PCS-II/-IIA
Introductory
Manual

2200

PCS-II/-IIA INTRODUCTORY MANUAL

WANG LABORATORIES, INC.

Disclaimer of Warranties and Limitation of Liabilities

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HOW TO USE THIS MANUAL

This manual introduces the Wang PCS-II and PCS-IIA to the user. It describes the two systems and each of the integral components: the central processor, the CRT display, the keyboard, and the minidiskette unit. The routine maintenance procedures, Master Initialization, minidiskette preparation, and the multiplexing capabilities of the PCS-IIA are also discussed. A general introduction to programming on the PSC-II and PCS-IIA is included. Appendix A contains a list of the BASIC statements and the documents in which these statements are described.

This manual is intended to be used in conjunction with the following documentation which is supplied with every system:

- Wang BASIC Language Reference Manual

- Wang BASIC Language Disk Reference Manual

- Matrix Statements Reference Manual

- General I/O Instruction Set Reference Manual

- Sort Statements Reference Manual

- Programming in BASIC (manual)

- System 2200 Summary (card)

- System 2200 $GIO Microcommands (card)

In addition to these manuals, a separate reference manual is provided for each device attached to the system. If Wang-supported software packages are ordered, each package is accompanied by an operator's manual.

CHAPTER 1 INTRODUCTION

1.1 SYSTEM OVERVIEW

Wang's PCS-II and PCS-IIA are compact desktop computer systems with minidiskette-based storage. The PCS-IIA offers, in addition to self-contained minidiskette storage, multiplexing capabilities which enable it to access a fixed-removable disk drive attached to a larger 2200 System. The basic PCS-II and PCS-IIA system components are:

- a central processor (contained within the desktop unit) with a standard 8K byte random access memory (RAM). The central processor is expandable in 8K increments, to 32K.

- a 9-inch (diagonal measure) cathode ray tube (CRT) with a standard 1024-character display capacity.

- a keyboard with numeric pad and Special Function Keys for simplified data entry and program control.

- a minidiskette drive for random access data storage. (A second minidiskette drive is optional.)

- printer/plotter connector (the PCS-II contains two printer/plotter connectors, the PCS-IIA contains only one.

- disk multiplexer (contained in the PCS-IIA - the multiplexer replaces the second printer/plotter connecter in the PCS-II).

The standard and optional components are discussed in detail in Chapter 2.

MINIDISKETTE DRIVE

LEFT DRIVE
(STANDARD)

RIGHT DRIVE
(OPTIONAL)

CRT DISPLAY

BRIGHTNESS
AND CONTRAST
CONTROLS

ON/OFF
SWITCH

CENTRAL
PROCESSING
UNIT (CPU)

MULTI-ZONE
KEYBOARD
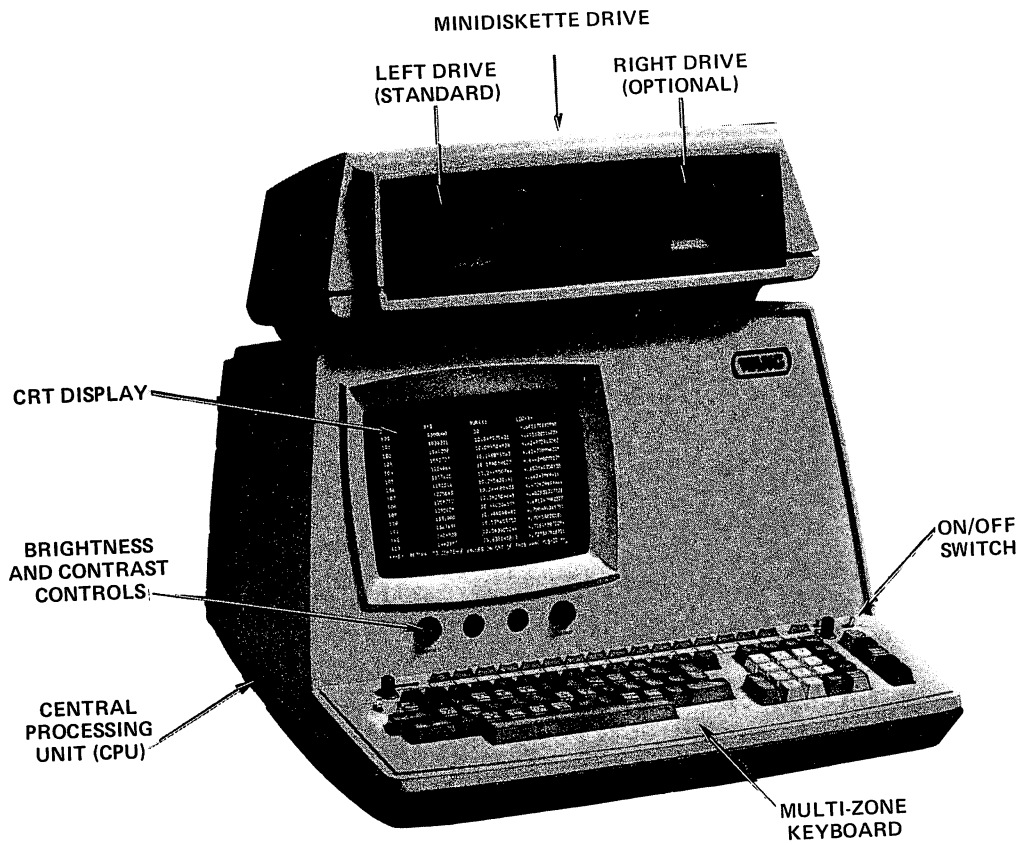
Figure 1-1. The PCS-II/-IIA

1.2   INSTALLATION GUIDE

Unpacking, Inspection, and Installation

Your PCS-II or PCS-IIA must be unpacked, inspected, and installed by a Wang Service Representative. Failure to follow this procedure will void your warranty.

Your Service Representative will ensure that the connectors for all peripherals are properly connected to the PCS-II/-IIA and locked in place and that power cords are properly plugged into a source of power. It is recommended that your PCS-II/-IIA be connected to a power line reserved exclusively for its use; the line should not be shared by other office equipment such as water coolers, calculators, air conditioners, typewriters, or copiers.

Selecting a PCS-II/-IIA Site

The PCS-II/-IIA is extremely compact, and can fit comfortably on a large desk or any similar work surface. If a printer is to be used at the PCS-II/-IIA site, more space will be needed, the exact amount depends upon the printer model.

In selecting a PCS-II/-IIA site there are three important environmental factors to be considered: temperature, humidity and cleanliness.

The temperature is the most important factor to consider because it can vary greatly from day to day. The recommended operating temperature range is from 65°F to 75°F, but the allowable range is from 20°F to 90°F.

Low outside temperatures are usually not a problem because nearly all locations are heated. High temperatures can be a problem because many locations do not have air conditioning. If the system is used where temperatures exceed the maximum specified, component failure rates will increase drastically, resulting in costly downtime.

If an air-conditioning unit is already installed, or if one is to be installed, it is imperative that a separate power line be used. If a separate power line is not used, system errors will occur when the air conditioning is in use.

While air conditioning is good for maintaining the proper temperature, it also removes moisture from the air, thereby lowering the humidity. If the system is installed in a carpeted room, the lower humidity plus the static generating capability of carpets and synthetic clothing impart static electrical charges to operating personnel. When an operator comes in contact with the system, the resultant static spark is uncomfortable, causes system malfunctions, and can even destroy recorded data.

If carpeting is to be installed, be sure it is a non-static variety. If carpeting already exists, and it is not a non-static carpet, it must be treated with an anti-static spray. Alternatively, an electrically-conductive mat can be installed to prevent a static charge build-up. Carpets treated with an anti-static spray should be thoroughly cleaned before the first treatment, and retreated at least once every three months thereafter. If an electrically-conductive mat is used, it should be installed under the system operating area and must be properly connected to an earth ground.

The recommended humidity range is from 35% to 65% Relative Humidity (R.H.), but 20% to 80% R.H. is allowable. Humidifiers and dehumidifiers should be installed to increase or decrease the humidity as required.

Dirt and grease can accumulate rapidly on circuit boards and components, and can form a film that traps heat and provides a leakage path for signals. To prevent unnecessary failures due to dirt, all air-conditioning, heating and ventilating units should have air filters. These filters should be cleaned or replaced regularly. In areas where ordinary filters do not remove airborne dirt sufficiently, an electrostatic filter should be installed.

Electrical Environment

A 15 ampere, 115 VAC power line is adequate for the PCS-II/-IIA. This line must be regulated to within ± 10% and must be noise free. It is recommended that the system have its own AC power line.

If the line is not sufficiently regulated to the limits indicated above, a constant voltage transformer should be installed. If the line is noisy, however, a detailed analysis of the problem must be performed to insure a correct solution.

Since computers and peripherals are extremely susceptible to Electromagnetic Interference (EMI), the source of the EMI must be determined before a solution is proposed. EMI can enter the system by conduction along wiring and cabling or by direct radiation. If the sources (which include office machines, air-conditioning units, electric motors, machinery and arc welders) are in close proximity to the Work Station, EMI will enter by direct radiation. The noise-generating device should be moved, repaired or filtered to prevent it from interfering with the system. If the source of the noise cannot be found, an EMI filter with a cut-off frequency near 10 KHz should be installed on the system's AC power line. In all cases, be sure the AC power line has been properly installed in a steel conduit, and that the conduit is properly connected to junction boxes. Also, ensure that other devices, including fluorescent lighting, are not connected to the same AC power line. In extreme locations, such as those with nearby arc welders, it may be necessary to shield the peripheral cables.

Location of the PCS-IIA Relative to Main 2200 System

When planning the location of the PCS-IIA, trace the route that the multiplexer cables are to run, taking care to avoid exposing a cable to intense electric or magnetic fields or to sources of electronic noise, since they may interfere with data transmission over the cable. In general, try to keep the connector cable away from electrical trunk lines, fluorescent lights, and electrical office equipment (such as electric typewriters and tape recorders). If you have a specific question about routing a cable, contact your Wang Service Representative.

