WANG

2200SVP Introductory Manual

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PREFACE

This manual introduces the Wang 2200SVP system to the user. It contains a description of the basic system and each of its integral components: the 2200SVP Central Processing Unit (CPU); the system diskette drive; the optional fixed, Winchester-style disk drive; the CRT display; and the keyboard. Routine maintenance procedures, system master initialization procedures, programmable and Immediate mode operation of the system, user diagnostics, and error recovery procedures are also discussed. The appendices include system specifications, available peripherals, system utilities, system diskette backup procedures, and IBM 3741 compatibility options.

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

- *Programming in BASIC* — Introduces the beginner to BASIC programming on the Wang 2200 series.
- *Wang BASIC-2 Language Reference Manual* — Provides complete descriptions of the system's operational features, documents the extensive set of system commands, and describes in detail each instruction in the BASIC-2 instruction set.
- *Wang BASIC-2 Disk Reference Manual* — Describes loading and operating procedures for all 2200 series disk drives, and documents the complete set of disk I/O instructions.

In addition to these manuals, a separate reference manual is provided for each peripheral device attached to the system.

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CHAPTER 1
INTRODUCTION

1.1 SYSTEM OVERVIEW

Wang's 2200SVP, as shown in Figure 1-1, is a versatile, single-user, disk-based system which offers simplicity of operation and high-performance processing capability in a self-contained, modular design. The basic 2200SVP system components are:

- The 2200SVP CPU with 32 or 64K bytes of user memory
- A Model 2236DE Interactive Terminal
- A dual-sided, double-density (DSDD) diskette drive (standard)
- A Winchester-style, fixed disk drive or a second DSDD diskette drive (optional).

