of application. In each case, the keys are to be pressed and held down in the sequence in which they are given. When all the keys specified are pressed, they can be released simultaneously.

Shift - Print Screen

Holding the Shift Key in the depressed position and then pressing the Print Screen Key results in a copy of the screen being sent to the printer.

Control - Print Screen

Holding the Control Key in the depressed position and then pressing the Print Screen Key means that whatever is displayed on the screen from now will also be copied to the printer. This copying remains in force until you repeat this combination.

Control - Numeric Lock

This stops the computer in what it is doing until you press (almost) any key. This facility is useful, for example, when you wish to take your time looking at what is on the screen.

Control - Scroll Lock
This combination usually has the effect of discontinuing what the computer is currently doing.

Because the word "Break" is engraved on the front of the Scroll Lock Key, this combination is often called Control - Break.

Control - Alternate - Delete
This three key combination (for the sake of abbreviation often called Control - Alt - Del) restarts the computer, as if you had operated the on/off switch.

A FEW DEFINITIONS

For those who are not familiar with keyboards the following definitions may be helpful.

Lowercase
These are the small form of alphabetic characters: normally when you press any of the alphabetic keys a lowercase character is displayed on the screen of your computer. For example b d f.

Uppercase
These are the large (capital) characters, for example B D F.

Els and Ones, Ohs and Zeros
On many typewriters you must type the lowercase alphabetic el when you wish to enter a numeric one, or the uppercase alphabetic oh when you wish to enter a numeric zero. This is not possible with a computer, you must enter the correct alphabetic characters and numeric digits.

They look like this:

Lowercase el	l
Numeric one	1
Uppercase oh	O
Numeric zero	0

Keyboard Rollover
The keyboard has "rollover" capability. That is, several keys can be pressed almost simultaneously and they will be registered in sequence. The keys will not jam; thus, rollover capability increases operator input speed.

Auto-Repeat

Most of the keys on the keyboard have auto-repeat capability. When a key with this capability is held down, it will repeat either until it is released or until another key is pressed.

ENHANCED KEYBOARD FUNCTIONS

This section looks at the special features of the keyboard of your NCR Personal Computer. These features are available through use of the row of function keys marked F11 to F30 at the top of the keyboard.

In the normal course of operation, these keys duplicate the functions of the function key pad situated on the left of the keyboard (F1 - F10):

- simply pressing one of the keys F11 to F20 has the same effect as the corresponding key combination Shift - F1 to Shift - F10, for example, F14 is equivalent to Shift - F4

- keys F21 to F30 relate in a similar way to the keys F1 to F10, the only difference being that the equivalent key combination on the function key pad uses the Control instead of the Shift key

As you have already learned, the key combination Control - Numeric Lock suspends the normal course of operation until (almost) any key is pressed. During this state of suspension, the function keys F12 to F19 assume special functions as described below.

Use of this special function is application dependent.

F12 and **F13** determine how quickly a character is repeated when a key is held in the depressed position. This rate can be varied between 2 and 30 times per second. F12 increases this rate in steps of one, F13 decreases it.

F14 and **F15** determine the length of delay between the initial depression of a key and that key being repeated. This delay can be varied between 1/4 second and 1 second. F14 lengthens this delay by 1/4 second, F15 shortens it.

F16 can be used to prevent codes transmitted by the main unit from being accepted by the keyboard. Such codes are sometimes used by applications to influence the keyboard LEDs. This function can be used to ensure that LEDs are switched on and off only by direct keyboard operation. F16 switches this function both on and off.

F17, **F18**, and **F19** reverse the on/off status of the Caps Lock, Numeric Lock, and Scroll Lock LEDs, respectively, without notifying the program of the change. This is useful for ensuring that the status of the LEDs reflects the status actually assumed by the program. (Disagreement could have arisen where you forgot to reset the lock keys before starting a new application.)

No special functions are assigned to the remaining function keys F20 and F22 to F30.

F21 allows the NumLock key to repeat like other keys. This facility is required by some applications. NumLock is non-repeating immediately after the computer has been switched on.

On keyboards which have an LED window in the Alt key, F11 enables the twenty function keys F11 to F30 to provide autonomous functions (as soon as normal operation resumes), instead of Shift and Control extensions of F1 to F10 (see above). This facility, which requires a system software extension, is disabled when the computer is switched on.

DISKETTE COMPATIBILITY

The uppermost (or only) flexible disk drive is a high capacity drive (1.2 MB). An additional flexible disk drive can be high capacity or standard capacity (360 KB).

A high capacity drive can be used in both high capacity and standard capacity formats. In the latter format, it "behaves" as a standard capacity drive. The format is either selected by you during diskette formatting (described in the NCR-DOS Manual), or it is determined by the format already used for that diskette.

Both high capacity and standard capacity **diskettes** are available. They must be used as follows:

- Reading and recording in high capacity format (possible only with a high capacity drive) requires the use of a high capacity diskette.

- Reading and recording in standard capacity format requires the use of a standard capacity diskette, even if this format is being used in a high capacity drive. Do not use high capacity diskettes for the standard capacity format.

HARD DISK PREPARATION

If your system has a Hard Disk Drive, then this drive must be unlocked before you start to use the system. If you are unsure, pull off the rear plastic cover from the Main Unit and look for a label instructing you to unlock the drive.

To unlock the drive use the following procedure:

1. Remove the cabinet, the correct procedure is given in the "Installing Options" chapter of this manual.

2. Referring to Figure 1-4, locate the shipping lock at the rear of the Hard Disk Drive and push the end of the lock until it is flush with the disk drive housing.

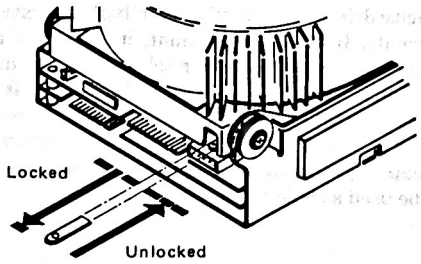


Figure 1-4

3. Re-assemble the cabinet.

NOTE: Whenever the system is moved from its normal location, then it is necessary to lock the drive before the move takes place. To do this, the shipping lock must be pulled out.

For the best operational performance, the main unit should be placed in its normal working position (horizontal or vertical) before formatting the hard disk.

SERIAL/PARALLEL ADAPTER

The expanded version of the PC8 is supplied with a Serial/Parallel Adapter Board already installed. This is the small size printed circuit-board with one 25-pin and one 9-pin connector at the end of the board. Both the serial and parallel ports on this board are set during manufacture to "Port 1", this is the standard setting which is most likely to be required by the software using this adapter. Should you require to change either port 1 to "Port 2", Figure 1-5 shows the switches on the Serial/Parallel Adapter Board that control the port selection.

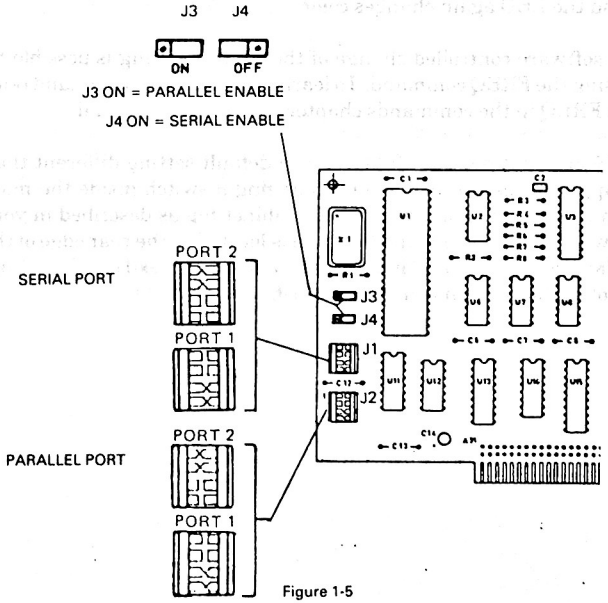


Figure 1-5

PROCESSOR FREQUENCY

The processor frequency is automatically set at power-on according to the position of a switch on the Main Processor Board. If at this time the power-on LED shows a red light then the frequency is 6 MHz. If the frequency is 8 MHz then the power-on LED shows a green light. The frequency setting at power on is known as the default setting.

To allow you to take advantage of software that is capable of running at 8 MHz and to be able to revert to the lower frequency, there are three ways in which you can change the frequency:

1. After the completion of the power-on diagnostics press the ALT, ESC and SYS REQ keys together. The processor frequency changes from the default value to the new frequency and the power-on LED changes color to remind you that you are now operating at this new frequency.

   Should you wish to change back to the default setting, press the same three keys again. The frequency reverts to the default setting and the LED again changes color.

2. A software controlled change of the default setting is possible by using the FREQ command. To learn how to use this command refer to FREQ in the commands chapter or your DOS manual.

3. If you find it more useful to have a default setting different than supplied, this can be done by changing a switch inside the main unit. To do this, first remove the cabinet top as described in your Owner's Manual. This slide switch is located at the rear edge of the Main Processor Board immediately under the Flex/Hard Disk Controller Board as shown in Figure 1-6.

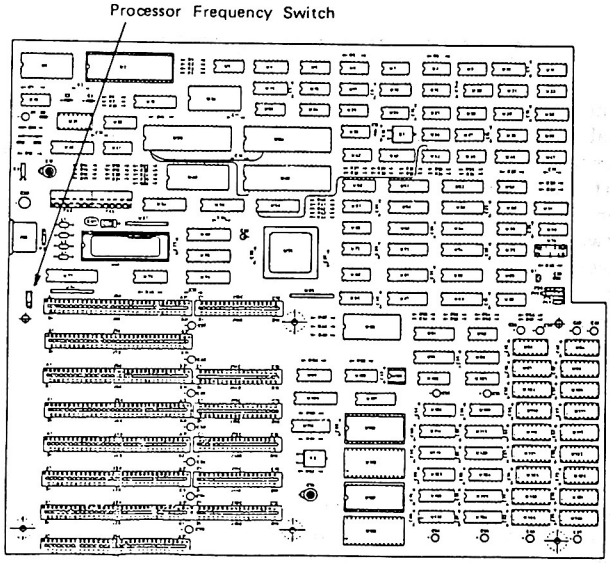


Figure 1-6

To set the processor frequency to 8 MHz, push the switch towards the "8" that is engraved on the board. To set the frequency to 6 MHz, push the switch towards the "6" that is engraved on the board.

NOTE: Making this change still allows you to change the frequency as described in 1 and 2.

STARTING WITH YOUR SOFTWARE

By now you should be fairly familiar with the hardware of your Personal Computer. If you have any options to install, then you should refer to Chapter 2 and do this work now. Otherwise, you are ready to start using your software. One of the first steps when using your operating system software for the first time, is to configure the software so that it matches exactly your hardware. To do this you must use a special procedure called SETUP. How to use this procedure and all the other information that you will need regarding your operating system software are fully described in your NCR-DOS Manual.

LEARNING BY DISKETTE

Your NCR Personal Computer is supplied with a "Getting Started" diskette. This diskette gives you the opportunity to put into practise what you have just read about the keyboard, and to learn about the way your computer can be made to work for you.

The introductory course provided by the "Getting Started" diskette is extensive, so you may not wish to "graduate" in one session. To interrupt the course, simply ensure that the diskette drive has come to rest, remove the diskette, and switch off the computer. You could continue reading this Manual between sessions.

You can decide how quickly you want to complete the course. You can repeat the course as often as you wish. To qualify for entry, all you have to do is ensure the computer is switched off, insert the "Getting Started" diskette just as you inserted a disk while reading the "Getting Started" booklet, and switch on.

ABOUT THIS MANUAL

In the remaining Chapters of this Manual you will find the following information:

Chapter 2 shows you how to install optional equipment, for example, a printer. This sometimes involves minor dismantling of the computer in order to install additional component boards. Even if you do not wish to install any such equipment for the moment, you might look briefly at this Chapter, just to get an idea of what your computer looks like from the inside.

Chapter 3 discusses points to watch regarding periodic care of the computer, and what to do if you wish to move your computer. In addition, you will find a description of the computer diagnostics supplied on one of the diskettes with your NCR Personal Computer. The diagnostics procedure is an easy way of confirming that your computer is functioning correctly.

Chapter 4 introduces you to some of the terms you may have already encountered when personal computers are being discussed. In particular, you will be introduced to the concept of an "Operating System", how it co-ordinates the various functions of the computer, and how it can serve as the starting point for using application programs.

You will also find a summary of what is to be found in the other Manuals belonging to your NCR Personal Computer.

The Appendices provide the keyboard layout charts needed when setting up your keyboard, and some interesting items of technical data.

INSTALLING
OPTIONS

Chapter 2

Installing Options

This Chapter provides information you need in order to install optional kits in your NCR Personal Computer. You will also learn how to set certain switches contained inside the main unit, enabling you to derive maximum efficiency from your computer. The Chapter consists of four parts:

POINTS TO WATCH - A number of precautionary measures which should be heeded when removing the cover from the main unit and handling integrated circuits.

AN INSIDE VIEW - A step by step guide to minor dismantling procedures, required when installing certain options.

KIT BY KIT - This part explains which dismantling and installation procedures are required for individual kits.

SWITCHES - This part looks at switches contained in the main unit. These switches are often looked at by programs which need to know, for example, how much memory is available.

MY OPTIONS - Here you can store the installation descriptions supplied with the kits you have installed in your NCR Personal Computer.

You probably purchased your NCR Personal Computer "ready to use". If this is not the case, you may have to install the display adapter board, connect the battery and/or check the switches. Finally, you will have to run the system set-up program. Then you can start using your computer. The Contents of this Manual can help you to find these installation descriptions.
For systems with a hard disk drive, see "Hard Disk Preparation" in Chapter 1 of this manual.

POINTS TO WATCH

ELECTROSTATIC PRECAUTIONS

If they are handled incorrectly some of the components used in some kits may be damaged by an electrostatic discharge. The following simple precautions will help to avoid electrostatic discharge problems:

- Do not install options in an area known to give electrostatic problems (e.g. some types of carpet are not anti-static).
- Do not handle printed circuit boards (PCBs) more than necessary.
- Hold PCBs by their edges, and do not touch the components.
- Before disconnecting the computer from the power source touch a metal part of the NCR Personal Computer. This ensures that there is no potential difference between you and the computer. Should you feel a very slight shock, remember this is not an indication of a fault in the computer, rather that you were the source of the electrostatic discharge.
- Do not move away from the work area until you have completed installation and replaced the cabinet.

SAFETY PRECAUTIONS

- Be sure that the power switch is OFF before starting kit installation work on the NCR Personal Computer.
- Unless you are a trained engineer, do not disconnect more than you are told to in the installation instructions.