An extension cable can be routed through a conduit or other tight spaces by removing one of its plugs. However, it is important that the plug be disconnected and reconnected by a qualified Wang Service Representative. Reconnection of the plug is a delicate job which, if done improperly, can hamper data transmission along the line.

Refer to Chapter 5 for more information concerning multiplexing the PCS-IIA.

CHAPTER 2   SYSTEM COMPONENTS

2.1   THE CENTRAL PROCESSOR

The central processor, built into the standalone PCS-II or PCS-IIA, contains the logic and memory necessary to resolve and execute programs and perform arithmetic operations. The PCS-II/-IIA central processor makes efficient use of memory by storing all programs in an "atomized" (condensed) form. The BASIC interpreter is contained in an independent control memory. Very little of the user memory is used for operation overhead. The system permits multi-statement lines, a feature which helps to conserve memory and speed program execution, and also allows the programmer to logically group related statements, thus enhancing program documentation.

The central processor contains two types of memory: user memory and control memory. The control memory is read only memory (ROM), which is used exclusively by the operating system and BASIC interpreter. Control memory cannot be accessed by the user or the user's programs. The 42.5K BASIC language interpreter, "hardwired" in ROM (control memory), translates and executes Wang's BASIC language instruction set.

The standard PCS-II/-IIA central processor contains an 8K-byte user memory, expandable in 8K increments to 32K. The user's programs and data are stored in user memory or random access memory (RAM). The "memory size" of a system refers to the size of user memory only. The system uses 700 bytes of RAM for housekeeping purposes. These 700 reserved bytes are not available for user programs.

2.2   THE KEYBOARD

The keyboard is used by the operator to interactively control the PCS-II/-IIA while entering data, performing quick calculations, issuing commands to the processor, writing programs, and initiating program execution. The keyboard is divided into several distinct "zones" containing keys with similar functions.

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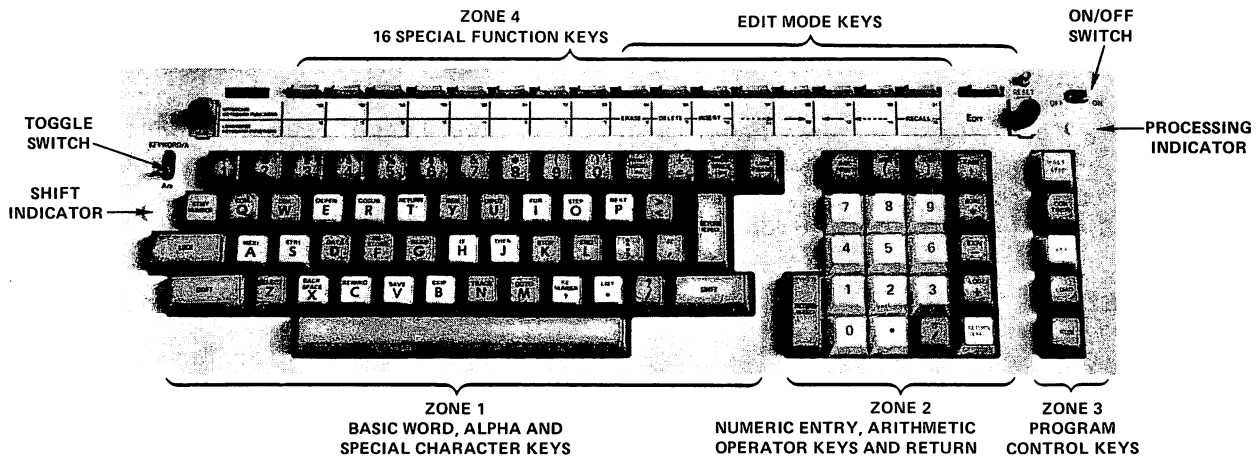
Figure 2-1.   The PCS-II/-IIA Keyboard

The Alphanumeric Zone

The keyboard's alphanumeric zone is similar in design to a standard typewriter keyboard; however, two modes of operation are available to produce quite different results.   The modes are selected by means of the toggle switch, labeled "KEYWORD/A" and "A/a", located in the upper left corner.   (See Figure 2-1.)

The KEYWORD/A mode is specifically designed for use during program creation.   In the KEYWORD/A mode, any word appearing above an alphabetic character can be entered by simply depressing SHIFT and that particular key; uppercase alphabetic characters are produced without shifting.   The words on the keys are known as "keywords"; they are the principal words in Wang's BASIC language.   The KEYWORD/A mode is convenient whenever only uppercase characters are to be entered.

In the A/a mode, the alphanumeric zone becomes a typewriter-like keyboard.   Uppercase characters can be entered by depressing SHIFT and the desired key; lowercase characters are entered without shifting.

It is important to note that the keyboard mode switch affects only the keys in the alphanumeric zone with keywords on the labels.

The Numeric Zone

The keyboard's numeric zone is designed for the rapid entry of numeric data or expressions.   The numeric keys are grouped together with the arithmetic operators (+, -, *, /,) and mathematical functions (SIN, LOG, SQR, etc.) for convenience only; digits may be entered either by using the numeric keys in the numeric zone, or by using the numeric keys across the top of the alphanumeric zone.   The PRINT key in the upper left corner of the numeric zone facilitates the use of the system as a powerful, one-line calculator for obtaining quick results in immediate mode.

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The Special Function Keys

Across the top of the keyboard are 16 Special Function Keys which can be used in conjunction with the SHIFT key to access up to 32 user-defined subroutines, text strings, and program entry points (each Special Function Key performs one user-defined function). A special function strip shows the numbers 0 through 15 and 16 through 31 corresponding to the Special Function Keys; the SHIFT key is used to obtain the latter range.

The EDIT Keys

The EDIT key, located to the right of the Special Function Keys, is used to enter the EDIT mode. When the system is in EDIT mode, the Special Function Keys temporarily lose any program-designated significance, and the eight rightmost keys become system-defined edit keys. The EDIT mode provides powerful on-line editing capabilities for program creation and data entry operations. (Use of EDIT mode is discussed in Chapter 3 of this manual.)

The System Command Keys

The column of command keys at the right side of the keyboard provides single-keystroke entry of some of the most commonly used system commands. (The commands are described in the Wang BASIC Language Reference Manual.)

The RESET Button and HALT/STEP Key

The RESET button provides a "last resort" means of terminating program execution. When depressed, RESET immediately ends program execution, clears the CRT, and displays the message:

        READY
        :_

Since RESET immediately interrupts a current operation, depressing RESET during a minidiskette operation can leave half-written, unreadable data on a minidiskette; the HALT/STEP key should be used. If the HALT/STEP key is depressed, program interruption is delayed until the current operation is complete; furthermore, execution may be resumed at the point of interruption when the CONTINUE and EXEC keys are used.

The RETURN (EXEC) Keys

On the PCS-II/-IIA keyboard, there are three keys labeled "RETURN (EXEC)". All three keys may be used interchangeably; they are in separate locations merely for convenience. RETURN (EXEC) is the standard entry-terminator key, used to signal that a keyboard response or an entered program line is complete. The RETURN (EXEC) key is usually referred to simply as EXEC.

2.3   THE DISPLAY

The Cathode Ray Tube (CRT) display is the system's principal means of conveying information to an operator. The CRT serves as a vital feedback mechanism by displaying the result of each keystroke, thereby allowing easy review and editing of data and program lines. The CRT's speed, flexibility, and character capacity are ideal for the interactive features built into Wang's BASIC language. The screen's brightness and contrast are manually adjustable via the two controls on the front panel.

The standard display capacity is 16 lines with a maximum of 64 characters per line; the optional display capacity is 24 lines with a maximum of 80 characters per line. In either case, the complete keyboard character set can be displayed. However, the 24 x 80 display (Option 60A) also provides foreign language characters, additional special symbols, and an underlining capability. (See the alternate CRT character set described in the Wang BASIC Language Reference Manual.)

The CRT Cursor

A special display character resembling an underline, called the CRT cursor, indicates the position where the next entered character will appear. As each character is typed and displayed, the cursor automatically advances to the next entry position. In the EDIT mode, the cursor can be moved manually to any position in the program line where character insertion or deletion is to be performed. The cursor also may be moved to any display position under program control, a useful feature when formatting displays for data entry applications. A list of the available cursor control codes is given in Appendix C.

Cleaning the CRT Screen

The CRT screen should be cleaned periodically with a damp cloth and mild soap and water. Do not use alcohol or abrasive compounds.

```
                        WARNING:

    Due to the danger of high voltage, do not attempt
    to remove the cover of the PCS-II/-IIA console
    for  any  reason.  Call  your  Wang  Service
    Representative if maintenance is required for the
    system.
```

2.4   THE AUDIO ALARM

If the system contains the optional Audio Alarm (available as part of Option 60A), HEX (07) activates the alarm tone, a 960 Hz beep. A sequence of 07 codes can be programmed to produce a longer signal or a series of beeps. The alarm is not automatically activated for system-generated error messages.

2.5   THE MINIDISKETTE UNIT

The minidiskette drive provides the PCS-II/-IIA with a compact and efficient direct-access storage capability. A minidiskette is a thin, flexible disk platter 5 1/4 inches (13.4 cm) in diameter, enclosed in a semi-rigid protective plastic jacket. The minidiskette turns freely within the jacket, and is coated on one side with magnetic material arranged in concentric circular tracks. When formatted (initialized), the tracks are divided into "Sectors" with unique, randomly-accessible addresses. By using these sectors, data can be stored and retrieved rapidly and directly. Typically, one minidiskette is used to store several programs while other minidiskettes are used to contain the data needed for use by the programs. The procedure for mounting and initializing a minidiskette is described in Chapter 3.

The total on-line storage capacity for the minidiskette unit is 89,600 bytes (standard) or 179,200 bytes with the optional dual minidiskette drive. In either case, the off-line storage capability is limited only by the number of minidiskettes acquired for the system.