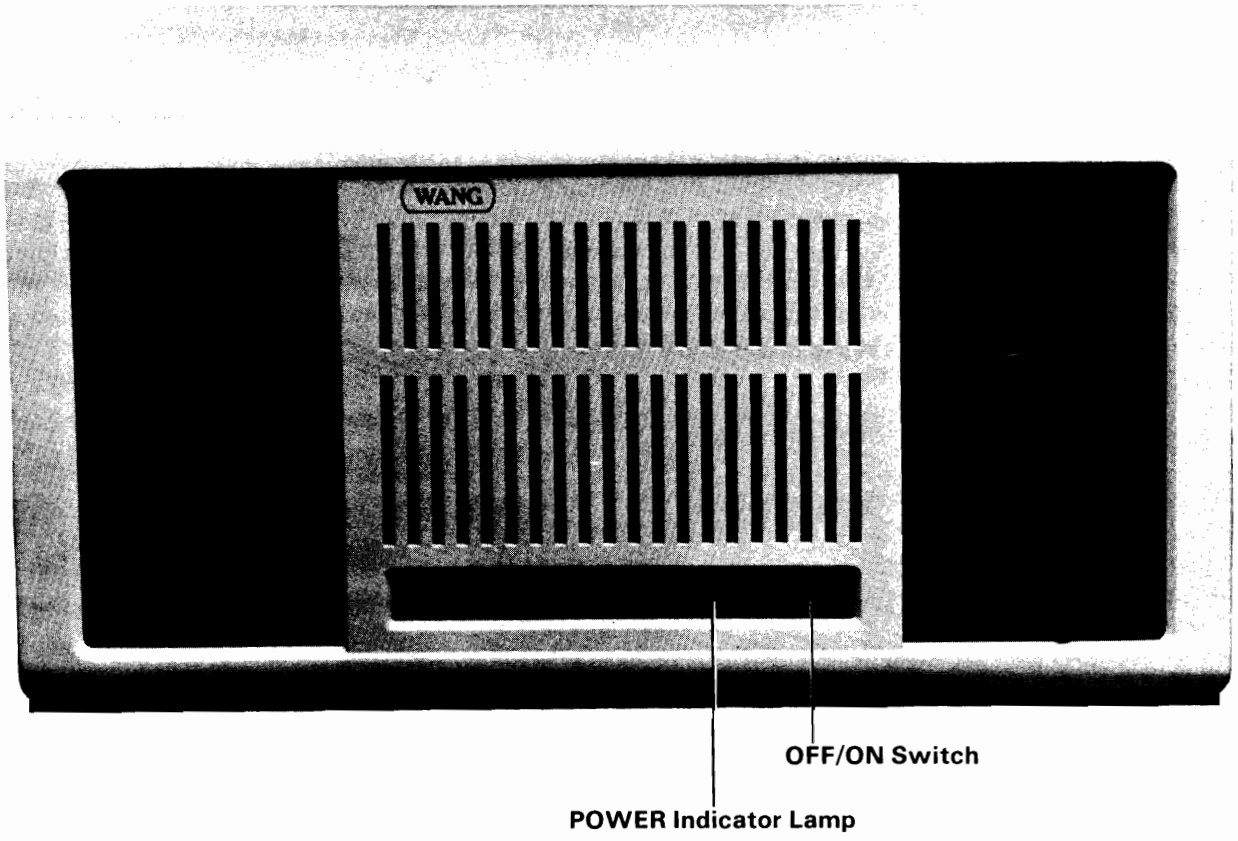

Figure 1-1. The Model 2200SVP

The System Memory

Control memory and user memory are separate and distinct areas within the 2200SVP Central Processing Unit (CPU). Control memory is used exclusively by the operating system and BASIC-2 interpreter and cannot be utilized by the user's programs or data files. The 2200SVP CPU has approximately 48K bytes of control memory wherein the system software (the BASIC-2 interpreter, operating system, and user diagnostics) is stored.

The "memory size" of a system refers to the size of user memory and does not include the size of control memory. User memory is that portion of memory wherein the user's programs and data are stored. The basic 2200SVP CPU contains 32K of user memory, which may be upgraded to a maximum of 64K. However, a small portion of user memory (about 3K bytes) is reserved for system control information and is not available to the user. Therefore, the actual available user memory in a 32K system is 32K minus 3K, or approximately 29K bytes.

The System Terminal

The Model 2236DE Interactive Terminal contains a 24-line, 80 character-per-line, Cathode Ray Tube (CRT) and displays a full 128-character set. Its keyboard contains a 10-key numeric keypad and 34 user-definable special function keys. The Model 2236DE is capable of both box and business graphics, as well as the display of special character attributes such as bright, blinking, underlined, and reverse video (dark characters on a light field). Special features of the Model 2236DE also include an audio signal to indicate a variety of error conditions, repeating keys, and the capacity to support a screen dump to its own local printer. The features of the Model 2236DE Interactive Terminal are detailed in Chapter 2.

The System Platter

The 2200SVP operating system and BASIC-2 interpreter are loaded from disk into the control memory. This allows the operating system and BASIC-2 interpreter to be easily upgraded without hardware modification. The system platter shipped with each 2200SVP contains the BASIC-2 interpreter and operating system, and a variety of system utilities and hardware diagnostic routines. The system platter must be handled with *extreme care*, and a backup copy should be made at the earliest opportunity to protect against its accidental loss or destruction. Chapter 3 discusses how to load the operating system from the system platter into control memory. Appendix E suggests procedures for backing up the system platter.

System Expandability

The 2200SVP's modular design makes it easy to upgrade user memory to 64K bytes. The 2200SVP can support any of a wide variety of Wang printers. One printer may be attached to the printer connector on the rear of the system cabinet. If a second printer is required, it can be attached to the back of the 2236DE terminal. Refer to Appendix B for a list of available peripherals.

Communications Capabilities

The 2200SVP supports a full range of communications capabilities between the 2200SVP and other computer systems. Wang Laboratories, Inc., also offers a number of software packages to emulate common communications protocols.

For communication with other computer systems the 2200SVP can be equipped with any of the following communications controllers: Option 27B, Option 28B, or Option 28C. The Option 27B Communications Controller supports asynchronous-only communications in half- or full-duplex at line speeds ranging from 300 to 9,600 bps. Both the Option 28B and Option 28C Communications Controllers offer a choice of synchronous or asynchronous communications at speeds ranging from 300 to 4,800 bps.

BASIC-2 Language Features

The 2200SVP is a general-purpose interactive system which can be programmed and controlled from the system keyboard using BASIC-2, a Wang-enhanced version of the BASIC language. BASIC-2 enables the operator to interactively enter, modify, trace, renumber, and step through programs, as well as generate comprehensive program listings and individual cross-reference listings for variables, program and subroutine branches, and special function references.