INSTALLING INTEGRATED CIRCUITS

With some kits it is necessary to install integrated circuits (ICs) into sockets that are already provided on the printed circuit board. Regardless of which kit is being installed, the method of installing ICs is always the same. Before starting to install a kit containing ICs, carefully examine an IC from the kit and a socket where the IC is going to be installed. Familiarize yourself with these components, handle them

carefully and observe the precautions about static electricity given above. If you are unsure about doing this type of installation yourself, enlist the help of someone who has experience in this type of work, or ask your NCR representative about having this work done for you.

When you are ready, proceed as follows:

1. Be sure that none of the pins on the IC are bent.

2. Be sure that the IC is the right way round, with pin 1 at the end of the socket with a notch (Figure 2-1).

3. Carefully push the IC into its socket, ensuring that none of the pins become bent underneath. Check that all pins are in their holes, and that the IC is fully seated onto the socket.

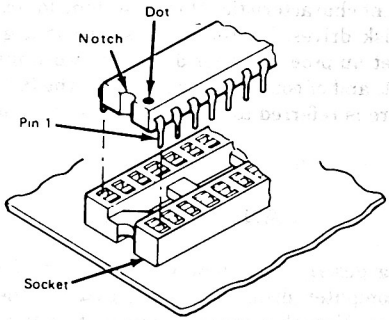


Figure 2-1

CONNECTORS

A few of the more advanced installation procedures require the temporary removal of cable connectors. Where this is necessary, you should note the positions of these connectors. Although many of them are keyed, it is also a good idea to note which way round they are connected before removal.

DIAGNOSTIC TESTING

After installing an option always use any available diagnostic routines to check that the computer is in working order. Some options may require special test routines that are not included in the standard diagnostics. In such instances special diagnostics are often supplied with the kit.

SYSTEM TIME

Your NCR Personal Computer includes an integrated circuit which registers time, even when the computer is switched off. This "real time clock" has the advantage that it requires very little electric current, provided by a small battery in the main unit. However, this means that the accurate measurement of time can be disturbed when printed circuit boards, especially the main processor board, are being handled.

This battery is also responsible for maintaining a small memory which notes important characteristics of your system, for example, type and number of disk drives. Therefore, it is always a good idea to run the system set-up program after doing any work involving removal of the cabinet, and of course, after replacing the battery (see below). This procedure is referred to in a separate section at the end of this Chapter.

AN INSIDE VIEW

The following descriptions show you how to perform various procedures of computer dismantling required for the installation of various options. Note that the installation of a particular option may require only some, not all, of the procedures described here. The individual installation descriptions given in "Kit by Kit" state for each kit which procedures are necessary. Except where stated, dismantling and re-assembly are reverse procedures.

Your NCR Personal Computer is provided with a double-headed screwdriver (for "square-head" and normal screws) to help you with the installation procedures.

Up to eight adapter boards can be present in the main unit at any one time. Slots 2-6 and 8 are electrically identical; slots 1 and 7 differ from the others in that they provide one instead of two sockets. Slot 8 is

already occupied by the disk controller board. Assuming that your computer was supplied "ready to use", the display adapter board is also already installed - in slot 1, although in principle, slot 7 could be used instead.

Procedures described here:

A. Removing the Cabinet
B. Installing an Adapter Board
C. Removing the Disk Controller Board
D. Removing the Main Processor Board (hardly ever necessary)
E. Exchanging an Connecting the Battery

A. REMOVING THE CABINET

1. Disconnect the power cable at the wall socket. Disconnect all cables connected at the back of the computer (keyboard, power input, power output and signal cables to display, and any other connections to expansion slots).

2. Remove the floor stand if one is present. Place the computer on a level surface (e.g. desk top).

3. Remove the back panel held in place by self-adhesive strips.

4. Unlock the system (key clockwise), if it is not already unlocked.

5. Remove the 5 cabinet retaining screws. Then holding the sides of the upper cabinet, slide it forwards about 20 - 30 mm (approx. 1 inch) and then lift it away (see Figure 2-2). It may be necessary to tap the back of the cabinet lightly.

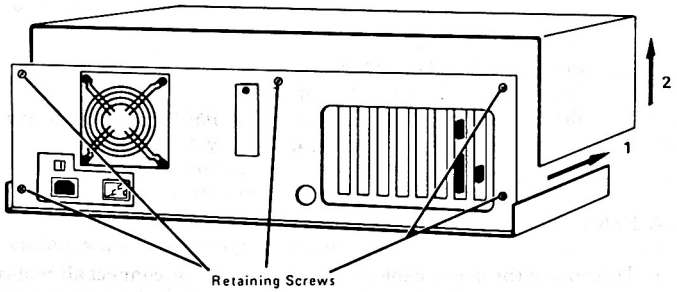


Figure 2-2

6. Re-assembling is the reverse of the procedure. In addition, you should observe the following

CAUTION

The power supply of your NCR Personal Computer possibly includes more connectors than required by the disk drives present. The power connectors not required must not be allowed to lie on the component boards, but should be held by clamps (Figure 2-5). Similar clamps are provided for unused ground connectors (Figure 2-5). Non-insulated ground connectors may, of course, be in contact with other grounded parts, such as the frame.

7. The back cover is supplied with seven of its eight slots blanked off. If the kit you have just installed is for connection to an external cable, you will need to break away from the cover the piece of plastic covering the newly occupied slot. A knife maybe helpful.

B. INSTALLING AN ADAPTER BOARD

1. Remove the blanking plate for the slot you are going to use. Each blanking plate is held in place by a single screw (Figure 2-3).

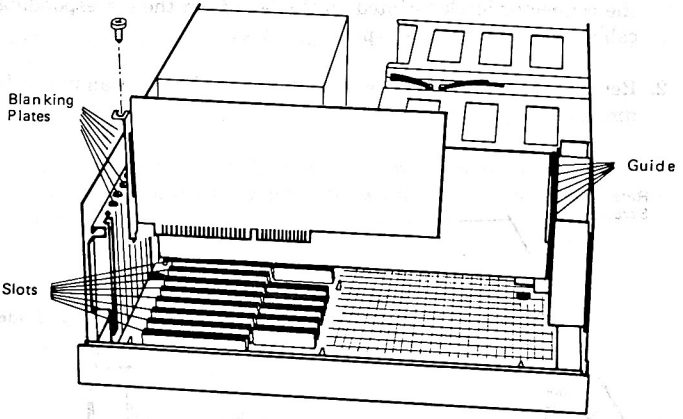


Figure 2-3

2. Plug the adapter board into the slot(s) facing upwards from the main processor board. If the adapter board is "full-length", ensure that the edge of the board nearest the loudspeaker drops into the guide (Figure 2-3).

3. Use the screw which previously held the blanking plate in place to fasten the new facing plate attached to the board.

C. REMOVING THE DISK CONTROLLER BOARD

Removal of the disk controller board (slot 8) is sometimes required for access to the main processor board.

1. Note which cable band is connected to which connector block on the board. You could do this by, for example, writing the "J" number of the connector block (printed on the board) on the corresponding cable band, using a felt-tip pen.

2. Remove the retaining screw and lift out the board in an upwards direction (Figure 2-4).

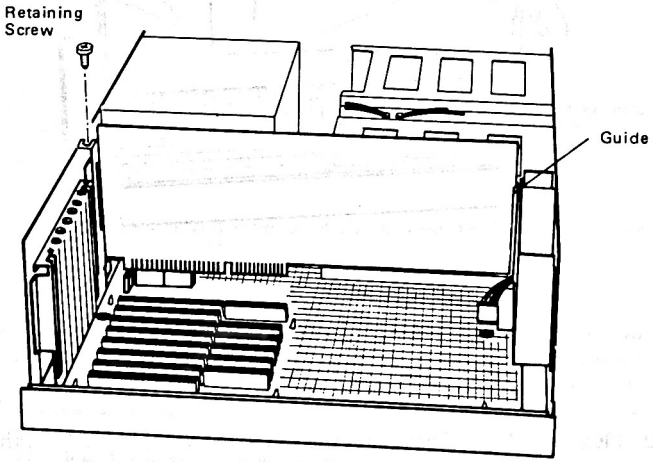


Figure 2-4

3. When replacing the board, be sure to place it correctly in the guide at the edge nearest the loudspeaker before pushing it down into place. Make sure that the edge connectors engage properly in the sockets of the main processor board, the press the disk controller board firmly into place.

D. REMOVING THE MAIN PROCESSOR BOARD

This procedure is required for only a very small minority of installations.

1. Remove all adapter boards.

2. Remove connections to battery and power supply (connectors near back of computer), as well as the two small connector blocks near the loudspeaker (see Figure 2-5).

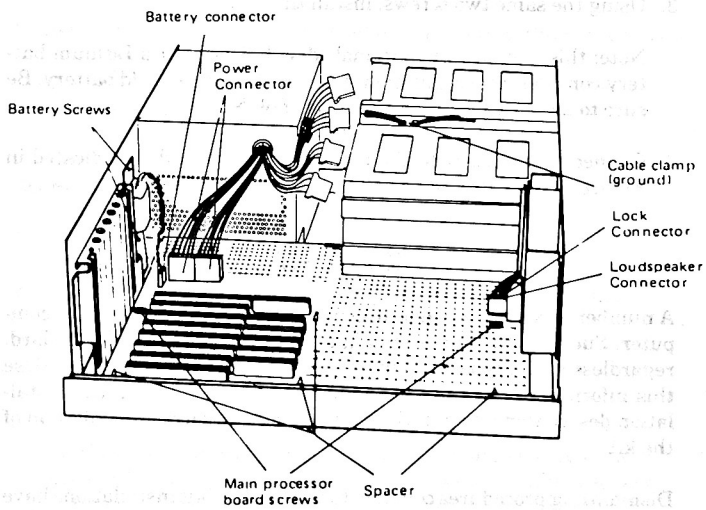


Figure 2-5

3. Remove the two screws indicated in Figure 2-5.

4. Carefully pull the board out by the side of the computer opened up by the removal of the cabinet.

5. When replacing the board, there is no need to separate the four plastic spacers (Figure 2-5) from the board. The spacers will engage in their slots as you slide the board in.

E. EXCHANGING AND CONNECTING THE BATTERY

If you are connecting the battery as part of "first-time" system installation, proceed to step 4.

1. Remove the battery connection (Figure 2-5). With care, this can be done without the need to remove the disk controller board.

2. Remove the two screws which hold the battery unit in place. The battery unit with its leads can now be removed.

3. Using the same two screws, install the new battery.

   Note: this is not a conventional "dry" battery but a Lithium battery,consider local regulations when discarding the old battery. Be sure to use only batteries approved of by NCR.

4. Connect the battery to the main processor board as indicated in Figure 2-5 (see Procedure D).

KIT BY KIT

A number of NCR kits can be used in more than one type of NCR computer. Such a kit includes installation information that is standard, regardless of the type of computer in which it is being installed. Use this information together with the information given in the installation description given in this Chapter for the correct installation of the kit.

Dismantling procedures common to a number of kit installations have been described in "An Inside View". These procedures are referred to below, as and when required for the installation of specific kits.

When you have completed the installation of a kit, file the kit installation instructions under "My Options" at the end of this Chapter.

CAUTION

You should only install kits or options which have been approved for use with this NCR Personal Computer. The installation of non-approved kits may cause damage to the equipment. Such kits may also contravene local safety or radio interference regulations. Consult your NCR representative or dealer for further information regarding the suitability of kits and options.

DISPLAY ADAPTER BOARD (3299-K201)

1. Remove the cabinet (Procedure A).
2. Set the jumpers on the display adapter board in accordance with the separate kit description.
3. Set switch group 2 (primary display selection) on the main processor board as described in "Switches" in this Chapter.
4. Install the display adapter board in slot 1 (Procedure B).

CO-PROCESSOR (3299-K020)

1. Remove the cabinet (Procedure A).
2. Remove the disk controller board (Procedure C) and any other options installed.
3. Remove the main processor board (Procedure D).
4. Find the Co-processor socket on the main processor board (marked U68). It is situated near the keyboard connector, and has a plug installed in it. (This "plug" looks just like a socket with a piece of wire connected across the top.) Remove this plug.
5. Install the Co-processor. Insertion of the integrated circuit requires a considerable degree of care (see "Installing Integrated Circuits" in "Points to Watch", and the instructions supplied with the kit itself).

SERIAL/PARALLEL ADAPTER (3299-K306)

1. Remove the cabinet (Procedure A).

2. Set the port selection switches on the adapter board as shown in the separate kit description. Which ports you select depends to a great degree on the programs which are going to make use of the adapter. If you are installing the adapter with a particular program in mind, refer to the instructions belonging to the program. If no selection is specified, set the serial interface to "base port address" PORT 1 and the parallel interface to PORT 1.

   If there is already an adapter K306 installed, set the port selection switches on the new adapter to the opposite of what they are on the old adapter board. If there is already an adapter K307 installed, ensure that the serial port selected on the new board (K306) is not also being used as a serial port on K307.

3. Install the adapter board in one of the vacant slots (Procedure B).

NOTE: The correspondence between the above mentioned ports and program descriptions of printing and communication devices is discussed in the NCR-DOS Manual ("MODE" command).

SERIAL/SERIAL ADAPTER (3299-K307)

1. Remove the cabinet (Procedure A).

2. Set the port selection switches on the adapter board as shown in the separate kit description. Which ports you select depends to a great degree on the programs which are going to make use of the adapter. If you are installing the adapter with a particular program in mind, refer to the instructions belonging to the program. If no selection is specified, set connector I to "base port address" 3F8 and connector II to 2F8.

   If there is already an adapter K306 or K307 installed, set the serial port selection switches on the new adapter in such a way that port addresses already selected on the old board are not duplicated.

3. Install the adapter board in one of the vacant slots (Procedure B).

NOTE: The correspondence between the above mentioned ports and program descriptions of printing and communication devices is discussed in the NCR-DOS Manual ("MODE" command).

128 KB MEMORY EXTENSION (3299-K110)

If you are installing these memory extension integrated circuits on the main processor board, proceed with description I. If they are to be installed on a separate memory board, follow the instructions in description II.

I.

1. Remove the cabinet (Procedure A) and any options obstructing access to the main processor board areas illustrated in Figure 2 K110-1.

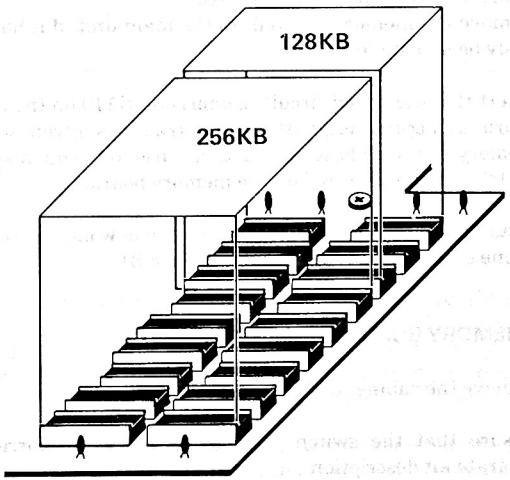


Figure 2 K110-1

2. If the main processor board presently includes no more than the standard 256 KB memory, install 256 KB of memory (2 kits K110) in the appropriate IC slots as delineated in Figure 2 K110-1. If 512 KB are already present, install 128 KB of memory (1 kit K110).