2.6   PCS-II/-IIA PERIPHERAL CONNECTORS

The back panels of the PCS-II and PCS-IIA provide connectors for the peripheral devices that may be attached to the system. (See Figure 2-2.) The back panel of the PCS-II contains two printer/plotter connectors. The PSC-IIA contains one printer connector—the second printer connector is replaced by the disk multiplexing connector.
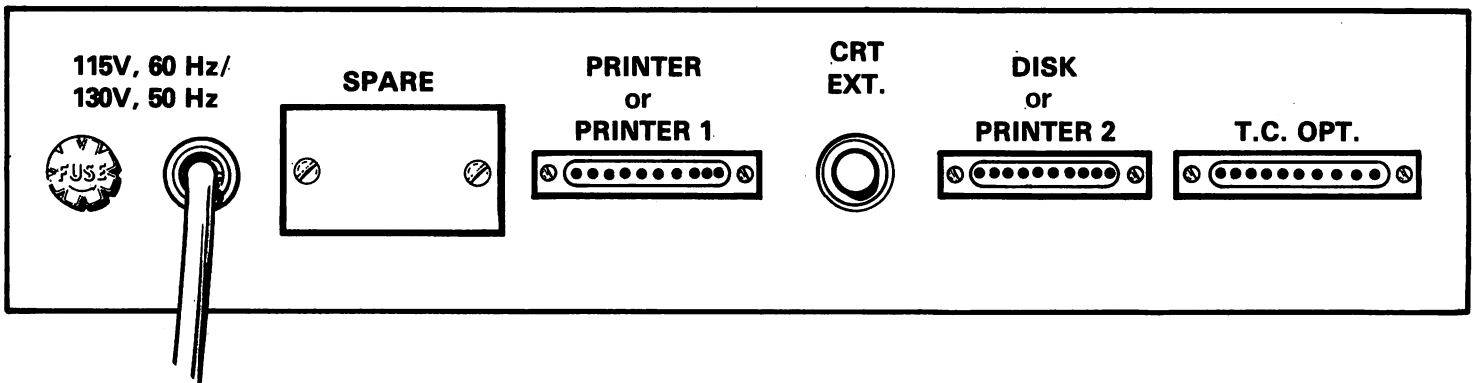
Figure 2-2.   The PCS-II/-IIA Back Panel

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When connecting a peripheral cable, observe that the trapezoidal shaped connector permits only one orientation. Little pressure is needed to insert a properly aligned cable connector. After inserting a cable connector, screw its retaining screws into place to ensure a proper connection (see Figure 2-3).
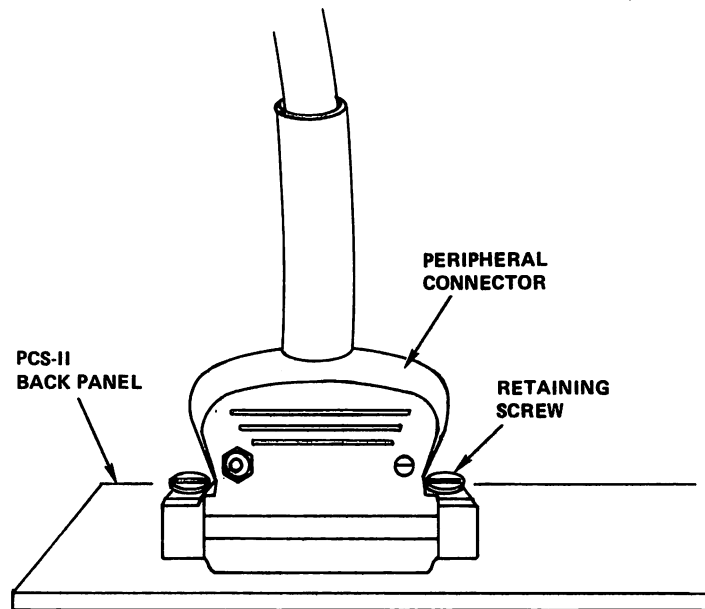
Figure 2-3. A Peripheral Connector

To remove a peripheral cable from the PCS-II/-IIA, unscrew the retaining screws and pull the cable connector out.

WARNING:
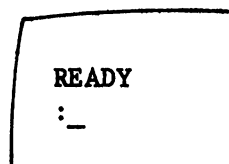
Printer connectors and disk connectors are the same size. Be sure to double check to make sure that the proper cable has been plugged into each connector. Improper connection may result in damage to the system when power is applied.

CHAPTER 3 OPERATING THE PCS-II

3.1 MASTER INITIALIZATION (POWER-ON) PROCEDURES

When the PCS-II/-IIA is turned on, certain critical internal parameters are initialized to system default values. This power-on procedure is called "Master Initialization" and includes the following steps:

1. Verify that the PCS-II/-IIA and all peripherals are properly connected and attached to a source of electric power.

2. Turn on the PCS-II/-IIA by placing the toggle switch (located at the top right of the keyboard) in the ON position.

3. Turn on any peripherals (if a printer is attached to the system the SELECT key must be backlighted indicating the printer is online and subject to control by the system).

4. As soon as Master Initialization is completed (after about 15 seconds), the display shown in Figure 3-1 appears.

```
  READY
  :_
```

Figure 3-1. The READY Display

```
┌─────────────────────────────────────────────────┐
│                    NOTE:                         │
│                                                  │
│   If the READY display does not appear, press the│
│   RESET button.  If the display still does not   │
│   appear, Master Initialize again.  If normal    │
│   operation is not restored after checking all   │
│   connections and master initializing the system,│
│   call your Wang Service Representative.          │
│                                                  │
└─────────────────────────────────────────────────┘
```

     5.   The PCS-II/-IIA is ready to use as soon as the READY display appears.

Power-On Procedure for Multiplexed PCS-IIAs

1. Switch ON the power switches on all system peripherals, including the disk unit.

2. Switch ON the Main Power Switches on all system CPU's.

3. On the disk unit, the POWER light should be illuminated. The CRT display at each station looks like this:

<p align="center">READY</p>

4. Touch RESET on the keyboard of the master system to initialize the controller. The disk may now be accessed via the multiplexer from any attached system.

```
+-------------------------------------------------------------+
|                          NOTE:                              |
|                                                             |
|  If you experience difficulty in maintaining valid data     |
|  transmission between the disk and one or more systems, the  |
|  problem may lie with the connector plugs.  A coating       |
|  sometimes forms on the pins of a plug during extended      |
|  periods of disuse.  To remove this coating, which may      |
|  inhibit transmission, simply insert and remove the plug in |
|  a jack several times, or cut a piece from a white ink-type |
|  eraser small enough to fit between the pins, and use it to |
|  clean the surfaces of the pins.  Transmission problems     |
|  also  can  be  created  by  electrical  and  magnetic      |
|  interference in the cables.                                |
+-------------------------------------------------------------+
```

Master Initialization sets default values for CRT line length and establishes a table containing the primary addresses for the following classes of input and output operations:

I/O Class	Primary Address and Associated Device	
CI (Console Input)	001	Keyboard
INPUT	001	Keyboard
CO (Console Output)	005	CRT
PRINT	005	CRT
DISK	310	Diskette Drive
PLOT	413	Plotter (if included)
TAPE	10A	none

The default value for CRT line length is 64 characters for the standard PCS-II/-IIA, or 80 characters if the system includes Option 60A.

Default addresses and CRT line length can be changed with a SELECT statement (see SELECT in the Wang BASIC Language Reference Manual). Also, see Chapter 5 in Programming in BASIC if the system includes a printer and detailed information is needed.

3.2   THE RETURN (EXEC) KEY

The RETURN (EXEC) key is the standard means of signaling the termination of operator entry to the system.

When entering a program line, use the EXEC key to signal the end of the line and cause the system to store the line in memory. For example:

:10 A=25   (EXEC)

As the characters of the program line are entered, they are stored one byte at a time in memory. When EXEC is keyed, the line is scanned by the system, and the syntax of the line is checked (if the syntax is incorrect, an error message is displayed). The program line is appended to any program statements currently in memory; the line is <u>not</u> executed until the program is run.

To perform a quick calculation, use the EXEC key to signal the end of a line entered in immediate mode. For example:

:PRINT 25+273   (EXEC)
:298

In this case, when EXEC is keyed, the line is immediately executed; the expression 25+273 is evaluated and the result displayed. The line is not saved in memory since it was not preceded by a line number when entered.

3.3 PREPARATION OF MINIDISKETTES

As indicated on the permanent label attached to each minidiskette, a minidiskette is protected from accidental over-writing when the "write protect" notch is uncovered. To write programs or data on a minidiskette, the notch must be covered to disable the write-protect feature. (Adhesive tabs are provided for this a purpose.)

PERMANENT LABEL

WRITE-PROTECT NOTCH

HEAD SLOT EXPOSES SURFACE OF THE MINIDISKETTE TO THE DRIVE READ/WRITE HEAD.
(EXERCISE CARE TO AVOID TOUCHING THIS AREA.)

USER LABEL
(IF ATTACHING A NEW LABEL, REMOVE OLD ONE. USE FIBER-TIP PEN TO AVOID DAMAGING THE MINIDISKETTE WHEN WRITING ON THE LABEL.)
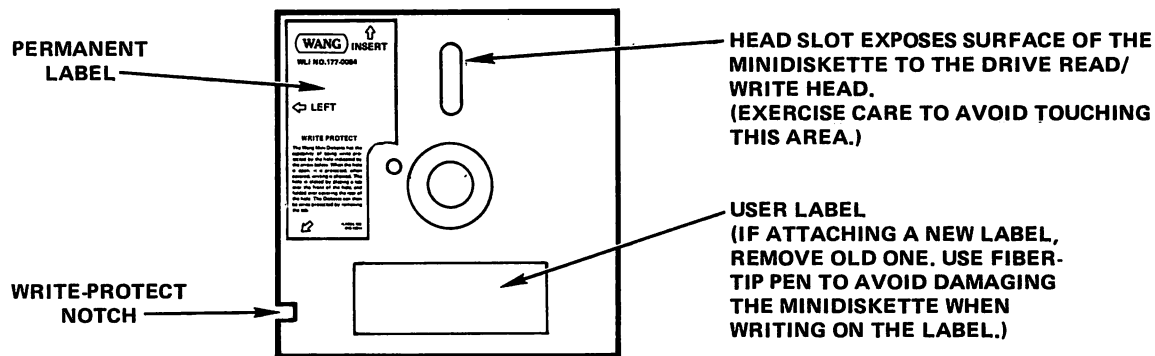
Figure 3-2. A Minidiskette

A blank, unused minidiskette must be formatted before it can be used to store the <u>first</u> program or data file. Ordinarily, a used minidiskette is not formatted before storing additional files. Minidiskettes containing packaged programs must never be formatted or scratched because the process destroys any information previously recorded on the minidiskettes.