Numeric operations are carried to 13 digits of accuracy for most operations, and the user may specify whether results are to be rounded or truncated at 13 digits. The dynamic range is:

$$-(10^{100}) < n < = -(10^{-99}),0,(10^{-99}) < = n < (10^{+100})$$

The 2200SVP supports both numeric and alphanumeric scalar and array variables. The maximum number of elements in a one-dimensional array is 65,535, and 255 x 255 in a two-dimensional array. Each alphanumeric array element or alpha scalar variable can be from 1 to 124 bytes in length. Alphanumeric arrays can be used in data manipulation statements as scalar variables (element boundaries are ignored), providing a convenient technique for manipulating extremely long character strings.

The BASIC-2 language contains statements, comparable in scope to those available in many assembler languages, for testing and manipulating data, and for performing logical operations at both the bit and byte levels. Special features have been added to better support formatting printed output for forms-filling applications (PRINTUSING, PRINTUSING TO), and formatting the CRT display for data entry operations (LINPUT, PRINT AT). Many general programming tasks are also supported including passing common data between overlayed program modules (COM, COM CLEAR), passing multiple arguments to a subroutine (GOSUB'), and testing for multiple conditions in a single statement (IF...THEN). Many data operation statements can support both numeric and alphanumeric expressions, and operate on all or part of alphanumeric arrays, thus enhancing the system's data handling capability.

In addition to an extensive set of tailored I/O statements which support standard peripherals such as disk units, printers, plotters, and card readers, two general-purpose I/O statements, $GIO and $IF ON/OFF, enable the programmer to write custom-tailored I/O routines, control nonstandard I/O devices, and support special interfacing requirements such as telecommunications. Special statements are also provided to perform the complex task of converting data from one format to another, either for interpreting information in a foreign format, or for packing data into a more efficient form for storage.

The Operating System

The 2200SVP operates BASIC-2 under the single user 2200VP operating system. VP BASIC-2 is also used by Wang's 2200VP system.

An introduction to BASIC-2 programming on the 2200SVP is contained in Chapter 4. The general BASIC-2 instruction set is discussed in the *Wang BASIC-2 Language Reference Manual.* Disk I/O instructions are covered in the *Wang BASIC-2 Disk Reference Manual.* Instructions used to control all other I/O devices are described in the reference manual for the particular device.

1.2 ENVIRONMENTAL CONSIDERATIONS

The 2200SVP is designed to operate in a normal office environment, but the environment should reflect concern for the effect it can have on the system's performance. An ideal environment is one in which the temperature and humidity are controlled and airborne contaminants are minimal. The AC power source should be dedicated, grounded, regulated, and noise free. The room should have space for future expansion and be easily accessible to operating personnel, yet be sufficiently removed from the main traffic flow so as not to interfere with the system's operation. A general rule of thumb is: *An environment comfortable for the operator will be acceptable for the system.* Also refer to Appendix C, "Preventive Maintenance and Environmental Considerations."

1.3 UNPACKING, INSPECTION, AND INSTALLATION

Special factory packing techniques require that the 2200SVP be unpacked, inspected, and installed by a Wang Service Representative. When the system arrives, call the Wang Customer Engineering Office and request that this service be performed. Failure to follow this procedure will void the warranty.

The Wang Service Representative will check that all equipment has been delivered, inspect each unit for possible shipping damage, and verify the proper operation of all system components.

CHAPTER 2
SYSTEM COMPONENTS

2.1 THE CENTRAL PROCESSING UNIT

The Central Processing Unit (CPU) contains the logic and memory necessary to resolve and execute programs and perform arithmetic operations. The 2200SVP CPU makes efficient use of memory by storing all programs in a condensed form. The independent control memory uses very little of the user memory for operating overhead. Additionally, memory parity is provided throughout user and control memory so most errors are automatically identified. The system permits multi-statement lines, a feature which helps to conserve memory and speed program execution. It also enables the programmer to logically group related statements, thus enhancing program documentation.

The standard 2200SVP CPU contains 32K bytes (1K = 1024 bytes) of user memory. User memory is expandable to a maximum of 64K bytes. The operating system and BASIC-2 interpreter are loaded from a system diskette into a separate control memory area (16K words of 3 bytes each) used exclusively by the operating system. Once the operating system has been loaded, the system diskette can be removed, and the drive is available for the user's application diskettes.

The 2200SVP CPU provides a series of error diagnostic and control facilities. System diagnostics automatically verify proper CPU operation whenever the system is master initialized. Additional diagnostics are performed to detect non-hardware errors during any system operation. Errors and their approximate positions are identified by an error code. System response to many types of errors can be suppressed and the errors handled under program control. Debugging facilities provide complete program, variable, and subroutine cross-reference listings, and allow the programmer to step through the execution of a program one statement at a time, observing variable assignments and program transfers as they occur. The programmer can interactively edit program lines, Immediate mode lines, and input data values both during and after entry.