   Two types of integrated circuit are used, so take care to insert one of matching size (16 or 18 pins) in each socket. Furthermore, observe the precautionary measures set out in the "Points to Watch" part of this Chapter as well as the instructions supplied with K110 itself.

3. Refer to "Switches" at the end of this Chapter, and set the memory selection jumpers on the main processor board in accordance with the new memory capacity (512 KB or 640 KB).

II.

Installation of a separate memory board requires that the main processor board already contain its maximum memory capacity of 640 KB.

1. Remove the cabinet (Procedure A).
2. Remove the memory board from the main unit, if it has previously been installed.
3. Insert the integrated circuits comprising K110 on the memory board in accordance with the instructions given with the memory board. These instructions also tell you about any switch settings required on the memory board.
4. Install the memory board containing the new memory capacity in one of the vacant slots 2-6 (Procedure B).

512 KB MEMORY BOARD (3299-K111)

1. Remove the cabinet (Procedure A).
2. Ensure that the switch settings on K111 are correct (see separate kit description).

3. Install the memory board in one of the vacant slots 2-6 (Procedure B).

1 MB MEMORY BOARD (3299-K112)

1. Remove the cabinet (Procedure A).

2. Ensure that the switch settings on K112 are correct (see separate kit description).

3. Install the memory board in one of the vacant slots 2-6 (Procedure B).

360 KB FLEXIBLE DISK DRIVE (3299- K711)
1.2 MB FLEXIBLE DISK DRIVE (3299-K701)

1. Remove the cabinet (Procedure A).

2. Remove one pair of plastic guides from inside the computer. These are strips of plastic a little shorter than the disk drive itself. They are attached in pairs in the areas left vacant for additional disk drives.

3. Fasten the plastic guides using the screws provided. Special fastening instructions are attached to the guides themselves.

4. Refer to the separate kit description. A number of switches (straps) must be installed on the disk drive itself:

   3299-K701: DS1, FG, U2, DC, HG, and II
   3299-K711: DS1, FG, U2, and XT

5. Unscrew the two retaining clamps at the front of the main unit adjacent to the area where the disk drive is to be installed. Figure 2 K701-1 shows these clamps for the installation of a second flexible disk drive. Note which way you removed the clamps: some are brackets with flanges of unequal length.

6. With the drive lock lever facing you and the red indicator lamp top-left, slide the drive from the front of the computer into the vacant opening immediately below the flexible disk drive already present.

7. Screw the retaining clamps into place (Figure 2 K701-1).

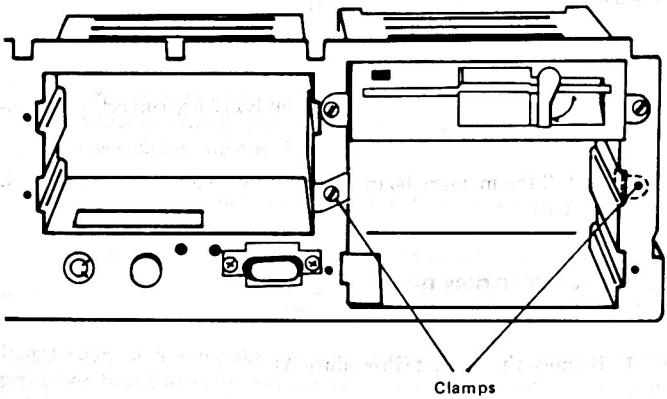


Figure 2 K701-1

8. At the back of the disk drive there is a multipin edge connector fastened to a cable band. This connector is just like the one already connected to the original drive in the computer. Push this connector onto the board containing conductive strips at the back of the newly installed drive (see separate kit description).

9. Withdraw a "spare" power connector from the plastic clamp attached to the metal housing of the power supply (Figure 2-5) and connect it at the socket indicated in the separate kit description.

10. Withdraw a spare ground connector (Figure 2-5) and connect it at the point indicated in the separate kit description.

11. It is necessary to remove from the cabinet the panel still obstructing the opening for the newly installed flexible disk drive.

20 MB HARD DISK DRIVE WITH DATA CABLE (3299-K753)

1. Remove the cabinet (Procedure A).

2. Remove one pair of plastic guides from inside the computer. These are strips of plastic a little shorter than the disk drive itself. They are attached in pairs in the areas left vacant for additional disk drives.

3. Fasten the plastic guides using the screws provided. Special fastening instructions are attached to the guides themselves.

4. Unscrew the two retaining clamps at the front of the main unit adjacent to the area where the guides you have just attached to the drive are to be inserted. (If a full-height drive is being installed, the guides will be inserted at the lower of the two disk unit positions required.) Note which way you removed the clamps: some are brackets with flanges of unequal length.

5. With the end of the drive at which the various connectors are situated facing away from you, slide the drive from the front of the computer into the vacant opening.

6. Screw the retaining clamps back into place.

7. If this is the first or only hard disk unit to be installed, connect the remote end of the cable band already connected to the disk controller board at location 3 (Figure 2 K753-1) to the edge connector at the back of the drive indicated in the separate kit description.

   If a hard disk unit was already present, connect the unoccupied connector of this band.

8. An additional cable is required (3299-K757). Connect one end of this cable to location 2 (first hard disk unit) or location 1(second hard disk unit) on the disk controller board (see Figure 2 K753-1). Connect the drive end of this cable band as shown in the separate kit description.

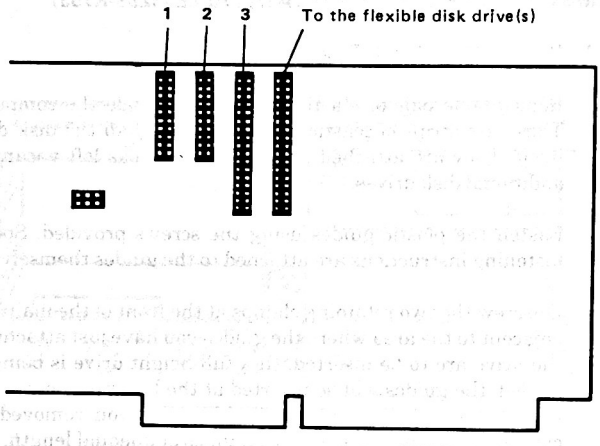


Figure 2 K753-1

9. If a hard disk unit was already present, withdraw a "spare" power connector from the plastic clamp attached to the metal housing of the power supply (Figure 2-5) and connect it at the socket indicated in the separate kit description.

   If this is the first or only such unit being installed, separate the plug/socket connection leading to the heavy-duty resistor attached to the metal housing of the power supply. Use the power connector thus freed.

10. Withdraw a spare ground connector (Figure 2-5) and connect it at the point indicated in the separate kit description.

FLOOR STAND (3299-K801)

1. Disconnect power to the main unit at the wall outlet.

2. Disconnect all cables to the main unit and place the display out of the way.

3. Remove diskette(s) from the flexible disk drive(s). Place protective cardboard inserts (or "scrap" diskettes) in all flexible disk drives.

4. Follow the description provided with the Floor Stand and fit it to the Main Unit. After completion re-assemble by using the above procedure in the reverse order.

SWITCHES

MAIN PROCESSOR BOARD

The main processor board contains three groups of switches which must be set correctly to reflect certain important characteristics of the computer system. If your NCR Personal Computer was supplied "ready to use", these switches are already set correctly. If this is not the case, you should check, and if necessary adjust these settings.

The "switches" are not switches in the conventional sense of single-finger operation. This is because their positions need rarely, if at all, be adjusted. They are really "jumpers", that is, small spring-wires which can be hooked in two or more positions, or electrical bridges encapsulated in plastic which can be placed onto connecting pins in various patterns to create various combinations of electrical connection. The jumpers on the main processor board of your NCR Personal Computer are of the latter type.

The three groups are for

1. Memory selection
2. Primary display selection
3. Program memory storage selection (factory-set, therefore does not require setting)

The positions of these groups on the main processor board are indicated in Figure 2-6. Note that the disk controller board has been removed from slot 8 (Procedure C described in "An Inside View"). This is normally necessary in order to access the jumpers (although with care you might be able to access group 2 without having to remove the disk controller board). You may also consider it necessary to remove boards installed in other slots.

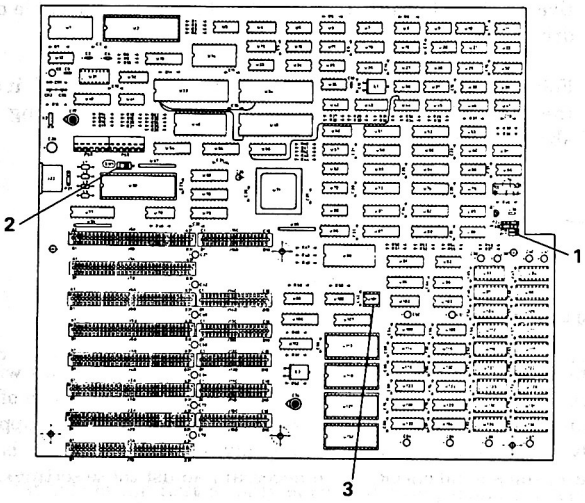


Figure 2-6

When you have checked/altered the switch settings, do not forget to replace any boards and connectors that had to be removed in order to gain access to the switches.

The memory selection jumpers, marked P17 and P18 on the main processor board, are situated next to the loudspeaker and keyboard lock connectors. These two jumpers together can take on any one of three combinations, according to the amount of memory installed on the main processor board (Figure 2-7).

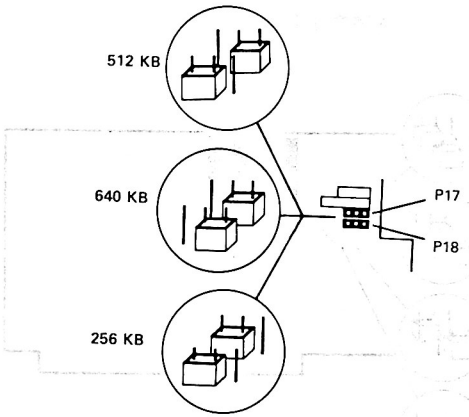


Figure 2-7

Primary display selection reflects the type of display adapter being used. If you are using an NCR 3295 display (whether color or monochrome), you have a "graphic" display adapter. This requires the slider switch to be moved to the right of its two positions, when viewing the main processor board as in Figure 2-6. Other monochrome displays might make use of a "character" (or "alpha") display adapter. In this case, move the switch to the left.

The remaining jumper block is set according to the type of "Read Only Memory" integrated circuits used in your NCR Personal Computer to store important programs which get the system going as soon as you switch on the computer. As already stated, this block is factory-set and will not normally require setting.

DISK CONTROLLER BOARD

A pair of plastic-encapsulated bridges on the disk controller board determines separately for flexible and fixed disk drives whether so-called "primary" or "secondary" channels are being used (Figure 2-8).

These switches are both factory-set to primary. These settings should not be changed unless you are explicitly told to do so in connection with the use of a particular kit or program.

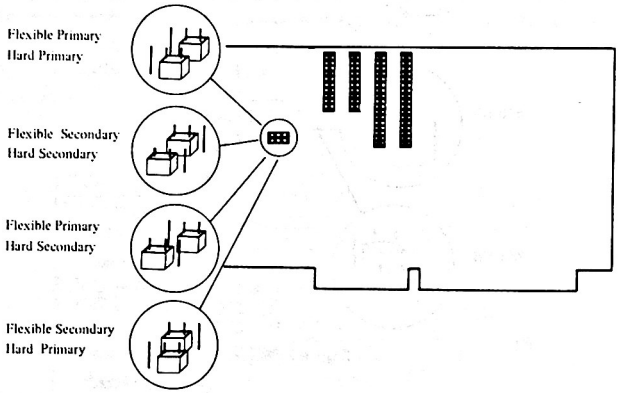


Figure 2-8

SET-UP

If you have installed the NCR Personal Computer yourself, or you have just exchanged the internal battery, you will have to run the "set-up" program as soon as you have completely re-assembled the main unit. It is also advisable to run this program whenever you have installed an option that required the cabinet to be opened.

The set-up program is included on both the Diagnostics diskette and the NCR-DOS diskette. The Chapter "Keeping Going" describes how to start this program using the Diagnostics diskette.

The NCR-DOS Manual contains a more detailed description of the various system characteristics with which set-up is concerned. If your computer includes one or more hard disk drives, you should refer to the NCR-DOS description of the set-up and hard disk formatting procedures. Important information for the set-up program is provided on a label attached to the inside of the front panel.

MY OPTIONS

Keeping Going

Obviously you wish to get the best possible use from your computer. In this chapter information is given regarding the diagnostics, which can help you to isolate any problems that may arise. Also included are hints on the care of your computer, and what to do if you should wish to move your computer.

If you have just installed your NCR Personal Computer for the first time, you must now make use of the Diagnostics diskette. This diskette includes a "set-up" program which takes note of the type and number of disk drives in your system, and gives you the opportunity of telling the system the current time and date. This information is retained even after the computer has been switched off, but only as long as the battery is connected and still supplying sufficient current, and provided that there are no electrical disturbances in the system such as can occur when kits are being installed.

The set-up program will therefore also be necessary after working on the computer with the cabinet removed. This can be the case

- following installation or removal of an option
- after exchanging an exhausted battery (you notice that the battery is exhausted when, for no apparent reason, the system displays a disk or other error message almost immediately after switching on).

To run the set-up program refer to SETUPPC in your NCR-DOS Manual.

DIAGNOSTICS

POWER ON DIAGNOSTICS

Each time the system is switched on a number of basic tests are automatically made by the computer. As each test is performed, a mes-

sage is displayed on the screen and at the completion of the tests the screen shows a display similar to the one shown below:

_BOARD TEST (MINIMUM) COMPLETE
_DMA CONTROLLERS
_TIMER 0
_INTERRUPT CONTROLLERS
_MEMORY TEST
Basic Memory Test
00512 KB
Usable Memory 00512 KB
_KEYBOARD TEST
_FLEX DISK
_FIX DISK
_COPROCESSOR 80287 NOT INSTALLED

This message will vary slightly according to the features that are installed on your computer, and is then followed by a copyright notice for the diskette that is currently in drive A similar to the one shown in Figure 3-1.