The recording surface of a minidiskette is divided into 350 sectors, each with a capacity for 256 bytes of data (or program text) and control information, in addition to the two sector-address bytes, and two CRC (cyclic redundancy check) bytes for data verification. During formatting, the system writes a sector address and CRC control information in each sector, filling the remainder of the sector with zeros.

Mounting and Formatting a Minidiskette

To mount and format a minidiskette, follow these steps:

1. Turn on the PCS-II/-IIA and await the READY display. If the READY display does not appear, first check the Brightness and Contrast adjustments. If this does not correct the problem, Master Initialize the system again. If the READY display still fails to appear, contact your Wang Service Representative.

2. Remove the minidiskette from its envelope. Check the write-protect notch: it must be covered.

Write-Protect disabled   Write-Protect enabled
(writing permitted)   (writing not permitted)
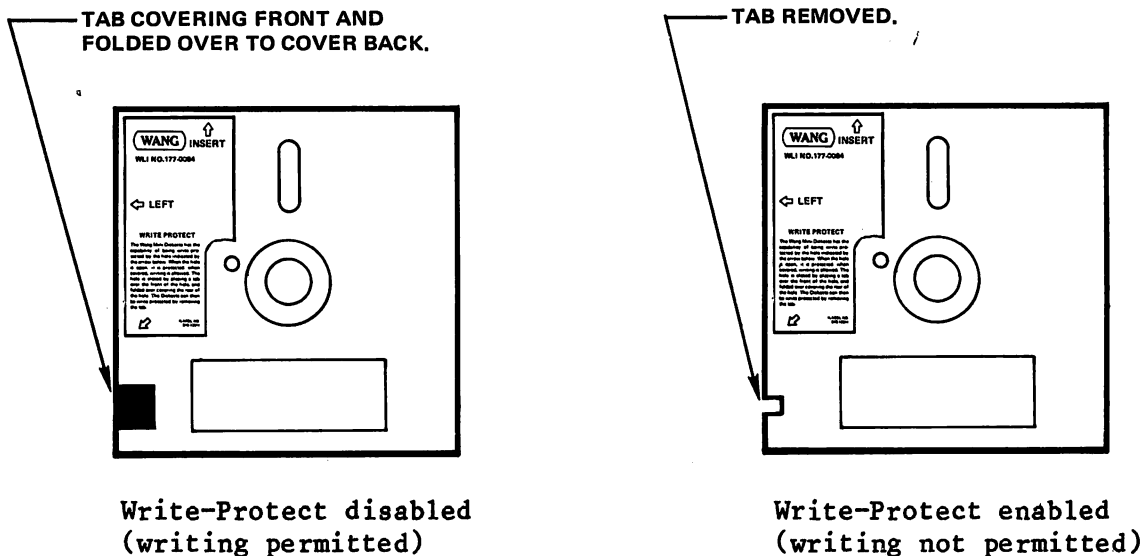
Figure 3-3. Write-Protect Feature

3. Properly orient the minidiskette (as indicated by arrows on the label) before inserting it into the slot in the left minidiskette drive. Be sure the minidiskette is firmly seated in the drive. Then close the drive latch.

4. Depress the RESET button on the keyboard.

5. Depress the FORMAT button, located on the webbing between the two
    drives, with a pen or pencil. (The format button is recessed to
    prevent accidental use.)

6. The lamp on the minidiskette unit is illuminated throughout the
    formatting operation (45 to 50 seconds). If the lamp remains on, or
    begins to flash, formatting has not been properly concluded (the
    minidiskette may not be formattable). Generally, format errors
    result from three causes:

    a) drive latch not tightly closed,
    b) write-protect notch not covered, or
    c) defective minidiskette.

7. Remove the minidiskette from the drive and proceed to format another.

```
+--------------------------------------------------------------------+
|                                                                    |
|                              NOTE:                                 |
|                                                                    |
|    If a minidiskette cannot be formatted, it cannot                |
|    be used for storage and should be discarded.                    |
|                                                                    |
+--------------------------------------------------------------------+
```

If the formatting procedure aborts repeatedly with several minidiskettes,
there may be a hardware problem with the minidiskette drive. Contact your
Wang Service Representative.

Scratching a Minidiskette

Once a minidiskette has been formatted to contain the necessary sector
identification information, it is ready to be used for storing data and
programs. The PCS-II/-IIA supports two methods of writing information on a
minidiskette: (1) a "direct" method, called Absolute Sector Addressing, in
which the address of each sector to be accessed must be provided explicitly by
the programmer, and (2) an "indirect" method, called Automatic File
Cataloging, in which each program and data file is assigned a name by the
programmer, and may be accessed by that name without reference to its actual
location on the minidiskette.

Under Automatic File Cataloging, the PCS-II/-IIA operating system
maintains a "catalog" on each minidiskette consisting of a Catalog Area, where
program and data files are stored, and a Catalog Index, which contains the
name of each file and its location in the Catalog Area. Whenever a new file
is created, the system automatically records the file name and location in the
Catalog Index. When a particular file is subsequently accessed, the system
automatically looks up the file name in the Index to determine the file's
location. Thus, the programmer does not have to remember the exact sector
location of each file on a minidiskette. Only the file names need be
remembered, or a LIST DC statement can be used to obtain the names of existing
files.

The automatic file cataloging mode is the recommended cataloging method; it is the mode used by most Wang software for maintaining data files. Before the first program or data file can be stored on a minidiskette in catalog mode, however, someone must open a catalog on the minidiskette. The process of opening a catalog is called "scratching" the minidiskette, because the SCRATCH DISK statement, is used to perform the operation. In a SCRATCH DISK statement, the user must specify how many sectors are to be reserved for the Catalog Index as well as specify the last sector to be used for the Catalog Area (where the contents of the files are actually stored). The Catalog Index always begins at the first sector on a minidiskette (sector numbering starts with zero), and occupies a number of sequential sectors specified by the user. The Catalog Area begins immediately after the Catalog Index, and occupies all sequential sectors up to and including the user-specified last, or ending, sector. The end of the Catalog Area is usually specified as the last available sector on the minidiskette.

The size of the Catalog Index is defined with the "LS" parameter in a SCRATCH DISK statement. For example, setting LS = 10 indicates that 10 sectors are to be reserved for the Catalog Index. If no value is specified, the system assigned (default) value is 24.

The last sector in the Catalog Area is specified with the "END" parameter in a SCRATCH DISK statement. For example, setting END = 349 indicates that sector #349 (the last accessible sector on a minidiskette, containing a total of 350 sectors numbered from 0 through 349) is the last sector to be used for the Catalog Area.

To scratch a minidiskette, follow these steps:

1. Insert a formatted minidiskette in the left drive of the PCS-II/-IIA.

2. Enter a statement such as:

    SCRATCH DISK T/310 = 2, END = 349

    and key EXEC. Here, LS = 2 specifies that 10 sectors be reserved for the Catalog Index; "END = 349" specifies that sector 349 is the last sector to be used by the catalog. The number of sectors allocated for the catalog and data storage may be other values (see the Wang BASIC Language Disk Reference Manual for more information).

3. Repeat steps 1 and 2 for any other minidiskettes which must be scratched.

After a minidiskette is formatted and scratched, it is ready for data or program storage.

Absolute sector addressing is discussed in detail in the Wang BASIC Language Disk Reference Manual.

3.4 USING THE PCS-II/-IIA AS A CALCULATOR

The PCS-II/-IIA is a versatile system which can also be used as a calculator. (When used as a calculator, the system is said to be in immediate mode since BASIC statements and functions are entered without a preceding line number and are not saved in memory.) If there are no syntax errors, an immediate mode statement is executed when the EXEC key is pressed. The PRINT statement is used to display the results of an immediate mode calculation. For example:

```
PRINT SQR(55) (EXEC)
PRINT 7*13+5 (EXEC)
```

Multiple statement lines (individual statements separated by colons) are acceptable in the immediate mode. For example:

```
FOR J=2 TO 10: PRINT J, LOG(J): NEXT J    (EXEC)
```

Upon execution, nine values of J and log J are displayed.

The immediate mode is also an extremely useful program debugging tool for interrogating variables while an executing program is temporarily halted (see examples in Chapter 4).

3.5 RUNNING SOFTWARE PACKAGES

Running pre-programmed software packages on the PCS-II/-IIA is relatively simple. Merely insert the program minidiskette in the drive, and, if it contains a program module named START, enter the commands:

```
CLEAR   (EXEC)
LOAD DC F "START"   (EXEC)
```

Most Wang-developed software packages have starting modules named START; however, some software packages have starting modules with names other than START. The name required for loading a software package is indicated in the manual supplied with the software package.

The CLEAR command removes all program text and data currently in memory. However, if the system has just been Master Initialized, CLEAR is unnecessary; memory is cleared automatically by Master Initialization.

Once a program module is in memory, it may be executed by keying:

```
RUN (EXEC)
```

During program execution, the operator-prompts usually appear on the video display. Remember the following facts when responding to these prompts:

1. In general, a displayed question mark indicates that a keyboard entry is expected.

2. If a numeric value is requested, the system permits a maximum of 13 digits, decimal point, sign, and a signed two-digit exponent to be entered. (However, the program itself may impose more restrictive limits on a response.) The sign of the value must precede the digits; the letter "E" is used to mark the beginning of the exponent. Some examples of system-acceptable numeric entries are:

    ```
     25.15
    -79.5
      4.56E4
     23.2437E-12
    ```

3. If an alphanumeric response is requested, any keyboard characters are acceptable to the system, except for some sequences containing commas and double quotes (see the BASIC Language Reference Manual, INPUT statement). Most software packages remove the restrictions imposed by the INPUT statement by using KEYIN.