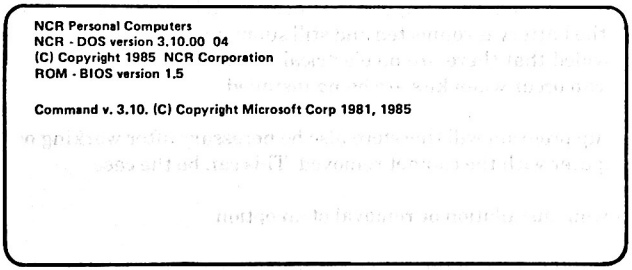


Figure 3-1

USER DIAGNOSTICS

These diagnostics are contained on the User Diagnostic diskette that is supplied with your system. They may be used as little or as often as you wish, however, we suggest that you use them when:

- you first set up your system
- you add or remove options
- you suspect that some problem may exist

These tests are designed so that you may use them with the minimum of supporting documentation. Easy to understand screen displays allow you to select which routines you wish to run, and how many times the selected tests are run.

Each test has simple to understand messages indicating either the test has been successfully completed, or that a failure has been detected. Some tests, for example the Memory Test, take several seconds to complete. In these instances there are supplementary messages indicating how much of the test has been completed; this saves you wondering if the test is really working or is there some problem that you do not understand.

Remember that the "Passed" or "Failed" message is only indicative of the state of the system at the time the test was performed; there may be intermitent failures that are not detected, this is especially true for disk failures. Should you still suspect your computer after having used your diagnostic diskette then contact your dealer or NCR representative. He can arrange for a trained engineer to check your system with the use of more sophisticated diagnostic routines.

COPYING THE DISKETTE

As soon as you have made a copy of this diskette, you can use the copy and store the original in a safe place. The copying procedure differs according to whether your system has one or two flexible disk drives.

Copying with One Drive

1. Switch off and insert the original diagnostic diskette into disk drive "A", switch on:

   A number of messages appear on the screen, then the following message appears:

   Press (F1) for DISKCOPY or any key to continue

2. Press the F1 key and the following message appears:

   Insert SOURCE diskette into drive A
   Press any key to continue

   You have already inserted your source diskette into drive A, press any key.

3. After a few moments the following message is displayed:

   Insert TARGET diskette into drive A
   Press any key to continue

   You must now remove the original (SOURCE) diskette from drive A, and insert a new (TARGET) diskette into A, then press any key.

4. The messages and actions described in steps 2 and 3 must be repeated until the complete diskette has been copied.

5. When the following message appears:

   Copy Complete
   Copy another disk (Y/N)?

   Press Y if you wish to make more copies, or press N if you require no more copies.

6. When you respond with N, the copying procedure is completed.

Copying with Two Drives

1. Switch off and insert the original diagnostic diskette into disk drive "A", switch on:

   A number of messages appear on the screen, then the following message appears:

   Press (F1) for DISKCOPY or any key to continue

2. Press the F1 key and the following message appears:

   Insert SOURCE diskette into Drive A:
   Insert TARGET diskette into Drive B:
   Press any key when ready . . .

   You have already inserted your source diskette into drive "A". Now insert a new diskette into drive "B". Then press any key to continue.

3. When the following message appears:

   Copy Complete
   Copy another disk (Y/N)?

Press Y if you wish to make more copies, or press N if you require no more copies

4. When you respond with N, the copying procedure is completed.

RUNNING THE DIAGNOSTICS PROGRAM

A configuration test is automatically made to ensure that the diagnostics match your system. If they do not match, then you must run the SETUP procedure. To do this refer to your NCR-DOS Manual.

To load the diagnostic diskette use the following procedure:

1. Switch on the computer.

2. Load the diskette into drive A and close the lock lever.

3. Respond to the messages that are displayed on the screen until the Main Menu is displayed. The Main Menu displays are shown in Figures 3-2 and 3-3.

```
The NCR Personal Computer
Copyright 1985 NCR Corp.                                  Page 1 of 2
User Diag. Version 8.00

                              MAIN MENU

Available Tests (highlighted)

      01 Mainboard Test
      02 Memory Test
      03 Memory Extension Test
      04 Keyboard Test
      05 Alpha - CRT Test
      06 Graphic - CRT Test
      07 Flex Disk Test
      08 Fixed Disk Test

(F1)  Explanation of Tests              (F7)  Run All Tests Once
(F6)  Utilities                         (F8)  Run All Tests Continuous
(F9)  Add/Delete Tests to Main Menu     (PgUP) Previous Page
(F10) Exit to DOS                       (PgDn) Next Page

Press selection and (Enter) for running test once  OR
Press selection and (F8) for continuous run of selection ( (F4) to stop)
SELECTION =>
```

Figure 3-2

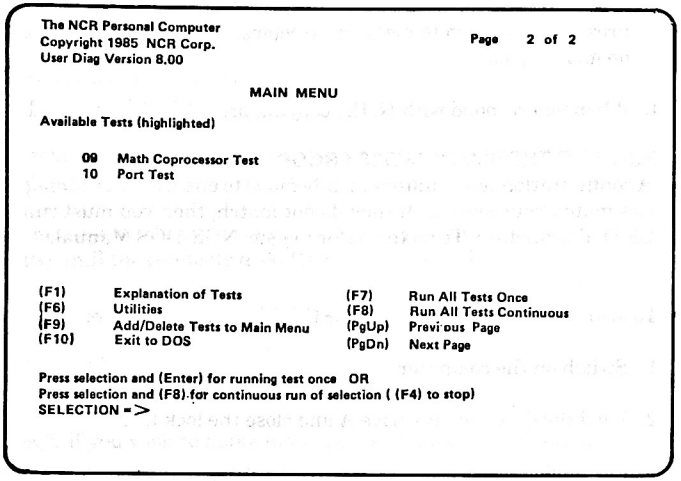


Figure 3-3

Please note it is not possible to display the complete menu on the screen, to see the remainder of the menu you must press the "PgDn" key. Then if you should wish to see the first part of the menu again this is possible by pressing the "PgUp" key.

4. You are now ready to select which test you want to run. All you need to do is enter the number of the test that you wish to run and press the Enter key.

Error Log

During the execution of some of the diagnostic tests, errors sometimes occur however, the tests continue to run. Such errors are automatically recorded in a special file for future reference. This file is called the Error Log, and is part of the utilities that are provided with the diagnostics.

To select this file, from the Main Menu press the Function key F6. Then, from the Utilities Menu press the 3 key and the Enter key. You can now display, print or delete the contents of the error log file. This file can be a valuable source of information when evaluating the performance of the system over a long period of time.

Initialize Fixed Disk

This utility asks some questions that for the first time user there may be a little difficulty in fully understanding. The procedure is identical to the procedure used by NCR-DOS and is fully described under INIT-FIX in your NCR-DOS manual.

Keyboard Test

The keyboard test displays on your screen the different "key codes" that are generated when different keys are pressed.

To use this test, first be sure that the Caps Lock key is in the inactive mode (indicator not illuminated) and that the shift keys are not selected (lowercase letters). Select the keyboard test from the Main Menu, press each key and compare the key code that is displayed on the screen with those shown in Figure 3-4.

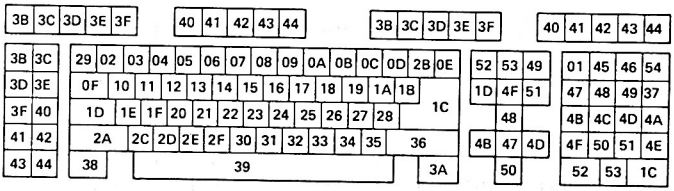


Figure 3-4

Add/Delete Tests to Main Menu

This routine is provided so that you may add diagnostic routines to the diskette for any new feature that you may install in your system at a later date.

Please note that since the original diagnostic diskette is write protected, it is not possible to use this routine with this diskette. You should only add or delete routines to your working copy of the diagnostic diskette.

There is one additional diagnostic routine which has not yet been described. It is a routine for testing the high capacity flexible disk drive. Instead of being called up from the User Diagnostics diskette, it can be activated during power-on diagnostics. This routine is described in a separate section at the end of this Chapter.

HELPFUL HINTS

GOOD OPERATING HABITS

You should practice a regular routine of care when using your computer. Train yourself to be conscious of the little details that could affect your NCR Personal Computer's performance.

- Always wait a few seconds after switching off, before you switch on again.
- Never remove or insert the plug when the power switch is on.
- Do not eat, drink, or smoke in the computer environment.
- Store the diskettes after each use. Always store them in their protective envelopes and try to keep them in some type of closed cabinet.
- Cover the computer and any peripherals if the system will not be in use for an extended period of time. You could make this a daily habit if you are concerned about dust and particles in the air.
- Do not touch the exposed parts of the diskettes.
- Do not bend the diskettes.
- Do not write on the diskette labels with anything but a soft felt-tip pen.
- Keep the diskettes clear of small particles such as dust, food, tobacco, etc.
- Keep the diskettes away from other equipment that may have magnetized components. There are many possibly magnetized items that may be in your computer environment: radios, charm bracelets, telephones, electric pencil sharpeners, etc.

You should also develop habits to protect your data from harm due to human error.

- Update your backup copies as you change the originals.

- If you are working with new information in volume, periodically store the information on a diskette. This will reduce your loss should the information in the computer's memory be lost. Some programmers store their work to disk every 15 minutes, do what you feel is comfortable.

Periodic Checks

Make it a habit to periodically check your computer and its peripherals for any problems that may have arisen since installation. Here are a few points to consider:

- Are the connections secure?

- Has any magnetized hardware been moved into the computer environment? Remember that magnetized objects might damage the information on the diskettes and can affect the computer's memory. This is very important; even jewelry can have magnetic properties, so be careful.

- Is the computer environment still as static free as possible? (some types of carpet require regular anti-static treatment)

- Are the air circulation vents uncovered? They should be exposed at all times.

- Is the computer near a window or heater, or something else that could seasonally affect the environment?

Maintenance

Unless you are capable of performing your own service, and you purchase the Service Manual, the computer should be repaired only by a qualified technician. However, there are steps you can take to keep your unit in working order. You can remove dust that could get into the computer and affect its performance by cleaning the unit periodically. Clean the display and the cabinets as needed using the following steps:

1. Turn off the unit and remove the power cable from the wall outlet.

2. Wipe the screen with a soft cloth and an ammonia-based glass cleaner, a very mild detergent solution, or a water dampened cloth. Dry the screen with a soft cloth.

3. Wipe the cabinet with a cloth slightly dampened by a mild detergent solution, but be careful not to damage the unit by allowing liquid to get inside the cabinet.

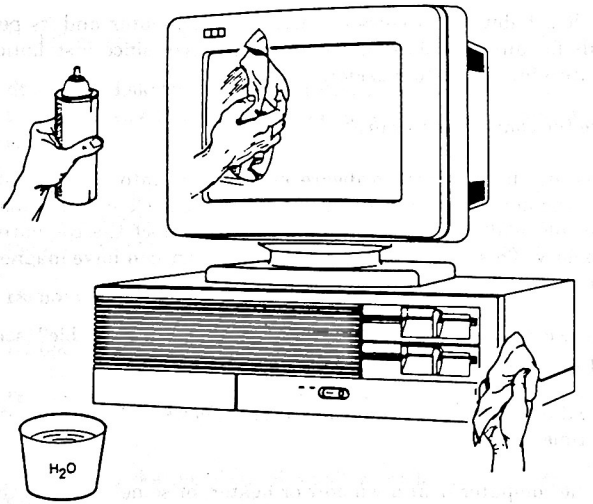


Figure 3-5 Cleaning the system

Disk heads should be cleaned once a month. More frequent cleaning may be necessary depending on how much the system is used. If you use an abrasive cleaning diskette, cleaning time should not exceed 30 seconds. Contact your dealer or NCR Customer Service representative to determine which head cleaning method is best for your computer environment.

RELOCATING YOUR COMPUTER

This section describes the steps you must take before moving your NCR Personal Computer. Whether you are planning to move your NCR Personal Computer a short distance or a long distance, you need to make the same initial preparations to the system.

If you have a system with both a flexible disk drive and a hard disk drive, you need to prepare each of them differently before moving your NCR Personal Computer.

Preparing The Flexible Disk Drives(s)

1. Find the cardboard insert(s) that were in the flexible disk drive(s) when you first unpacked the system. If you have misplaced the insert(s), you may use old, "scrap" diskette(s) in place of the cardboard insert(s).

2. Insert the cardboard piece(s) or scrap diskette(s) in the drive(s), just as you would insert a diskette.

3. Turn the drive access lever(s) to the "lock" position. This keeps the head(s) locked in position.

NOTE: If you do not protect the head(s) with the cardboard insert(s) or the "scrap" diskette(s), the head(s) could be damaged during the move.

Preparing The Hard Disk Drive

To prepare the hard disk drive for moving, you need to use the Diagnostics diskette. Look to the "Utilities" section of the diagnostics diskette, and the section "Hard Disk Preparation" in Chapter 1.

NOTE: After preparing the hard disk drive, switch off the system and do not switch on again until the system is re-installed in the new location.

Preparing The Rest Of The System

1. Turn the power switches OFF on all units.

2. Disconnect the system power cable from the wall outlet; then dis-

connect all the cables from the rear of the unit. Note where the cables are connected as you pull them off to facilitate re-connection and set-up at the new location.

3. Protect the connectors by wrapping them with suitable material such as foam sheets, heavy paper, etc.

4. Coil the cables, and tape them securely to the top of the display unit.

Your NCR Personal Computer is now ready to be moved. If you want to move it a long distance, look at the section "Moving a Long Distance", below.

Moving a Short Distance

If you are moving the NCR Personal Computer a short distance (that is, within the same building), each unit can be carried by one or two people; however, using a cart (avoiding excessive vibration) will make the move easier.

When you move the system, keep the following points in mind:

- Each unit should be moved separately; do not try to carry more than one piece at a time.

- Always use both hands to lift the units.

- You may want to have another person help you lift the heavier units.

- Have an extra person available to open doors, or to call the elevator.

Moving a Long Distance

During a long distance move, the original cartons and packing materials that your NCR Personal Computer arrived in will provide the best protection for the system.

Pack the computer, keyboard, and display in the original cartons and packing material using the following procedure:

1. Place each unit in a plastic bag. Do not forget to insert the protective cardboard tabs into the flexible disk drives.

2. Position the cushioning material on each unit, and carefully place the unit in its packing box.

3. Check to be sure that the cushioning material is correctly positioned around the unit, and make sure that the equipment is secured inside the packing box. To avoid damage, the unit must be packaged so that it won't slide around in the box. Add more cushioning if necessary.

4. Tape the boxes shut with strong packing tape.

Your NCR Personal Computer is now ready to be moved a long distance.

IF YOU GET RADIO/TV INTERFERENCE

If this equipment should cause interference to radio or television reception, (this can be checked by turning the equipment off and on), you could try to correct the interference by one or more of the following measures:

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

If necessary, you should consult your NCR dealer or an experienced radio/television technician for additional suggestions.

TESTING THE HIGH CAPACITY FLEXIBLE DISK DRIVE

You have already read in Chapter 1 that diskette data can be stored in two formats with your NCR Personal Computer: high capacity (1.2 MB) and standard capacity (360 KB).

Your User Diagnostics diskette includes a test routine for flexible disk drives, but using this routine only the standard capacity format of a high capacity drive is tested. The power-on diagnostics, that is, those system checks carried out as soon as you switch on the computer, include a special testing routine for the high capacity format. If the User Diagnostics diskette could find no fault with the high capacity drive but you still suspect that there is a problem with the drive, you should make use of the special power-on diagnostic test.

To carry out the test you need an unused **high capacity (1.2 MB) diskette**. Have this diskette ready, then proceed as follows:

1. Switch off the computer, wait a few seconds, then switch it on again. Do not insert any diskettes.

2. Observe the power-on diagnostics (they are described in a section at the beginning of this Chapter). As soon as the KEYBOARD TEST message appears, press the key combination Control-D (that is, press the D key while holding down the Control key).

3. The power-on diagnostics will complete as normal, but then a special screen message will appear. This screen is shown in Figure 3-6.

   If this screen does not appear and your computer starts looking for a diskette in drive A, it simply means that you were too late pressing Control-D or you mistyped. In that case all you have to do is start again at step 1.

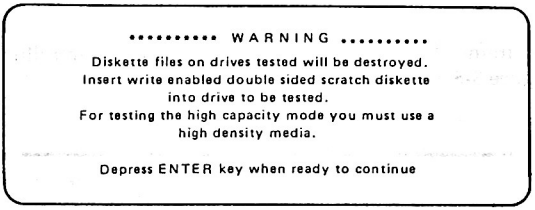


Figure 3-6 High capacity test introduction

4. Take this warning seriously: do not insert any diskette containing data you wish to keep. Insert your unused high capacity diskette in the high capacity drive you wish to test (most probably drive A) and close the drive lock lever. Then press the Enter key.

5. The menu shown in Figure 3-7 is now displayed.

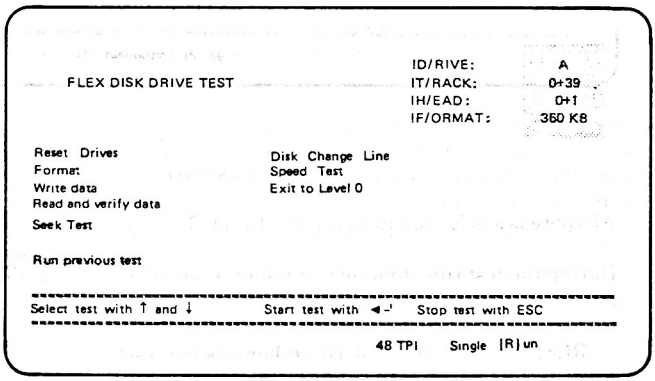


Figure 3-7 Initial menu

6. Press T, followed by F (do not press Enter).

7. Press R (again, do not press Enter). This means that the drive will be tested continuously until you are satisfied about its condition. This is the most effective way of testing the drive. (If you did not press R, the drive would be tested once only.)

NOTE: Do not yet press any keys other than those mentioned in steps 6 an 7, otherwise the test will not be performed correctly.

8. Assuming that you pressed R at step 7, the menu illustrated in Figure 3-8 is displayed.

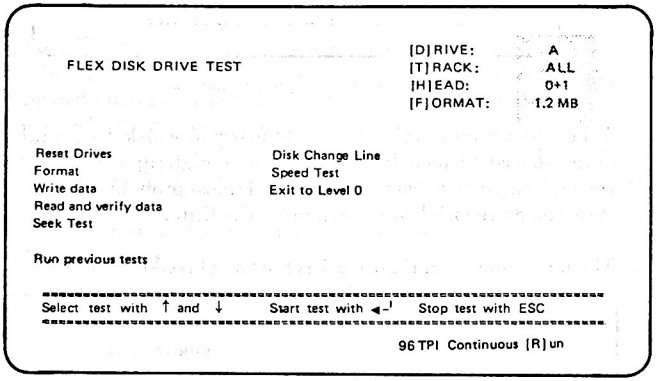


Figure 3-8 High capacity test selected

All there is left for you to do is press Enter. The test then starts.

During the test run, items of test information are displayed at the bottom of the screen. These are:

RESET (the flexible disk controller is being reset)
FORMAT (the diskette is being formatted)
WRITE (test data is being written to the diskette)
READ and VERIFY (that data is being read from the diskette to make sure that it has not been corrupted)
SEEK (the drive is making sure that it can find all the tracks the diskette is supposed to have)

Most of these tests are accompanied by a notification of the particular area on the diskette currently being examined. Do not be concerned that you cannot follow this quickly changing information.

9. Should an error occur the tests are suspended and an error message is displayed (for example, FLEX DISK CONTROLLER FAILED TO RESPOND). It may be a spurious error, so for the mo-

ment at least, you should let the tests continue by pressing Enter or some other key.

If there is a persistent error, try starting again at step 1 with a different unused high capacity diskette. If the error still persists, start again at step 1, this time writing down the exact text of each error message and how often it occurs. This information could save a lot of time if a service call is required.

10. Assuming that no error occurs after each test item has run at least once, it is almost certain that your high capacity drive (and the diskette inserted in the drive) are functioning correctly. You may wish to let the test run longer before finally deciding that there is no defect. Then simply press the Esc key to stop the test.

    The test routine stops, leaving the cursor in the bottom left part of the screen. You should now restart the system in the normal way (that is, switching off and on, or Control-Alt-Del).

NOTE: If your system has a high capacity flexible disk drive as drive B, you can also apply the test routine to this drive. The only difference in the test procedure is for you to press the D key immediately after pressing the T and F keys at step 6. The high capacity diskette should, of course, be inserted in drive B.


THE WAY AHEAD

The Way Ahead

If you are a newcomer to computing, you may be asking yourself what it is that makes your computer function with such speed and discipline. The next few pages in this Chapter go at least some of the way to explaining the source of the computing power of your NCR Personal Computer.

In the course of this Chapter, you will meet several computing terms, many of which may be new to you. These are printed in italics so that you can later refer back to the individual explanations. Your NCR Personal Computer, as well as the disks and Manuals belonging to it are, of course, prepared in such a way that you can put your computer to immediate professional use, without having to learn this new terminology. So if you are in a real hurry to start up a program, you can turn straight away to the "Applications" section of this Chapter. If you are just a little bit curious, read on.

DOES MY COMPUTER REALLY THINK?

The component inside the computer normally associated with its "intelligence" is the *microprocessor* or *Central Processing Unit (CPU)*. This microprocessor recognizes sequences of electrical pulses in much the same way as we can recognize the significance of a light flashing, when we have been told that these flashes represent Morse code.
The important difference between our complexity of thought and that of the computer is that we immediately associate ...– – –... as an SOS situation, and work out a course of action accordingly, often in an imperceptible instant of time. The microprocessor, too, is fast, but its power of thought in a single instant seems rather limited: a similar sequence of dots and dashes in terms of electrical pulses would make the microprocessor do no more than "add one to the last number you were told to remember".

There is an apparent contradiction between the simplicity of the microprocessor's, and therefore the computer's, power of thought, and the ability of a computer to, for example, create in a matter of seconds a list, in alpahabetical order, of all the titles accessioned by a library in the past month.

To resolve this apparent contradiction, we have to gain an understanding of the speed with which the microprocessor carries out its simple operations. An arithmetic operation like the one described above takes a fraction of one microsecond. This means that the microprocessor can carry out up to several million such "thought processes" in a single second. But this still leaves open the question of how such simple thought processes can be accumulated into such "superior" activities as putting a list in alphabetical sequence and writing it out so that somebody else can read it.

As already implied, the computer is potentially a wizard with numbers, but can do little else. Therefore, it converts everything it needs to read to numbers, including the letters which go to make up the titles which require sorting. Accordingly, the unsorted list

PARADISE LOST
PRIDE AND PREJUDICE
AS YOU LIKE IT
CANTERBURY TALES

would be encoded by the computer as sequences of numbers, where each letter of the alphabet is represented by a unique number, which in turn can be represented by a unique pattern of electrical pulses. This is the principle behind computer codes. The code used by your NCR Personal Computer is the almost universal *ASCII* code, which interprets our book-list like this:

80 65 82 65 68 73 83 69 32 76 79 83 84
80 82 73 68 69 32 65 78 68 32 80 82 69 74 85 68 73 67 69
65 83 32 89 79 85 32 76 73 75 69 32 73 84
67 65 78 84 69 82 66 85 82 89 32 84 65 76 69 83

With a little detective work it becomes apparent that code number 65 stands for A, 66 stands for B (here not used), 67 stands for C, and so on. Even the space between two words has a code number: 32.

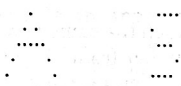
The computer can now sort these four items in much the same way as we would: if the first letter of the first title is "further from" A in the alphabet than the first letter of the second title, then exchange the positions of these two entire titles (as the first letters of the two titles are here the same, make the decision whether to exchange or not dependent on the two second letters, here A and R). Repeat this process for the second and third, then for the third and fourth titles. Repeat this triple comparison over and over again until it has been carried out once without any exchange being necessary. The list has then been sorted.

The principle difference between the way we see the titles and the way the computer performs the comparison, is that the computer compares in terms of numbers: "depending on whether the first number code is higher or lower than the second, proceed with one of two possible sets of further instructions".

To get the results onto the screen, the computer has to look up for each code number a pattern of screen dots (or *pixels*) which can be illuminated so that we see one of the letters of the alphabet. (The electronics looking after the screen display are much like those which give a picture on a household T.V. set. but there are some differences, mainly due to the fact that your display is designed to be read close-up.)

For example, for the letter E (code number 69) the computer tells its *display controller* to refer to the sixty-nineth pattern in a collection of patterns. Each of these patterns consists of a group of electronic "switches", far too small for the eye to see, which, on an individual basis, either let electric current through or impede it. Thus, a series of electric pulses corresponding to the original letter shape can be fired at the fluorescent surface of the screen, causing appropriate points on the screen to be illuminated.

Returning to the analogy of the Morse code, we might consider the dots as representing those points which are to illuminated, while the dashes correspond to those "switches" which impeded electric current. The beginning of the first title (after sorting) can then be depicted something like this (as the dashes correspond to electric current which didn't flow, we are justified in suppressing them altogether):



This, of course, is only one of many possible examples. However, it is already becoming apparent that the power of thought so often attributed to the microprocessor and its electronic assistants is in essence an intricate accumulation of

- highly miniaturized switching combinations, each of which is in concept no more complex than the switch on your desk reading-lamp, although on an almost infinitely smaller scale (a term often encountered is *large scale integration*), combined with precision mechanics (e.g. the disk drives) and some refined chemistry (the phosphor layer of the screen which ultimately illuminates to provide us with readable information)

- highly complex schemes of "dots and dashes" which convert our "computable" problems into the microprocessor's junior grade arithmetic, and also convert the answers into our higher forms of understanding.

You have probably already heard many allusions to the first-mentiond of these two components of computer intelligence - in the expression *hardware*. The second of these components is what we refer to as *software*.

* The microprocessor is good at sums, but it can't spell, and you can't ask it for an opinion

* Computing power comes from:
  large scale integration
  thorough programming

PROGRAMS AND DATA

We have already established that the computer makes use of electrically representable code numbers: you have seen an example of the encoding of *data* (book titles). Similar sequences of numbers represent the instructions telling the microprocessor what arithmetic to perform on that data. This action of instructions on data is called the *program.*

At this point, we must depart from the Morse code analogy. The reason is that letters in Morse code are encoded in various lengths, for example, A is represented in two positions (.-) while S is assigned three positions (...). The microprocessor expects units of data and instructions to consist of eight (or multiples of eight) positions. This unit of eight is called a *byte*, the eight positions making up a single byte are called *bits*.

Example: in the ASCII code, the following patterns are associated with the uppercase letters B and C:

_._____ = B
_._____.. = C

In computing, there is a convention which uses ones and zeros instead of dots and dashes, for writing out these unique patterns. B and C then have the following appearance:

01000010 = B
01000011 = C

Remember that the ones and zeros correspond to miniature electronic "switches". If you were to write out all the unique on/off combinations for a single byte, you would conclude that there are 256 unique combinations between all open and all closed, inclusive. As we established in the previous section, the ASCII code says that combination 66 is to be interpreted as uppercase B, 67 is uppercase C. If you count up the total number of combinations required for all the uppercase and lowercase letters of the alphabet, the ten digits, and the punctuation signs, you will see that not even half of the 256 possible combinations are required. This leaves plenty of combinations beyond the requirements of the ASCII code which can be used to represent characters used by languages other than your own, and to represent *control characters.*

Control characters are those which do not produce a readable character, but instead instruct the computer to carry out some other type of action. For example, combination 7 is regarded as an instruction to create a short beep tone in the computer's loudspeaker.

The instructions which the microprocessor carries out in order to process data are, like the data codes, represented by unique combinations of eight or multiples of eight bits. For example, the code

01000001

tells the microprocessor to add 1 to the number it has noted in one of its internal scratchpad areas, or *registers*. The code

01001001

causes 1 to be subtracted from that number.

Suppose the number is 66 without either of these codes being encountered, and that this number is subsequently to be handed over to the display controller for interpretation as an ASCII character (B). The intervention of the first of the two microprocessor instruction codes would ultimately result in the letter C being displayed, instead of B. If the second of those two codes were to intervene, instead of the first, the letter A would be displayed.

An example of widely used techniques used by programs processing ASCII data is to add 32 to an ASCII number code in the range 65 to 90. This has the effect of converting one of the 26 common uppercase letters to its lowercase counterpart.

If you are interested, you might care to study the full chart of ASCII code numbers and their characters given in the NCR-DOS Manual. But before you do this, you should take some time to read the following section which deals with some curious conventions used for writing numbers in computing.

* ASCII has a number for every letter; instructions are also uniquely coded

* 8 bits make 1 byte

NUMBERS

The 8 ones and zeros of a single byte yield 256 unique combinations, in other words, a byte can store any whole number between 0 and 255, inclusive. For example, the ones/zeros pattern for the number 185 is

10111001

Such a pattern is called the *binary* ("base 2") representation of a number. Each of the eight positions (bits) has a particular value:

The rightmost position is worth 1
The next position to the left is worth 2
The third position from the right is worth 4
...

And so the position value doubles as we move from right to left:

The leftmost position is worth 128

The value for a particular bit is actual or merely potential, according to whether the bit is one or zero. In the above example five values are actual:

1	0	1	1	1	0	0	1
↑		↑	↑	↑			↑
128		32	16	8			1

Add these values together and we have the value in the *decimal* notation, that is, the way in which we are accustomed to reading and writing numbers: 185.