4. The EDIT mode keys may be used to correct a response before keying EXEC to enter the information.

5. When a response has been keyed in, and appears in the display in its desired form, key EXEC to enter the response and terminate the keyboard entry operation.

6. If a message of the form:

    ERR xx   (where xx represents the number identifying the error code)

    appears after keying EXEC and the question mark reappears, the entered response is unacceptable to the system. Check the form of the response, and enter another.

7. If the program uses minidiskettes for data storage, format and scratch one or more minidiskettes unless initialized minidiskettes are already available (see Section 3.3).

3.6   STOPPING PROGRAM EXECUTION

If it becomes necessary to stop the execution of a program before normal program termination (and if the program operating instructions do not prescribe a procedure for doing so), key HALT/STEP (at the top of the command keys). HALT/STEP stops execution at the end of the currently executing BASIC statement, and displays the system colon. Then, to continue the program from the point at which it was halted, key CONTINUE (EXEC), if desired, unless an action has occurred which would prevent the program from being continued.

Although the RESET button also stops program execution, it should not be used unless HALT/STEP fails to display the system colon. RESET can leave half-written, unreadable information on a minidiskette if pressed during program execution. RESET also prevents the use of CONTINUE.

3.7   EDIT MODE

Whenever the EDIT key at the right of the keyboard is depressed, the system enters EDIT mode and an asterisk (*) replaces the usual colon at the start of a line. In EDIT mode, the normal operation of the Special Function Keys is temporarily inhibited, and the Special Function Keys at the right end of the Special Function strip assume the following special meanings as EDIT Keys:

Key	Operation
EDIT	Used to enter EDIT mode; when this key is pressed, an asterisk replaces the usual colon at the beginning of the current line and the following keys may be used to effect editing operations.
RECALL	Used to recall a program line from memory for editing.
----	Moves the cursor five spaces to the left.
-	Moves the cursor one space to the left.
----	Moves the cursor five spaces to the right.
-	Moves the cursor one space to the right.
INSERT	Expands the current line by inserting a space character prior to the current cursor position; when this key is pressed successively, space for additional text or data can be inserted in the line without destroying the previous characters.

DELETE   Deletes the character at the current cursor
                       position.

ERASE   Erases all characters in a line from the current
                       cursor position to the end of the line.

```
+--------------------------------------------------+
|                     NOTE:                        |
|                                                  |
|   The EDIT mode keys operate as described only if|
|   the CRT is the currently selected Console Output|
|   (CO) device and the correct line length 64 or 80|
|   is in effect; see SELECT in the Wang BASIC     |
|   Language Reference Manual.   The   CRT   is    |
|   automatically  selected  as  the  Console Output|
|   device when the system is Master Initialized.  |
+--------------------------------------------------+
```

Example

Enter   :10 PRINT 1A,B1,C1   (EXEC)   (The line is checked for syntax
                          ERR 10   and stored; an error message is
             :_   displayed because 1A is not a
                                                legal BASIC variable.)

To correct the error in line 10, follow the procedure below:

       Step   Result

1. Depress the EDIT key.   *_   (An asterisk replaces the colon
                                             in the third line of the display.)

2. Enter the line number.   *10_

3. Depress the RECALL key.   *10 PRINT 1A,B1,C1_

4. Move the cursor to the   *10 PRINT 1A,B1,C1
    incorrect variable name.

5. Correct the variable name.   *10 PRINT A1,B1,C1

6. Key EXEC to store the   *10 PRINT A1,B1,C1
    corrected line and exit   :_
    from EDIT mode.

```
+--------------------------------------------------+
|                     NOTE:                        |
|                                                  |
|   It does not matter where the cursor is positioned|
|   when exiting from the EDIT mode; the entire line|
|   is stored.                                     |
+--------------------------------------------------+
```

CHAPTER 4 PROGRAMMING THE PCS-II/-IIA

4.1   WRITING PROGRAMS IN WANG BASIC

Although the PCS-II/-IIA can function as a convenient and powerful calculator, it is also a versatile small computer programmable in the high-level BASIC language. BASIC is an interactive programming language which utilizes many English words (such as PRINT, READ, STOP, etc). Although such words are given a special and clearly-defined meaning when used in a BASIC program, their purposes are similar to ordinary usage and meanings to reduce learning time for beginning programmers.

This chapter introduces some general topics related to programming the PCS-II/-IIA, including BASIC program format, general terminology, entry of program lines, and the assortment of available program editing and debugging features available on the PCS-II/-IIA. Detailed information about the BASIC instruction set is covered in the Wang BASIC Language Reference Manual, and programming techniques are discussed in detail in Programming in BASIC.

4.2   USING SPACES

Spaces are customarily used between characters in a line for readability; however, the system ignores them. For example, 10 READ A, B, C, D is easier to read than 10READA,B,C,D. Both are equally acceptable to the system. The only situation in which spaces have a significance is when they are included within a character string enclosed in quotes, e.g., the character strings "ABC" and "A B C" are different.

4.3   PROGRAM MODE

In program mode, each line must be preceded by a unique line number in the range from 0 through 9999. Once the line number and program line are entered and the EXEC key is depressed, the line is checked for syntax and saved in memory. The line is not executed immediately (program lines are executed only when the program itself is run). If a syntax error is discovered, the appropriate error code (ERR xx) is displayed; the line has

nevertheless been stored in memory. The line can be corrected by reentering both the line number and the correct text, or by recalling the entered line and correcting it with the EDIT mode keys.

Program Mode makes it possible for the user to enter a complete program line by line into the system. Line numbers identify the lines and specify the order in which the lines are to be executed. Lines do <u>not</u> have to be entered sequentially; at execution time, the system automatically processes the lines in proper order according to the line numbers.

Line numbers should be assigned with suitable increments between them to allow for the insertion of additional lines. Line numbers can be entered automatically by using the Statement Number (STMT NUMBER) key which generates line numbers in increments of ten. Line numbers do <u>not</u> require leading zeros, e.g., 0010 can be entered simply as 10.

Examples:

```
:10 FOR J = 2 TO 10    (EXEC)
:20 PRINT J, LOG(J)    (EXEC)
:30 NEXT J             (EXEC)
```

4.4   TERMS USED IN WANG BASIC

BASIC Keyword

A keyword is a BASIC word which can be entered by depressing a single key on the keyboard rather than the individual characters in the word. The keyboard contains the entire alphabet, all the decimal digits, and many special characters (such as $, #, %, etc.), along with a set of BASIC words. Thus, an entire BASIC word (such as PRINT or PRINTUSING) can be entered with a single keystroke. (A BASIC word can, of course, always be entered character-by-character as well.) No matter how it is entered, a BASIC keyword is compressed by the system into a one-byte code (called a "text atom") before it is stored in memory; a few keywords require two bytes. This so-called "atomization" process saves space in memory and speeds up program execution.

BASIC Statement

A BASIC "statement" is a programmable instruction which serves as a fundamental building block when writing a BASIC language program. A BASIC statement generally includes one or more operands which specify the data to be used by the statement when performing its operation. Many of the statements can be used in immediate mode as well as program mode. A general rule is that BASIC statements which do not reference other program text or cause program execution to pause may be used in immediate mode, i.e.: PRINT may be used; PRINTUSING may not because it references an image statement in a separate program line; INPUT may not be used because it causes program execution to pause; PRINT FNL (5) may not be used because it references a user-defined function.

Examples of Wang BASIC statements:

```
10 A = 5*B
20 IF A = 100 THEN 90
40 FOR I = 1 to 20: A(I) = I+5: NEXT I
```

Note that more than one BASIC statement may be placed on the same program line (as in line 40 in the previous example). In such a case, the individual statements are separated by colons (:).

BASIC Command

A BASIC "command" is a nonprogrammable instruction by which the operator may control a critical system function (such as clearing memory, initiating or terminating program execution, loading a program, etc.) directly from the keyboard.

Examples of Wang BASIC commands:

```
RUN
CLEAR
RENUMBER
SAVE DC R "NEW PROG"
```

BASIC Function

A BASIC "function" is a special type of BASIC instruction which accepts a given value as an argument, and returns a unique value as a result. A BASIC function must appear as an operand within a BASIC statement; a function cannot stand alone in a program or in immediate mode.

Examples of BASIC statements with SIN, STR, and HEX functions as operands:

```
30 READ STR(A$,9,3)
40 PRINT HEX(51)
50 PRINT SIN(K*2/C)
```

The following incorrect examples of function use produce error messages:

```
50 STR(B$,3,5)
60 SIN(M)
```

The result of a function can be displayed in immediate mode if the function is included in a PRINT statement. The following example prints the square root of 55:

```
PRINT SQR(55)
```

4.5   GETTING STARTED

Entering Program Lines

A program line is entered by keying in a line number followed by one or more BASIC statements and their operands. Each line is terminated by keying EXEC. When EXEC is keyed, the entire line is saved in memory. For more information see Programming in BASIC.

Executing a Program

Once a program has been saved in memory, the program can be run by executing the RUN command, i.e., by keying RUN (EXEC). For example, enter the following program in memory:

```
10 A = 14 + 2
20 PRINT "A=";A
```

```
RUN   (EXEC).
```

The program is resolved and executed and the result is displayed as:

```
A= 16
```

The resolution phase, which occurs immediately before execution, consists of scanning the program for syntax errors and invalid line number references, and setting up space for program variables.

Once execution is underway, an execution error may occur. In such a case, the program line in which the error occurred is displayed, with an ERR code immediately below the line, usually pointing to the approximate location of the error. (For a list of error codes, see the Wang BASIC Language Reference Manual.) Corrective action can be taken before the program is rerun. For example, suppose a program contains the following lines:

```
10 T = 0
20 B = 15
30 A = SIN(B)/T
40 PRINT A
```

Because division by zero is an illegal operation, an execution error (ERR 03 - Math Error) is signaled when line 30 is executed. The display is as follows:

```
30 A = SIN(B)/T
                ERR 03
```

However, if line 10 is edited or entered again to assign a non-zero value to T, the program can be run successfully.

```
┌─────────────────────────────────────────────────────┐
│                        NOTE:                        │
│                                                     │
│   Numeric  variables  are  set  to  zero  and  alpha │
│   variables  are  set  to  spaces  at  resolution  time; │
│   these  default  values  are  retained  until  specific │
│   values are assigned by the program.               │
│                                                     │
└─────────────────────────────────────────────────────┘
```

4.6   EDITING PROGRAMS

Deleting a Program Line

An existing program line can be deleted by entering its line number and keying EXEC.