One further example: the binary pattern for the uppercase letter A according to the ASCII code is

01000001

The decimal equivalent is 65:

```
0   1   0   0   0   0   0   1
↑   ↑   ↑   ↑   ↑   ↑   ↑   ↑
    64  +                   1
                                equals 65
```

Remember, the binary system is a representation of how the **computer** sees numbers. It is part of the task of a program author to ensure that you can communicate with the computer in terms you are accustomed to. If you are typing in your age, you can still write, say, 31, just as if you were filling in a questionnaire with a ball-point pen; you are not required to write 00011111!

We have seen that binary notation is a suitable way of indicating in written form the way the computer sees numbers. We have also established a method of converting these numbers into the kind of numbers we understand more readily. However, this process of conversion is not ideal, due to the fact that the number of binary digits is not easy to relate to the number of decimal digits. Examples: the 3-digit binary number 111 is a 1-digit number in decimal (7), binary 1000 is a 1-digit number in decimal (8), binary 1010 is a 2-digit number in decimal (10). The greater the number, the greater the discrepancy between the length of the binary number and its decimal counterpart: already the decimal number 129 requires 8 binary digits (10000001)! A shorthand form is therefore called for.

Again, this is of no concern whatsoever to the successful use of the computer in its everyday tasks, but it does concern the art of programming the microprocessor. The solution to the problem lies in the use of a number base which is a power of 2: 4, 8, 16, 32 etc. The base which has established itself as the norm is 16. Numbers represented in this base are called *hexadecimal* numbers.

Increasing hexadecimal numbers carry to the next position whenever the next power of sixteen is attained, whereas decimal numbers carry

whenever the next power of ten is reached. The advantage of hexadecimal numbers as a binary shorthand is that the hexadecimal number carries to the next position at every fourth binary position, thus providing for easy conversion.

Because our reading and writing convention provides for ten digits (0 1 2 3 4 5 6 7 8 9) and not 16, the hexadecimal system improvises for the missing six digits with the first six letters of the alphabet (A B C D E F). This means, for example, that the decimal number 10 is represented by A in hexadecimal notation; 12 is then C, 15 is F, and decimal 16 must carry - to hexadecimal 10.

It is not uncommon for computer documents of a technical nature to state numbers in hexadecimal notation. Strictly speaking, such numbers should be qualified with the word "hexadecimal" or "hex", or at least the letter H.

Here are some examples of (decimal) numbers with their binary and hexadecimal equivalents:

Decimal	Binary	Hexadecimal
9	00001001	9
14	00001110	E
20	00010100	14
31	00011111	1F
32	00100000	20
65	01000001	41
99	01100011	63
100	01100100	64
125	01111101	7D
129	10000001	81
218	11011010	DA
255	11111111	FF

How does the microprocessor store numbers greater than 255? The answer is simply to use an additional byte, so that the number is contained in a byte pair, or *word*. A word can hold a number as great as decimal 65535. This is how the microprocessor sees this number (the asterisk separates the two halves of the word simply for ease of reading):

```
 1  1  1  1  1  1  1  1  *  1  1  1  1  1  1  1  1
 ↑  ↑  ↑  ↑  ↑  ↑  ↑  ↑     ↑  ↑  ↑  ↑  ↑  ↑  ↑  ↑
32768 +                   128 +
  16384 +                   64 +
    8192 +                    32 +
      4096 +                    16 +
        2048 +                    8 +
          1024 +                    4 +
             512 +                    2 +
               256 +                    1

                                 equals 65535
```

The hexadecimal equivalent is FFFF.

For larger numbers it is even possible to use a *double word*. The number can then be as great as 4294967295!

* Your computer understands your way of counting

* Binary and hex are for programmers

DISKS

Bytes of data and instructions can be stored on electromagnetic media such as *diskettes* and *hard disks*.

Diskettes, also called *flexible disks*, can store hundreds of thousands of bytes by means of transitions of magnetic flux. Figure 4-1 shows the visible characteristics of a diskette. The diskette is permamently contained in a square protective jacket. The diskette spins within the jacket and a number of openings provide access for the drive mechanism:

- The recording slots are where the read/write heads of the disk drive can read or influence the patterns of magnetic flux on the diskette.

- The index hole enables the drive to recognize the starting point of each diskette revolution.

- The write protect cutout allows or prevents the alteration of the magnetic flux patterns on the diskette: as long as this cutout is open, the diskette may accept information for storage; if it is covered (special labels for this purpose are usually provided when you purchase diskettes), any attempt to change what is at present on the diskette will be rejected.

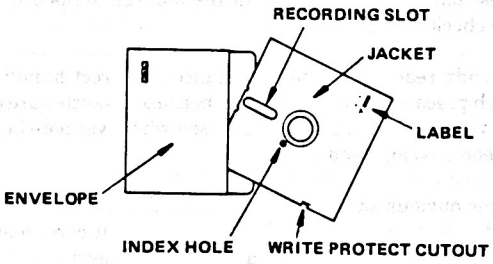


Figure 4-1 Typical diskette

Before information can be stored on a diskette, the diskette must be *formatted.* Formatting is a process which divides the disk up into units of storage space, namely *tracks* and *sectors* on either one or both sides of the diskette surface (see Figure 4-2).

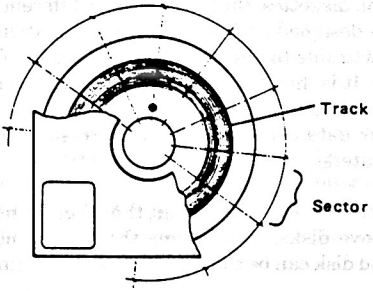


Figure 4-2 Sectors and Tracks

Tracks can be regarded as circular bands of recording space, of which there are usually at least 40. Each track is divided into 8 or 9 sectors, each capable of storing 512 bytes (typical values). The distance between tracks is determined by the size of step the read/write head takes when moving towards or away from the center of the diskette. The divisions between sectors are achieved by certain byte patterns being written at intervals on each track. These divisions are later recognized by the program performing disk access.

Your NCR Personal Computer is supplied with a program on diskette which does this formatting for you. In addition to the diskette being formatted, test patterns are written in the storage areas and read back again to check storage integrity.

You have already read about the importance of correct handling of diskettes. Such precautions are necessary because diskettes are often handled, and the recording surface is exposed whenever a diskette is passing between envelope and drive.

There are some obvious advantages in the use of diskettes: they are interchangeable between compatible computers; you can create as many as you need and store them for as long as you need.

The drive(s) in your NCR Personal Computer use 5 1/4 inch diskettes. When purchasing diskettes, tell your supplier that they are for the NCR Personal Computer, and the type of disk drive(s) with which your computer is equipped.

Your NCR Personal Computer can be equipped with a hard, or *Winchester*, disk unit. The principle of magnetic flux storage on hard disks is like that used on diskettes, the most obvious difference being that a hard disk unit is designed as a permanent installation. This means that it is not practicable to transport hard disk units from one computer to another. It is, however, possible and usual to copy from the hard disk unit to diskette and vice versa, thus facilitating the portability of hard disk data between your NCR Personal Computer and compatible computers.

The main advantage of a hard disk unit that there is no need for you to insert or remove disks. This means that mechanical tolerances between drive and disk can be that much closer, resulting in a storage

capacity which runs into millions of bytes. Speed of reading and writing is also considerably greater than that possible with a diskette drive.

* Buy the right diskettes - and look after them

* Write-protecting diskettes prevents unwanted changes

* A hard disk holds millions of bytes - but you can't move it

MEMORY

You have most likely heard of memory capacities being quoted, for example, 256 KB (Kilobyte). 256 KB means that the computer has a memory capacity of approximately 260000 bytes (256 x 1024 = 262144 to be precise).

As already explained, a byte can contain instruction information for the microprocessor or data for processing. Each byte of a 256 KB memory has a unique identifier, or *memory address*, by which it can be referred to. For example, the microprocessor could read an instruction which tells it "fetch your next instruction from byte number 72000"; this instruction might read "compare the number stored in your internal arithmetic scratchpad area with what is stored at byte number 73004". These are examples of the microprocessor reading memory; however, it is equally possibe to change the contents of memory, for example, with the instruction "subtract one from the contents of byte number 73004".

So far the discussion has been about memory which can be both read and altered while the computer is switched on. This type of memory is called *Random Access Memory (RAM)*. Switching on the computer alone does not give this memory meaningful contents. Information has first to be read from the keyboard or a disk drive. Processing can then take place at high speed.

In a sense, disks are a kind of memory, but they have the disadvantage that accessing their information involves mechanical movement. This movement appears to take place quickly, but compared with the speed with which bytes are transferred between microprocessor and memory, disk access is a slow procedure.

Processing in random access memory is a fast procedure, but as soon as you switch off your computer, memory contents are lost, and that permanently if your program did not first write them to disk.

Another kind of memory, *Read Only Memory (ROM)*, has the same property of fast access as RAM, but this access is in one direction: read only memory can be read, but not written. The fact that this type of memory cannot be altered also means that its contents are not lost when you switch off your computer. Obviously, the microprocessor cannot read this memory while there is no power, but the contents are available again for reading as soon as power is restored.

The "indestructable" nature of read only memory makes it a suitable place of storage for instructions the microprocessor needs to get the computer started, as soon as power is switched on. Read only memory is also used as a storage place for collections of microprocessor instructions, or *routines*, which go to make up the *Basic Input Output System (BIOS)*. The BIOS is a program integral to the functioning of your computer: it co-ordinates the activities of the various parts of the computer system: disk drive(s), keyboard, display, loudspeaker, even memory itself. There are also routines to look after some additional items of equipment you may have installed, for example, printers.

* RAM is fast, but volatile memory

* ROM is fast, too. It doesn't mind being switched off. But you can't tell it anything

THE OUTSIDE WORLD

The NCR Personal Computer consists of the main unit and the keyboard. This is all you need for a working system - but you would not see any results, and you would not know if the computer were trying to ask or tell you something. This is why "Getting Started" told you to connect a display. With the main unit, keyboard, and display, you have a self-sufficient system: the computer speaks to you by means of the display, you give your instructions to the computer over the keyboard.

One way for your computer to communicate with the world outside has already been mentioned, namely, carrying diskettes processed on one computer to another (compatible) computer.

There are also many other occasions when you would like to make use of external equipment *(peripherals)*. The first such occassion that springs to mind is the use of a printer. This is a uni-directional form of *communications*, that is, data is passed in one direction only, namely, from the computer to the printer. After all, there is nothing much the printer can tell the computer except to confirm that printing is going according to plan.

Data is transmitted by the computer via an *interface* and a suitable cable. An interface is a piece of electronic circuitry installed in the computer which adapts the signals coming out of the computer to the kind of signals the printer is expecting to receive. For this reason, this circuitry is sometimes referred to as an *adapter*.

An interface for a printer is described as *serial* or *parallel*. Serial means that data is transmitted one **bit** at a time, parallel means that data is transmitted one **byte** at a time. Your computer is capable of being adapted to both serial and parallel modes, but many peripherals are constructed for use with either one or the other.

Serial communications require only one line for the data: the line is either active or inactive for a particular bit, analogous to the binary representation of the bit as one or zero. However, serial communications require careful timing, so that transmitter and receiver can agree whether a particular bit is the first, second, third etc. of the byte.

For this reason, transmitter and receiver must agree on a speed of transmission, or *baud rate*. The baud rate specifies the number of bits per second which are to pass over the data line. The actual baud rate chosen depends on the capability of the printer to read the bits off the data line, and also on certain electrical properties of the line: choosing a baud rate too fast for the line would make the bits indiscernible from one another.

To detect possible misunderstandings between transmitter and receiver, serial communications are conducted in accordance with a strict *protocol* of data and control information. One of the most widely used protocols is *RS-232-C*. The inclusion of such a protocol means that additional lines are included in the cable. A serial communications protocol ensures that both transmitter and receiver are ready to interact before the first bit is transmitted; as soon as all the data bits for one byte have been received, the receiver checks the credibility of the data just received by adding up the "ones" and comparing the odd or even result with an additional bit also received on the data line *(parity check)*. The receiver must then notify the correct or incorrect arrival of data to the transmitter.

Parallel communications involve eight data lines, one for each bit. This means that all eight bits of a byte are transmitted, and received, concurrently, so there can never be any confusion between transmitter and receiver over which bit is which. The speed at which characters can be transmitted is clearly greater than the speeds achievable by serial communications. But there is one drawback, namely, that the cable must contain more lines than required for a serial interface, which makes the parallel mode unsuitable for long distances.

As with serial communications, the receiving device acknowledges arrival of the data. The name usually associated with parallel communications protocol is *Centronics*.

So far we have regarded your computer as the transmitter and a printer as the receiving unit. Although protocol required that signals pass in both directions, the transmission of data was in one direction only.

It is posssible for two computers to communicate with one another on equal terms, that is, for data to pass in both directions. Where this takes place over a long distance, the signals to and from the interface are controlled by an intermediary *modem* (**modulator-demodulator**). A modem converts the transmit/receive protocol (usually serial) into signals suitable for transmission over long distances, for example, by public telephone lines.

In addition to the communications possibilities introduced in this section, the computer can derive data from other types of peripheral, such as light-pens and "mouse" devices.

* Communications with peripherals require: a cable, an interface, and a protocol

* A protocol helps prevent data inaccuracies

* Serial (e.g. RS-232-C) = 1 bit at a time
  Parallel (e.g. Centronics) = 1 byte at a time

* Modems communicate over long distances

WHAT HAPPENS WHEN I SWITCH ON MY COMPUTER?

Suppose you were sitting in an armchair reading a book. After a while, you felt tired, placed the book on one side, and fell asleep. Now suppose that when you woke up, you could not remember anything you had read: you would now have to start reading the book again from page one.

Something like this happens to the microprocessor when the computer is switched on: it has no recollection of what it was doing when the computer was last switched off, so it starts over again as if the computer were being switched on for the very first time. The microprocessor need not have been "asleep" for a very long time: a fraction of a second without power is all that is needed to clear its memory. This is, however, not to be seen as a deficiency: the computer does not get tired, but has to be turned off deliberately.

When you switch on the computer, the microprocessor looks to a predetermined address in the ROM BIOS for an instruction, just as the reader starts with the book at page one. The first instructions tell the microprocessor to check that all is well with the computer. This involves checking how much RAM is installed and that it is one hundred percent in working order: a test pattern is written to each byte, the pattern is then read back and checked against the original. The microprocessor is also able to carry out the same kind of check on its own internal registers. These "scratchpad" areas are in constant use for arithmetic purposes, and for reading and writing to bytes of memory. Therefore, it is important that they hold data correctly.