Example:

```
10 A = 14 + 2
20 PRINT A + 4
30 PRINT A
```

To delete line 30, enter:

```
:30   (EXEC)
```

4.7   LISTING PROGRAMS

Listing a Program on the CRT

To review a program entered in memory, use the LIST command. LIST (EXEC) lists the entire program. LIST S (EXEC) lists the program a screen at a time; however, the operator must key EXEC when ready to view a screen of 15 lines. LIST line no. (EXEC) lists the specified line only, e.g., LIST 10 (EXEC) lists only line 10.

To save a program on disk, LIST the disk catalog, and LOAD the program again.

Listing a Program on a Printer

To obtain a listing of a program on a printer, turn on and manually select the printer (push the SELECT button). When the printer is selected, the SELECT button is backlighted. Then, enter the following statement from the keyboard to "select" the printer for listing:

```
SELECT LIST 215   (EXEC)
```

This statement changes the default output address for the I/O class parameter LIST from the primary address 005 (the address of the CRT) to the address 215 (the address of the printer). Next, enter

```
LIST   (EXEC)
```

Program listings formerly displayed on the CRT are now listed on the printer.

To again obtain program listings on the CRT, enter

SELECT LIST 005   (EXEC)

Further discussion of the SELECT statement and its various parameters can be found in the Wang BASIC Language Reference Manual and in the individual printer manuals.

4.8   DEBUGGING

Several debugging techniques are available on the PCS-II/-IIA. Keep in mind that the immediate mode permits a programmer to interrogate variables at any time during program execution. For example, enter the following short program:

10 A = 10
20 B = B + A
30 GOTO 20

Then, key RUN (EXEC), but do not expect a display since there is no PRINT statement. Also, since the program is an endless loop, B is continuously incremented. (During execution, a cursor without a colon indicates the system is not awaiting operator action.)

To interrupt program execution and interrogate the variables A and B, proceed as follows:

1) Key HALT/STEP
2) Enter PRINT A,B   (EXEC)

The current values of A and B are displayed. The program can be resumed at the point of interruption by keying CONTINUE (EXEC).

If desired, the immediate mode can be used to change the current values of a variable in an executing program. For example, after HALTing the previous program, enter the following statement:

A = 10.51   (EXEC)

Once the value of the variable has been modified, program execution can be resumed with CONTINUE (EXEC).

NOTE:

If a change is made to the program text itself, or a new variable is defined, program execution cannot be resumed with CONTINUE. Instead, the program must be rerun with the RUN command.

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Now key HALT/STEP, and then PRINT A, B (EXEC); the new values will be displayed.

Immediate Mode GOTO Statement

An immediate mode GOTO statement can be used to set execution pointers to a particular line when program execution is halted with a STOP statement or by a single depression of the HALT/STEP key. However, the immediate mode GOTO does not initiate execution, but must be followed by a CONTINUE command or a second use of the HALT/STEP key.

NOTE:

An immediate mode GOTO cannot be used unless program execution had been previously initiated with a RUN command; otherwise, an Immediate Mode GOTO can result in a SYSTEM ERROR! message. Under such circumstances the results of any execution are not dependable; furthermore, there is no recovery from such an error since the system must be Master Initialized (power off, and then on) to clear memory.

As an exercise in using an immediate mode GOTO, enter and run the following short program:

```
10 A = 10: B = 25
20 C = A - B
30 D = D + C
40 PRINT A, B, C, D
50 GOTO 20
```

While the program is running, the variable D is incremented continuously; the first line of output is:

```
10      25      -15     -15
```

To halt program execution, key HALT/STEP. Next, enter an Immediate Mode GOTO:

```
GOTO 30  (EXEC)
```

This sets the execution pointer at line 30. Key HALT/STEP a second time. Line 30 is displayed and executed:

```
30 D = D + C
```

Key HALT/STEP again; the next line is displayed and executed. (The value in the last column depends on how many loops have been completed.)

```
40 PRINT A, B, C, D
10      25      -15     -1065
```

To resume the normal execution mode, enter CONTINUE (EXEC).

29

RUN Command with Line Number

The RUN command can be used to start execution at a given program line. For example:

        RUN 20   (EXEC)

starts execution at line 20. Program resolution occurs normally; all variables are initialized prior to resuming execution.

TRACE Mode

When a program is executed in TRACE mode, the system automatically displays intermediate values and any internal program transfers (such as branches in GOTO, GOSUB statements, FOR/NEXT loops, etc.). Also, if an alpha function is executed on the left side of an equation, the function name is displayed. As an exercise, enter the following program.

PROGRAM LINE	MEANING
10 A$="ABCDEFGHIJ":K=0	Assign the character string to A$, and zero to K.
20 GOTO 40	Branch to line 40.
30 K=K+1: B$=STR(A$,3,K)	Increment K; then, starting with the third character of A$, store K characters of the A$ string in B$.
40 HEXPRINT A$, B$	Print hexcodes of characters in A$ and B$.
50 PRINT A$, B$	Print the characters currently in A$ and B$.
60 STOP	Stop program execution.
70 GOTO 30	Branch back to line 30.

Now, to execute the program in TRACE mode, turn on the TRACE mode by keying TRACE (EXEC). Then RUN the program. The first display is:

```
A$=ABCDEFGHIJ
K= 0                                         TRACE output
TRANSFER TO 40
4142434445464748494A202020202020
202020202020202020202020202020
ABCDEFGHIJ                                   program output

STOP
:_
```

30

The STOP statement in line 60 halts program execution and returns control to the operator as indicated by the colon and cursor. To proceed, enter:

        CONTINUE   (EXEC)

The second display is:

        TRANSFER TO 30
        K= 1   TRACE output
        B$=C
        4142434445464748494A202020202020
        4320202020202020202020202020202020
        ABCDEFGHIJ   C   program output

        STOP
        :_

        Now, again enter:

        CONTINUE   (EXEC)

The third display is:

        TRANSFER TO 30
        K= 2
        B$=CD
        4142434445464748494A202020202020
        4344202020202020202020202020202020
        ABCDEFGHIJ   CD

        STOP
        :_

        The TRACE mode can be continued for this example program until K = 15, although after K = 8 there are no further changes to B$ (all eight non-blank characters of A$ beginning with character C have been used).

```
+------------------------------------------------------------+
|                          NOTE:                             |
|                                                            |
|   Once K = 15, a program error (ERR 41) occurs; the error  |
|   arrow points to the variable K.  The error is "illegal   |
|   STR argument" since in line 30, B$=STR(A$,3,15); but A$  |
|   contains only 16 bytes, the default dimension set at RUN |
|   time (see STR and DIM in the Wang BASIC Language Reference|
|   Manual).                                                 |
|                                                            |
+------------------------------------------------------------+
```

31

Programmable Pause can be used with TRACE to review the tracing of a program without operator intervention. For example, using lines 10 through 70 of the previous program, remove line 60 by entering the line number without text:

>   60   (EXEC)

To view the new version of the program and verify that the line has been removed, enter:

>   LIST   (EXEC)

To turn on TRACE mode (if TRACE is not already on), key:

>   TRACE   (EXEC)

To set a pause of one-half second between the display of each line (one P = 1/6 second), enter:

>   SELECT P3   (EXEC)

Now RUN the program.

During program execution, TRACE output is displayed with a pause of one-half second between each line. Execution terminates when K = 15 produces ERR 41, illegal STR argument (see note for previous example).

To remove the system from Trace mode, enter:

>   TRACE OFF   (EXEC)

To deactivate the pause, enter:

>   SELECT P   (EXEC)

or

>   SELECT P0   (EXEC)

For further information on all these statements and commands, see the Wang BASIC Language Reference Manual.

CHAPTER 5   PCS-IIA MULTIPLEXING CAPABILITIES

5.1   INTRODUCTION

The Model 2230MXA disk multiplexer permits several independent systems to share a single disk unit.   A maximum of four independent CPU's can be multiplexed to the same disk, allowing users to share a common disk-resident data base, or to maintain independent files on a commonly-used disk.

The Model 2230MXA/B is a "daisy chain" multiplexer which consists of a 2230MXA-1 master controller board, and one or more slave controller boards.   A slave controller board is contained in each PCS-IIA (the connector on the rear panel is labeled DISK).   The systems are connected by running cables from the master board to the slave board of the next consecutive CPU.   The disk connector cable plugs into the disk jack on the master board to complete the chain; only the system with the master board connects directly to the disk unit.   When more than one PCS-IIA (or Work Station) is used, the stations must be connected via "T" connector cables as indicated below:
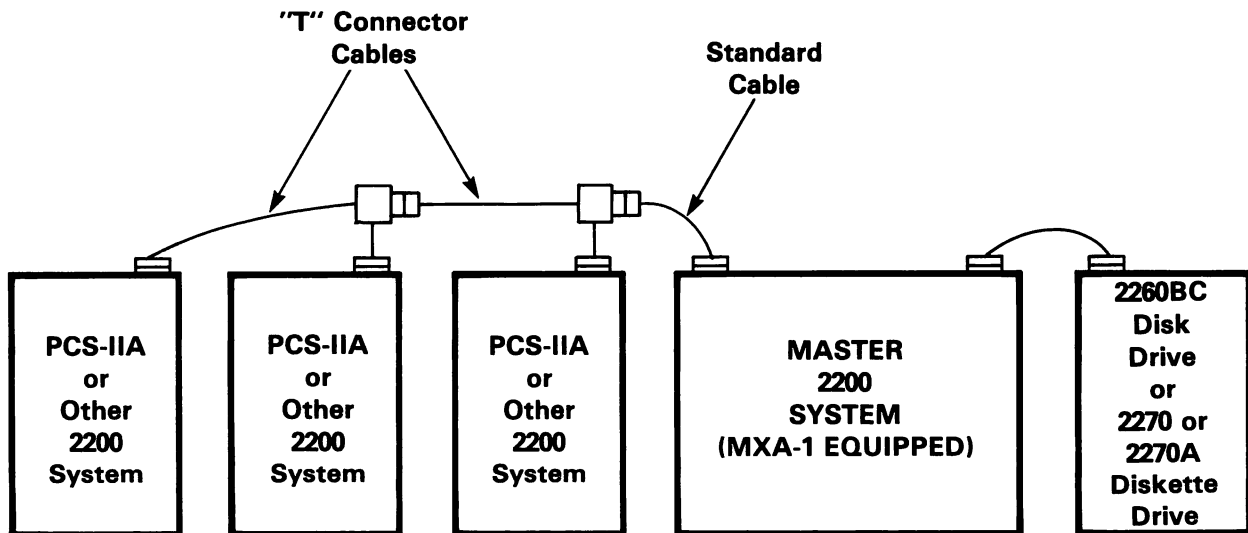

Figure 5-1.   Serial Connection

5.2   NORMAL MODE

The MXA-1 master board controls all communication between participating systems and the disk unit. When in the normal mode, the multiplexer sequentially "polls" each system (or station) until it finds a system attempting to access the disk. At that point, the multiplexer permits the inquiring station to execute one disk statement or command. Multiplexer polling resumes upon execution of the disk statement or command, and continues until another system trying to access the disk is encountered.

Generally, all multiplexed stations gain access to the disk on a statement-by-statement basis; there are, however, cases in which it is desirable to give one system a period of uninterrupted access to the disk. Hog mode enables a station to gain exclusive control of the disk. The hogging station maintains exclusive control of the disk until that station returns the disk to the normal mode.

5.3   HOG MODE

The disk drive may be hogged by either of two methods: $GIO hog, or address hog. In order to hog by address, the disk is accessed using a special disk address called the "hog mode address". The disk remains hogged until the hogging station accesses it with a normal disk address.

The $GIO hog is recommended since it instructs the multiplexer to hog and unhog the disk without actually performing a disk operation. Furthermore, $GIO utilizes the normal disk address – the programmer need not be concerned with two sets of disk addresses as with address hog.

$GIO Hog

The general form of $GIO hog is as follows:

a.   to hog the disk:

$$\text{\$GIO DISK HOG} \left\{ \begin{array}{c} \text{file number} \\ \text{or} \\ \text{disk device address} \end{array} \right\} (4480, \text{ alpha-variable})$$

b.   to release the disk:

$$\text{\$GIO DISK RELEASE} \left\{ \begin{array}{c} \text{file number} \\ \text{or} \\ \text{disk device address} \end{array} \right\} (4400, \text{ alpha-variable})$$

In either case, the alpha-variable is required to satisfy the general syntax of $GIO statements. The alpha-variable must be at least 10 bytes long and should be independent of program execution. File numbers are values which are assigned, within programs, to disk device addresses. For example, SELECT #1 B10 assigns #1 to disk device address B10. Disk device addresses are not programmer selectable, but are preset within each disk controller board. For more information concerning disk device addresses, refer to the <u>Wang BASIC Language Disk Reference Manual</u>.

Example 5-1. Entering and Leaving Hog Mode Using $GIO Hog

```
110       REM OPEN FILE IN NON-HOG MODE
120       SELECT #1 B20
130       DATA LOAD DC OPEN T#1, "DATAFILE"
  .
  .       (processing)
  .
270       DBACKSPACE #1, BEG
280       DSKIP #1, N S:  REM SKIP N SECTORS
290       REM UPDATE RECORD IN HOG MODE
300       $GIO DISK HOG #1 (4480, A$): REM ENTER HOG MODE
310       DATA LOAD DC #1, A,B,C:  REM READ RECORD
320       DBACKSPACE #1, 1 S
330       DATA SAVE DC #1, A, B+K, C: REM UPDATE
340       $GIO DISK RELEASE #1 (4400, A$):  REM LEAVE HOG MODE
```

This example illustrates a typical update routine in which hog mode is temporarily activated during the actual updating (from the time the record is read until its updated version is written). The file is opened with the disk drive in the normal mode (line 130). Lines 270 and 280 locate the desired record, also while in normal mode. Hog mode is entered upon execution of line 300; this station maintains exclusive access to the entire disk drive until executing line 340, at which time the hog mode is left.

Address Hog

The hog mode address for any multiplexed disk device can be calculated by adding HEX (80) to the normal address. Sample normal and hog mode addresses are:

NORMAL ADDRESS	HOG MODE ADDRESS
320	3A0
B20	BA0
B30	BB0

The hog mode addresses refer to the same disks as do the corresponding normal addresses.

Example 5-2.   Entering and Leaving Hog Mode Using Address Hog

```
290      REM UPDATE RECORD IN HOG MODE
300      SELECT #1 BAO :REM HOG MODE ADDRESS
310      DATA LOAD DC #1, A, B, C :REM ENTER HOG MODE AND READ RECORD
320      DBACKSPACE #1, 1 S
330      SELECT #1 B20 :REM NON-HOG ADDRESS
340      DATA SAVE DC #1, A, B+K, C:REM UPDATE, THEN LEAVE HOG MODE
```

In the above example, line 300 substitutes the hog mode address (BAO), for the normal address (B20), in the device table. Hog mode is entered upon execution of line 310. A normal address is selected in line 330 in preparation for leaving the hog mode. The disk is returned to normal mode upon exeuction of line 340.

The following points should be noted in regard to the operation of hog and non-hog mode:

1. When a multiplexed disk drive is hogged, the entire disk unit (all platters) is hogged.

2. Only the station which activates hog mode can deactivate it.

3. If a station attempts to execute a disk statement while another station is hogging the disk drive, the station simply waits, with the processing light on, until hog mode is released.

4. Hog mode is deactivated if RESET is keyed at the hogging station.

NOTE:

When several systems are multiplexed to the same disk with the 2230MX Multiplexer, the master CPU (the CPU with the 2230MXA-1 master board) must be powered ON in order for any other system to access the disk. One or more of the slave CPU's (those with 2230MXB-1 slave boards) may be OFF without disturbing the operation of the other CPU's. However, slave stations cannot be powered on or off while the disk is in operation.

APPENDIX A

PCS-II/-IIA SUPPORTING LITERATURE

The BASIC Language available on the PCS-II/-IIA is fully documented in five reference manuals supplied with the system. The names of the BASIC instructions and the manuals which describe them are listed below.

BASIC INSTRUCTIONS   SUPPORTING DOCUMENT

ABS, ADD, AND, ARCCOS, ARCSIN, ARCTAN,   Wang BASIC Language Reference
BIN, BOOL, CLEAR, COM, COM CLEAR,   Manual
CONTINUE, CONVERT, COS, DATA, DEFFN,
DEFFN', DIM, END, EXP, FN, FOR, GOSUB,
GOSUB', GOTO, HALT/STEP, HEX, HEXPRINT,
IF, %(image), INIT, INPUT, INT, KEYIN,
LEN, LET, LIST, LOG, NEXT, NUM, ON,
ON ERROR, OR, PACK, #PI, PLOT, POS,
PRINT, PRINTUSING, READ, REM, RENUMBER,
RESET, RESTORE, RETURN, RETURN CLEAR,
RND, ROTATE, RUN, SELECT, SGN, SIN, SQR,
STOP, STR, TAB, TAN, TRACE, UNPACK,
VAL, XOR

COPY, DATALOAD BA, DATALOAD DA,   Wang BASIC Language Disk Reference
DATALOAD DC, DATALOAD DC OPEN,   Manual
DATASAVE BA, DATASAVE DA, DATASAVE DC,
DATASAVE DC CLOSE, DATASAVE DC OPEN,
DBACKSPACE, DSKIP, IF END THEN,
LIMITS, LIST DC, LOAD DA, LOAD DC,
MOVE, MOVE END, SAVE DA, SAVE DC,
SCRATCH, SCRATCH DISK, VERIFY

$GIO, $IF ON, $PACK, $TRAN, $UNPACK   General I/O Instruction Set
                                                Reference Manual

MAT CONVERT, MAT COPY, MAT MERGE,   Sort Statements Reference Manual
MAT MOVE, MAT SEARCH, MAT SORT

MAT+, MAT CON, MAT=, MAT IDN, MAT INPUT,   Matrix Statements Reference Manual
MAT INV, MAT*, MAT PRINT, MAT READ,
MAT REDIM, MAT k*, MAT-, MAT TRN,
MAT ZER

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APPENDIX B

PCS-II/-IIA OPTIONS AND PERIPHERALS

OPTIONS

OP-60A	Keyboard Clicker, Audio Alarm, Auxiliary CRT Connector, and 24 x 80 CRT (24 lines with 80 characters per line capacity)
OP-62*	Buffered Asynchronous Communications Controller
OP-62B*	Synchronous/Asynchronous Communications Controller
OP-65*	IEEE-488 Standard Interface
OP-67*	I/O Interface Controller (8-bit parallel)
MEM-PCS-8K	Memory Upgrade of 8K Bytes (32K maximum)
MEM-PCS-16K	Memory Upgrade of 16K Bytes (32K maximum)
OP-101	A second minidiskette drive

PERIPHERALS

2201L	Output Writer (156 Col/15 CPS)
2221W	200 Characters/Sec Printer, 10 Pitch, 132 Characters/Line
2231W-1	120 Characters/Sec Printer, 10 Pitch, 112 Characters/Line
2231W-2	120 Characters/Sec Printer, 12 Pitch, 132 Characters/Line
2231W-3	2282 Graphic CRT Accessory Printer
2231W-6	High-density Matrix Line Printer, 132 col./70 cps)
2251	110 CPS Printer, 40 Characters/Line
2261W	Line Printer (240 LPM/Dual Pitch)
2263-1	Line Printer (400 LPM)
2263-2	Line Printer (600 LPM)
IP41L	Image Printer (18 pages per minute)

* Mutually exclusive

2272-2	Drum Plotter with Three Pens
OP-121	Pin Feed Forms Tractor for 2281
2281P	Plotting Daisy Output Writer (30 CPS)
OP-122	Pin Feed Platen for 2281P
2282	Graphic CRT

APPENDIX C

PCS-II/-11A SPECIFICATIONS

Unit Size
Height . . . . 18.75 in. (47.7 cm)
Depth. . . . . 20.5 in.   (52 cm)
Width. . . . . 19.75 in. (50.2 cm)

Weight
62 lb (30 kg) approximately

CRT
Display size . . . . 9 in. (22.9 cm) diagonal
Capacity . . . . 16 lines, 64 char/line
Character size
   Height. . . . . 0.125 in. (0.32 cm)
   Width . . . . 0.125 in. (0.32 cm)

Central Processor
Memory size: 8K, 16K, 24K, or 32K bytes
Language: Wang BASIC
Average Execution Time (Milliseconds)*
   Add/Subtract. 0.8
   Multiply. 3.8
   Divide. 7.4
   Square. 46.4
   e^x. 25.3
   $\log_e x$ 23.2
   x^y. 45.4
   Integer Value 0.24
   Absolute Value. 0.25
   Sign. 0.25
   Sine. 38.3
   Cosine. 38.9
   Tangent 78.5
   Arctangent. 72.5

   *Average execution times are determined using
random number arguments with 13 precision digits.
Speeds are faster for arguments with fewer precision
digits.