The microprocessor can then look for signals telling it something about its environment: in particular, it notes the number and types of disk drives (diskette and hard disk) available to your computer.

The *initialization* procedure now continues with a number of assistant processors which are present in your NCR Personal Computer. They relieve the microprocessor of some of the more time-consuming and tedious functions of a computer, so that it can get on with carrying out the task you have given it. Examples of what these assistants are responsible for:

- keeping watch for events that do not happen all the time, for example, your pressing a key on the keyboard *(interrupts)*
- transferring large numbers of bytes from disk to RAM or vice-versa *(Direct Memory Access)*
- accepting instructions as to what is to appear on the display *(graphic display controller)*
- preparing data for transmission to a peripheral, and making sense of data coming in *(input/output interface)*
- nudging the RAM bytes at regular intervals, so that they do not forget what they have been told to remember *(RAM refresh)*

Data is written to these processors to set them up in a way in which they will work best in your NCR Personal Computer.

The microprocessor must now look to a diskette drive for further instructions. This is why, in "Getting Started", you inserted a diskette before switching on. The moment is approaching when the microprocessor will read its instructions from RAM instead of from ROM: the final instructions read from ROM bring this about by reading a pre-determined sector on a pre-determined track from disk into RAM; the very last ROM instruction then tells the microprocessor to look to RAM for its next instruction.

This action of reading the the first sector is often called "reading the boot record", or *booting*: a jolt to get the system going. If no disk has been inserted, or you have forgotten to turn the drive lever to the locked position, booting obviously cannot take place, so all action stops until a diskette is loaded. The only exception is if your NCR Personal Computer has a hard disk unit at its disposal, in which case it will accept a boot record from hard disk.

The instructions read from disk are expected to indicate that the disk contains NCR-DOS, the *Operation System* for your computer.

THE OPERATING SYSTEM

You have already been introduced to the ROM BIOS as a collection of short programs, or routines, which co-ordinate the activities of various parts of your computer system. As they are held in ROM, they are available at all times and do not make any demand on RAM storage capacity. It is the task of the *Operating System* NCR-DOS, itself a collection of programs, some read, or *loaded*, from disk to RAM during booting, others waiting to be loaded, to put a friendly face on the ROM BIOS.

Example: ROM BIOS can accept instructions to read or write specific data to a specific sector of a specific track. You know that you want your office correspondence to be stored on disk, but you do not want to be concerned with finding empty sectors. You may well be in the position of saying

> "I am about to start writing a note to all departments.
> I do not yet know how many pages long it will be as I have not previously written it out with pen and paper.
> This letter should be stored on disk under the name CIRCULAR, a name that will later remind me what kind of letter it was.

I should like the opportunity of copying this letter, and perhaps changing it at a later date."

It is the Operating System which is the key to this "user-friendly" exploitation of the computer. The main feature of the Operating System is that it allows you to create and manipulate data in *files*. A file is a collection of data items you want to go together, items you can alter and copy as you wish, and which are stored under a name you have chosen, a name you can change at any time.

APPLICATIONS

Application programs, or simply *applications*, are programs to be applied to a specific task. Applications are created for all walks of professional life, and for leisure time, too. It would be impossible to list here all the applications which can be put to use with your NCR Personal Computer. The best way to get information is from your software dealer, or from the computer press.

You might even be tempted one day to "write" a program of your own, either because you have a very special use for one, or just for the fun of it. NCR has looked after the needs of both aspiring and proficient programmers by providing the GW-BASIC programming language with your NCR Personal Computer. The next section tells you more about this.

Perhaps you are less interested in programming and more interested in starting up a newly acquired application such as a spreadsheet or a letter writing program. If this is the case, there is just one note of caution you should heed.

The diskette(s) containing NCR-DOS, GW-BASIC, as well as the Diagnostics program are unique in that they are specially prepared for your NCR Personal Computer and available only from NCR. It is very important that you make one or more *backup copies*. You should then store the original NCR diskette(s) in a safe place and use only a backup copy when working with the Operating System and/or applications. The simple steps needed to create backup copies of disks are

described in your NCR-DOS Manual. These steps are so simple that you should consider making back-up copies of all disk files you create yourself, especially where you have devoted a lot of time to building up data on the diskette.

Many applications require the Operating System to be loaded before the program itself is started. This is hardly surprising in view of the useful routines the Operating System provides, routines which need not then be provided by the application. Simply follow the instructions supplied with your application.

HIGH RESOLUTION GRAPHICS

The High Resolution Graphics Adapter is supplied in two versions:

- 32KB memory with a monochrome display
- 64KB memory with a color display

A kit is available to upgrade the 32KB version of the adapter to 64KB, if desired.

The adapter supports both industry standard and NCR unique modes of operation. The following table shows the screen build-up and colors available in either the alpha/numeric or graphics modes.

INDUSTRY STANDARD MODE		
Screen Mode	Mono Display Foregrd Backgrd	Color Display Foregrd Backgrd
Alpha/Numeric (Text)		
40 ⁄ 25	1 of 16 (gray shades) 1 of 16	1 of 16 (color) 1 of 16
80 ⁄ 25	1 of 16 (gray shades) 1 of 16	1 of 16 (color) 1 of 16
Graphics		
320 ⁄ (200x 2)	3 of 16 gray shades* 1 of 16 gray shades	3 of 16 colors* 1 of 16 color
640 ⁄ (200x 2)	1 of 16 gray shades Black	1 of 16 colors Black

NCR UNIQUE MODE				
640 × 400	1 of 16 gray shades	Black	1 of 16 colors	Black
640 × 400	3 of 16 gray shades	1 of 16 gray shades	3 of 16 colors	1 of 16 colors
NOTE: * These colors and shades are in pre-defined sets of 3 colors each.				

WHAT IS IN THE MANUALS?

Two further Manuals are supplied with your NCR Personal Computer:

- NCR-DOS
- GW-BASIC

NCR-DOS

This is the Manual which tells you how to make the most of the Operating System. It also includes instructions on how to make those important backup copies of original disks, so do not be tempted to skip this Manual completely. Once you have mastered the technique of making backup copies, you can go on to use your applications, or to get to know some or all of the features offered by the Operating System.

If you choose to investigate the Operating System, you will learn, among other things, about

- making use of all the disk drives in your system
- formatting disks ready for use
- organizing files for different purposes or different owners on a disk
- sorting files according to the alphabet
- simple editing, checking and printing of files

- the Operating System's clock and calendar
- changing the colors displayed on the screen
- telling the keyboard that you wish to write in another language
- selecting a batch of tasks for your Operating System to do, while you sit back

GW-BASIC

You have learned quite a few things about how the microprocessor in your computer works, and how important programming is for the functioning of the computer system as a whole. This kind of programming must take place very much in the "language" the microprocessor understands. Specialists who do this sort of programming make use of an *assembler*. An assembler is a program which is used to make up the sequences of ones and zeros understood by the microprocessor. To obtain the best results with their assembler, an understanding of binary and hexadecimal numbers is required.

GW-BASIC is a "higher level" programming language: higher level, because it approaches more closely the way we communicate requests, using a vocabulary which has many similarities with natural language. This higher level must, of course, ultimately be converted to one and zeros. This is the task of the GW-BASIC *interpreter*.

GW-BASIC interprets your use of its language into computer actions. For example, if you tell GW-BASIC to count for you how many letters there are in a given word, it will do just that, and display the result before you've hardly had time to finish typing your request. Or you could tell GW-BASIC to draw a border along the edges of the display area on the screen.

You can create a whole list of different commands which GW-BASIC must put into effect. You have then written a program. Choosing the right commands for the effects you wish to achieve is the art of programming. The programs you write can be just like programs obtainable from software dealers.

You will find that the GW-BASIC Manual provides not only everything you need to know about the formalities of the language, but also a wealth of programming hints, and examples to go with them.

MORE INFORMATION

In addition to the Manuals provided with your NCR Personal Computer, a number of other Manuals are available from NCR. They are intended for users with knowledge of electronics or programming who are intending to write assembler programs or even make changes to the computer hardware. Your NCR representative can provide you with further information about these Manuals.

APPENDICES

Technical Data

MAIN PROCESSOR BOARD	
Central Processing Unit Co-processor	80286 microprocessor (8 MHz) 80287 (optional)
RAM standard expansion	256 KB or 512 MB Up to 640 KB Further expansion on optional board
ROM	64 KB BIOS
Software Protection	16 bytes in PROM
Real-time clock	Using CMOS RAM and Lithium battery
DMA channels	7
Expansion slots	6 8/16-bit (one of which is required by disk controller board) 2 8-bit (one of which is required by display controller board)

INTERRUPT CONTROL			
Controller 1		Controller 2	
IRQ0	Timer	IRQ8	Real-Time Clock
IRQ1	Keyboard	IRQ9	= IRQ2
IRQ2	Controller 2	IRQ10	Reserved
IRQ3	Serial Port 2	IRQ11	Reserved
IRQ4	Serial Port 1	IRQ12	Reserved
IRQ5	Parallel Port 2	IRQ13	Co-processor
IRQ6	Flex. Disk Contr.	IRQ14	Fixed Disk Contr.
IRQ7	Parallel Port 1	IRQ15	Reserved
NON-MASKABLE INTERRUPT: Parity or I/O Channel check			

I/O OPTIONS
Serial + Serial (RS-232-C) Adapter Serial + Parallel (Centronics) Adapter 1 or 2 adapters may be installed

STORAGE MEDIA	
High capacity slimline flexible disk drive	1.2 MB
Standard capacity slimline flexible disk drive	320 KB/360 KB
Hard (Winchester) disk drive	20 MB
Single-board disk controller can handle up to 2 flexible and 2 fixed disk drives	

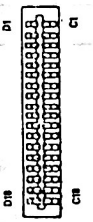
KEYBOARD	
Keytips	Cylindrical
LED on Keys	Caps Lock Num Lock Scroll Lock
Cable	300 mm (10 ft) approx., screened
Special Features	Key repeat and delay times adjustable Internal LED control

EXPANSION SLOT CONNECTIONS

8-bit Bus

B			A	
1	GND		1	I/O CH CHK/
2	RESET DRV		2	SD7
3	+ 5V		3	SD6
4	IRQ9		4	SD5
5	- 5V		5	SD4
6	DRQ2		6	SD3
7	- 12V	B1 A1	7	SD2
8	OWS		8	SD1
9	+ 12V		9	SD0
10	GND		10	I/O CH RDY/
11	SMEMW/		11	AEN
12	SMEMR/		12	SA19
13	IOW/		13	SA18
14	IOR/		14	SA17
15	DACK3/		15	SA16
16	DRQ3		16	SA15
17	DACK1/		17	SA14
18	DRQ1		18	SA13
19	REFRESH/		19	SA12
20	CLK		20	SA11
21	IRQ7		21	SA10
22	IRQ6		22	SA9
23	IRQ5		23	SA8
24	IRQ4	B31 A31	24	SA7
25	IRQ3		25	SA6
26	DACK2/		26	SA5
27	T/C		27	SA4
28	BALE		28	SA3
29	+ 5V		29	SA2
30	OSC		30	SA1
31	GND		31	SA0

16-bit Bus (extension)			
D		**C**	
1	MEM CS16/	1	SBHE
2	I/O CS16/	2	LA23
3	IRQ10	3	LA22
4	IRQ11	4	LA21
5	IRQ12	5	LA20
6	IRQ13	6	LA19
7	IRQ14	7	LA18
8	DACK0/	8	LA17
9	DRQ0	9	MEMR/
10	DACK5/	10	MEMW/
11	DRQ5	11	SD8
12	DACK6/	12	SD9
13	DRQ6	13	SD10
14	DACK7/	14	SD11
15	DRQ7	15	SD12
16	+ 5V	16	SD13
17	MASTER/	17	SD14
18	GND	18	SD15



POWER

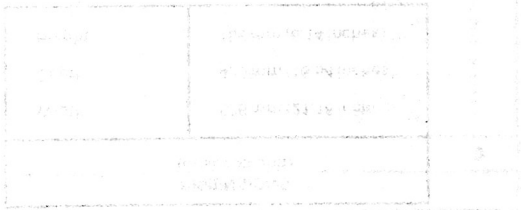
Requirements				
Voltage ac (nominal)	(range)	Frequency (nominal)	(range)	Current (max.)
115	100 - 127	60 Hz	57 - 63 Hz	5 A
230	200 - 240	50 Hz	47 - 53 Hz	3 A

NOTE: For installation in the U.S. and Canada with a power source above 120 Vac, a power cord set conforming to NEMA 6-15 must be used.

Outputs	
Voltage dc	(Current max.)
+ 5	19.8 A
- 5	0.3 A
+ 12	7.3 A
- 12	0.3 A

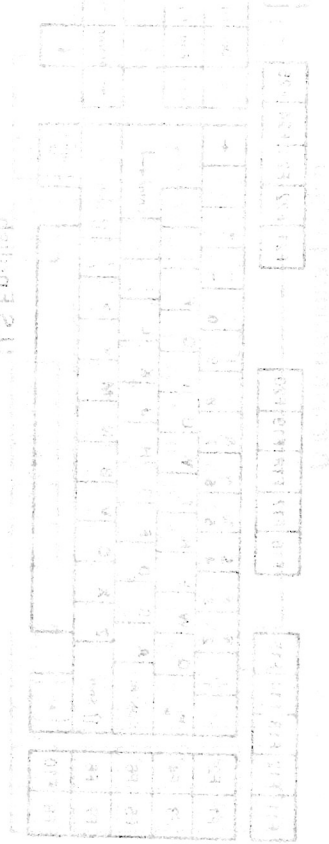
DIMENSIONS (desk-top unit)	
Width	538 mm (21.18 inches)
Depth	420 mm (16.54 inches)
Height	156 mm (6.14 inches)

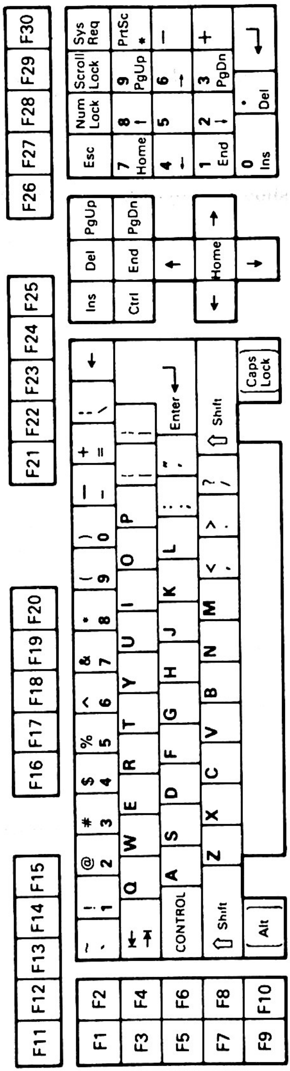
ENVIRONMENT		
Temperature	operating	10 - 32 °C (50 - 90 °F)
	storage	-10 - 50 °C (14 - 122 °F)
	transit	-40 - 60 °C (-40 - 140 °F)
Relative Humidity		20% - 80%



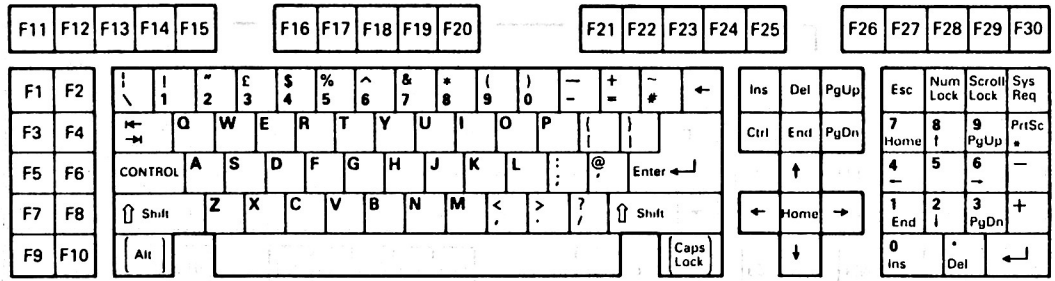
Keyboard Layout Charts

The following charts show the keytip positions for various languages.