Minidiskette Drive
Online storage capacity (single drive)
    Number of platters. 1
    Sectors per platter 350
    Bytes per platter 89,600
    With dual drive 179,200

Rotation Speed . . . . 300 RPM

Access Time (Position Head to Track)
    Average (across one-half
      available tracks) . . . . 533 ms

Latency Time (Platter Rotation to Sector)
    Average (one sector read/write
      one-half revolution) . . . . 100 ms

Transfer Rate. . . . . 125 kilobits/sec
                        (15,625 bytes/sec)

Power Requirements
115 or 230 VAC + 10%
50 or 60 Hz + 1/2 Hz
260 Watts

Fuses
3 amp 115V/60Hz
1.5 amp 230V/50Hz

Operating Environment
50°F - 90°F (10°C - 32°C)
20% - 80% Relative Humidity
    (Recommended: 40% - 60%, non-condensing)
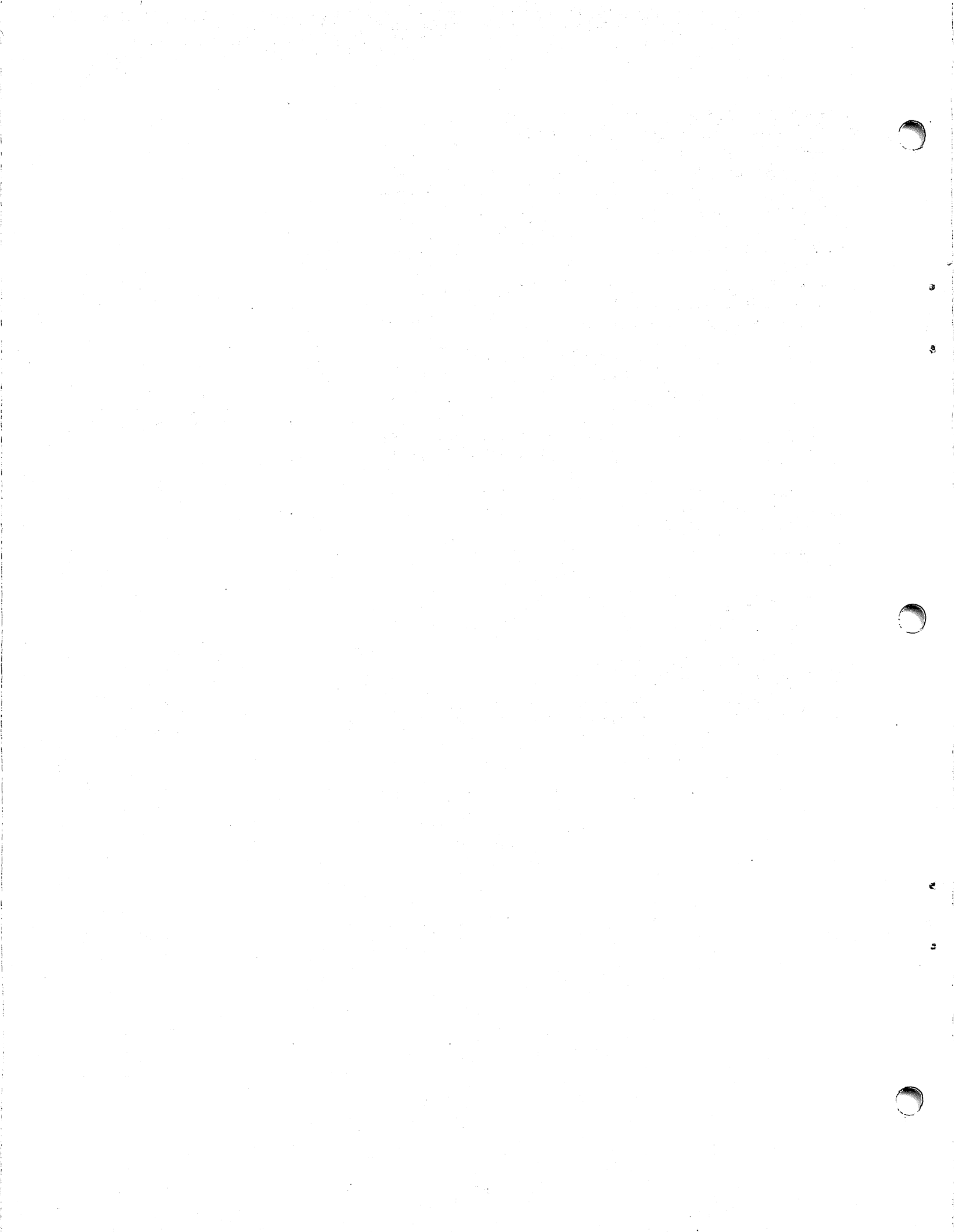
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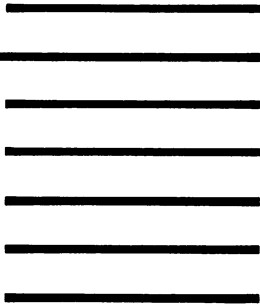
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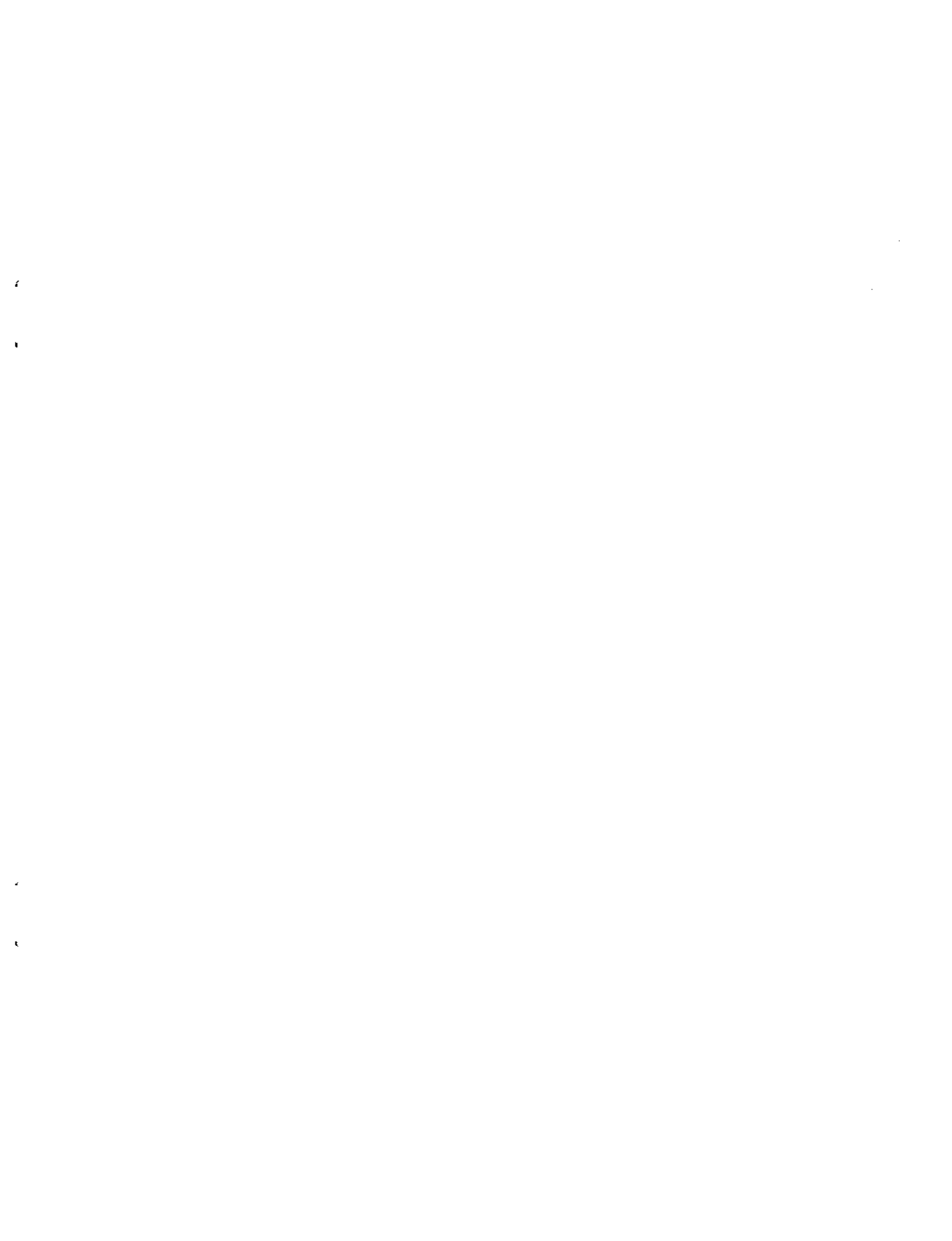
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