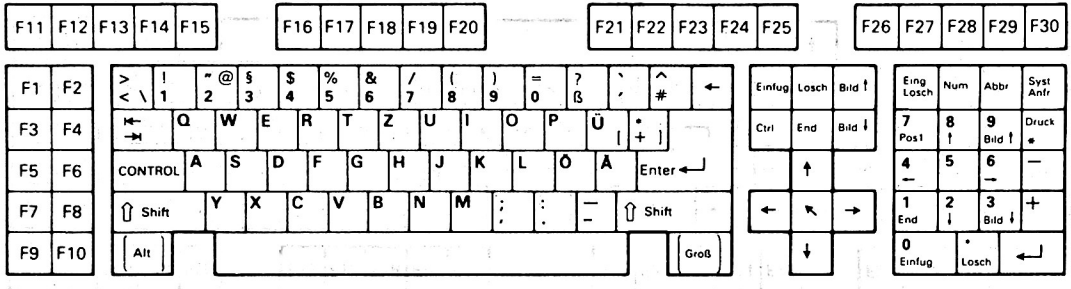



F1 F2 F3 F4 F5 F6 F7 F8 F9 F10
F11 F12 F13 F14 F15 F16 F17 F18 F19 F20 F21 F22 F23 F24 F25 F26 F27 F28 F29 F30
~ ` ! 1 @ 2 # 3 $ 4 % 5 ^ 6 & 7 * 8 (9) 0 _ - + = | \ ←
Q W E R T Y U I O P { [}]
CONTROL A S D F G H J K L : ; " ' Enter
Shift Z X C V B N M < , > . ? / Shift
Alt
Caps Lock
Ins Del PgUp Ctrl End PgDn
← Home → ↑ ↓
Esc Num Lock Scroll Lock Sys Req
7 Home 8 ↑ 9 PgUp PrtSc *
4 ← 5 6 → -
1 End 2 ↓ 3 PgDn +
0 Ins . Del

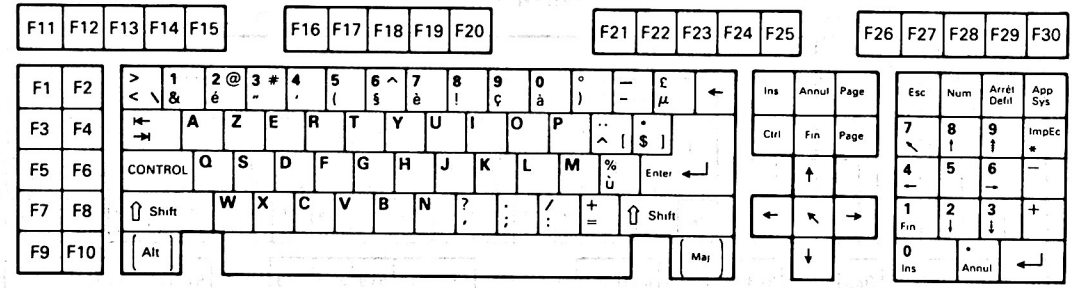
U.S.English



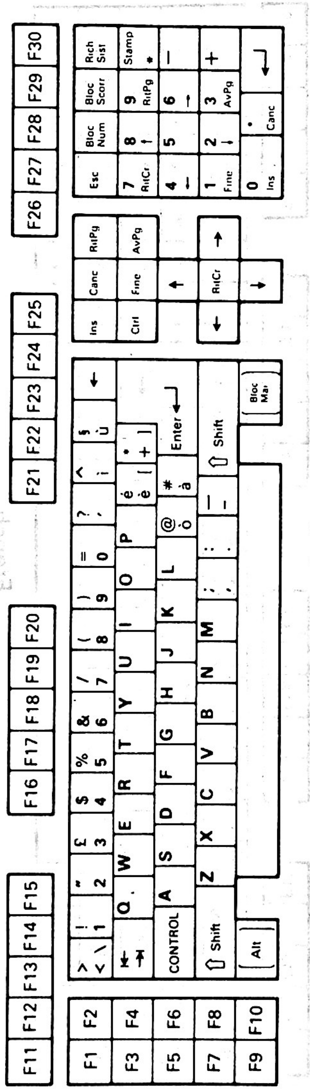
U.K./International English


F11 F12 F13 F14 F15
F16 F17 F18 F19 F20
F21 F22 F23 F24 F25
F26 F27 F28 F29 F30
F1 F2
F3 F4
F5 F6
F7 F8
F9 F10
CONTROL
Shift
Alt
Enter
Shift
Groß
Einfug Losch Bild ↑
Ctrl End Bild ↓
Eing Losch Num Abbr Syst Anfr
7 Pos1 8 ↑ 9 Bild ↑ Druck *
4 ← 5 6 → −
1 End 2 ↓ 3 Bild ↓ +
0 Einfug . Losch

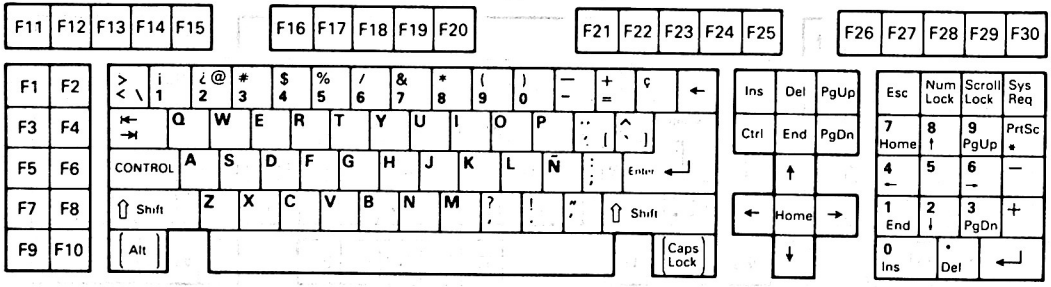
German


F11 F12 F13 F14 F15
F16 F17 F18 F19 F20
F21 F22 F23 F24 F25
F26 F27 F28 F29 F30
F1 F2
F3 F4
F5 F6
F7 F8
F9 F10
CONTROL
Shift
Alt
Enter
Shift
Maj
Ins Annul Page
Ctrl Fin Page
Esc Num Arrêt Défil App Sys
Pause
ImpEc
Fin
Ins
Annul

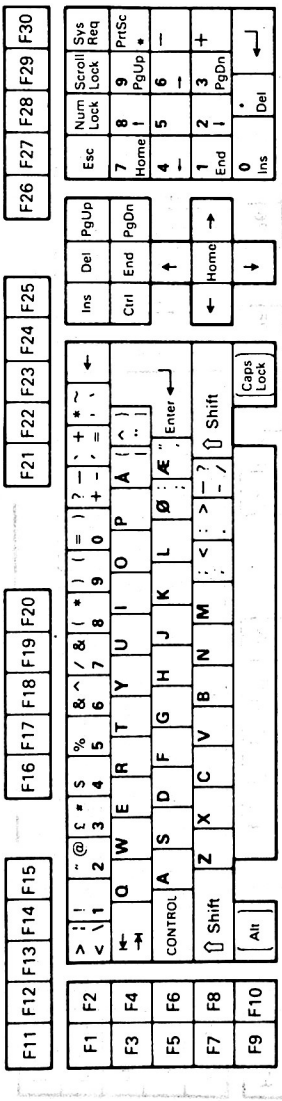
French

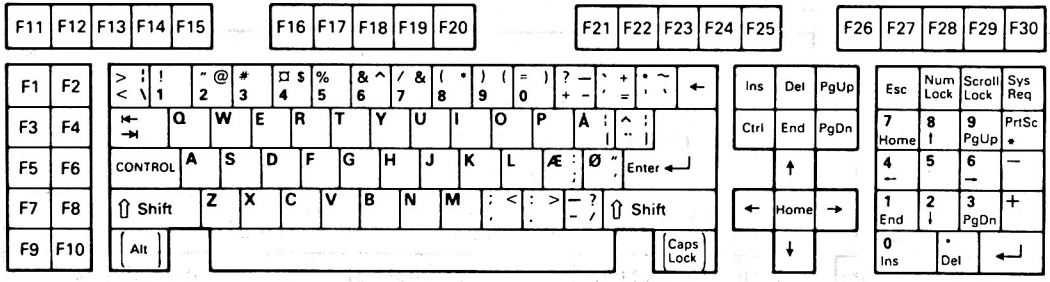

F1 F2 F3 F4 F5 F6 F7 F8 F9 F10
F11 F12 F13 F14 F15
F16 F17 F18 F19 F20
F21 F22 F23 F24 F25
F26 F27 F28 F29 F30
CONTROL
Shift
Alt
Enter
Shift
Bloc Mai
Ins
Canc
Ctrl
Fine
RitPg
AvPg
RitCr
Esc
Bloc Num
Bloc Scorr
Rich Sist
Stamp

Italian

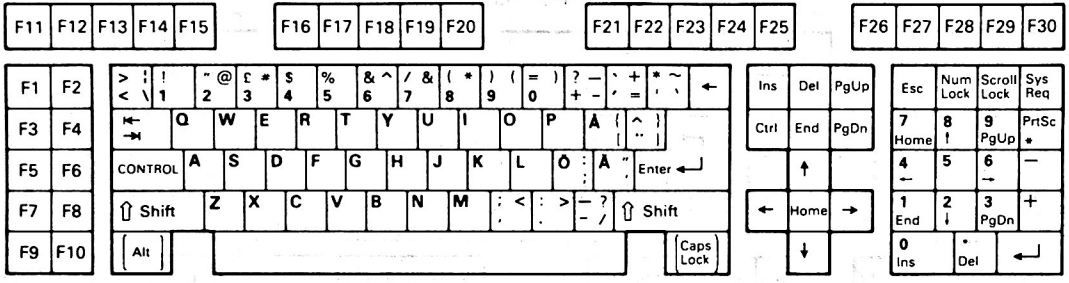

F11 F12 F13 F14 F15
F16 F17 F18 F19 F20
F21 F22 F23 F24 F25
F26 F27 F28 F29 F30
F1 F2
F3 F4
F5 F6
F7 F8
F9 F10
CONTROL
Shift
Alt
Caps Lock
Enter
Ins Del PgUp
Ctrl End PgDn
Home
Esc Num Lock Scroll Lock Sys Req
7 Home 8 PgUp 9 PrtSc
4 5 6
1 End 2 3 PgDn
0 Ins . Del

Spanish

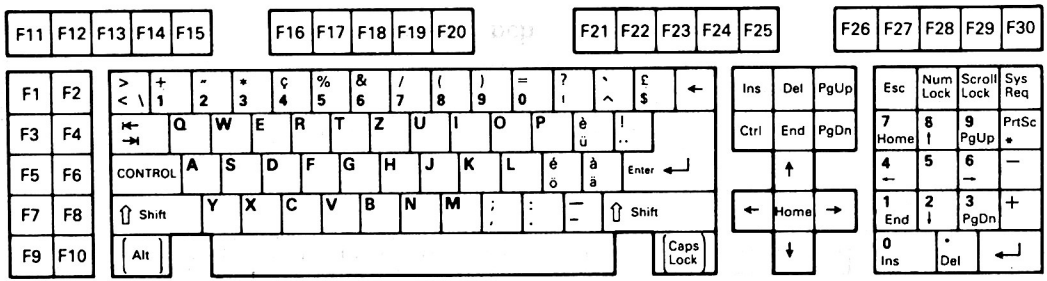

F11 F12 F13 F14 F15
F16 F17 F18 F19 F20
F21 F22 F23 F24 F25
F26 F27 F28 F29 F30
F1 F2 F3 F4 F5 F6 F7 F8 F9 F10
CONTROL
Shift
Alt
Caps Lock
Enter
Shift
Ins Del PgUp Ctrl End PgOn
Home
Esc Num Lock Scroll Lock Sys Req PrtSc
Home End Ins Del PgUp PgDn
Norwegian


F11 F12 F13 F14 F15
F16 F17 F18 F19 F20
F21 F22 F23 F24 F25
F26 F27 F28 F29 F30
F1 F2 F3 F4 F5 F6 F7 F8 F9 F10
CONTROL
Shift
Alt
Enter
Caps Lock
Ins Del PgUp Ctrl End PgDn Home
Esc Num Lock Scroll Lock Sys Req
7 Home 8 9 PgUp PrtSc
4 5 6
1 End 2 3 PgDn
0 Ins Del

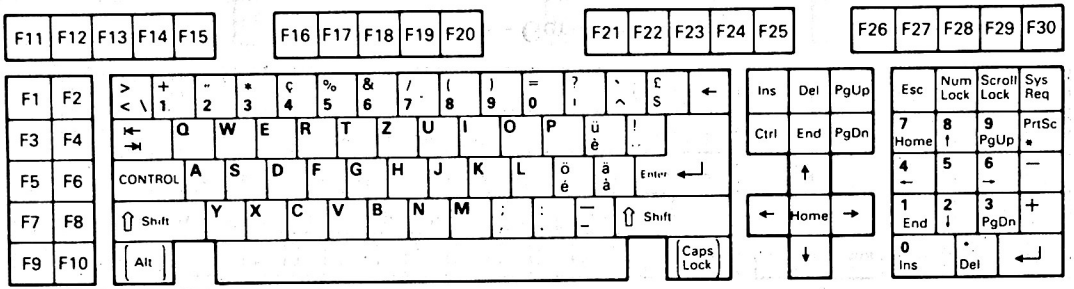
Danish



Swedish/Finnish



Swiss - German



Swiss - French