Device Addresses

The 2200SVP CPU allows program control of computed or conditional device selection, permitting great flexibility for I/O operations. Every peripheral attached to the CPU is identified with a unique device address of three hexadecimal digits. The system uses the device address to electronically identify a device when information is to be transmitted to or from it. The device address of the CRT normally is 005. The device address of the keyboard normally is 001. Table 2-1 lists the primary addresses for the performance of the various classes of Input/Output operations.

Table 2-1. Device Addresses

I/O Class	Primary Address	Associated Device
Console Input (CI)	001	Keyboard
INPUT	001	Keyboard
Console Output (CO)	005	CRT
PRINT	005	CRT
DISK	D11	Diskette or Disk Drive
PLOT	413	Plotter
TAPE	10A	None

Device addresses may be changed by means of the SELECT statement from the Wang BASIC-2 Language. In general, the common device address for the system printer is 215, and 204 for the local printer. The user normally selects a printer for printing by entering a statement such as SELECT PRINT 215 (132), where 132 represents the number of characters per printed line. The CRT can then be reselected for printing by a statement such as SELECT PRINT 005 (80).

There are three possible disk configurations for the 2200SVP.

1. One removable DSDD diskette drive (standard)
2. Two removable DSDD diskette drives (optional)
3. One removable DSDD and one fixed disk drive (optional)

If the removable diskette drive is the sole disk unit on the system, it is normally installed in the rightmost slot and assigned address D10 (or B10). A second removable diskette unit is normally installed in the leftmost slot and assigned address D11 (or 310). If the system includes a fixed disk unit in addition to the standard diskette unit, the fixed drive is normally installed in the leftmost slot and given address D11 (or 310). The removable diskette unit in the rightmost slot is assigned address D10 (or B11). The nature of these drives is discussed in Section 2.3.

Table 2-2 summarizes the possible 2200SVP disk configurations.

Table 2-2. 2200SVP Disk Configurations

Left (D11 or 310)	Right (D10 or B10)
1. —	Removable DSDD
2. Removable DSDD	Removable DSDD
3. Fixed disk	Removable DSDD

For a more complete discussion of device addresses, see the *Wang BASIC-2 Reference Manual*.

2.2 2200SVP PERIPHERAL CONNECTORS

The back panel of the 2200SVP contains an AC power supply outlet, as well as two ports for the peripheral devices that may be attached to the system. The Model 2236DE Interactive Terminal connects to the rightmost port and a printer or plotter can be attached to the leftmost port (refer to Figure 2-1).

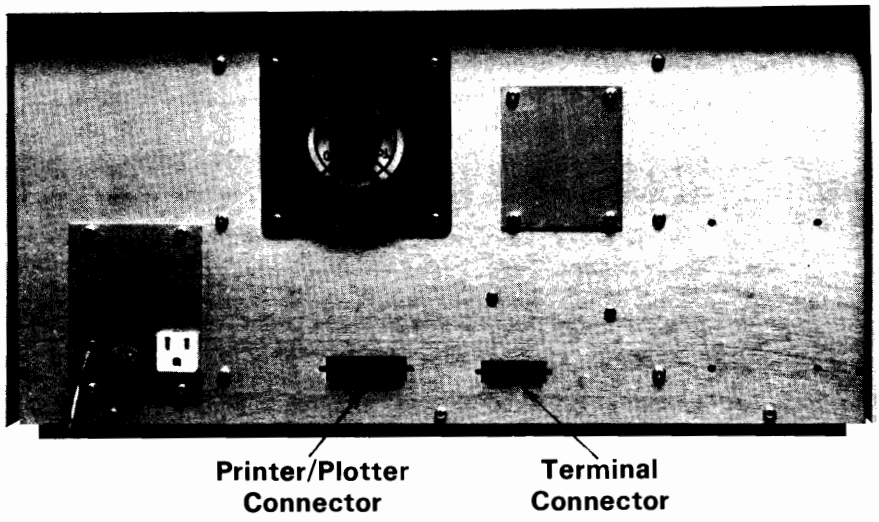

Figure 2-1. 2200SVP Peripheral Connectors

When connecting the cables, observe that the trapezoidal-shaped connector permits only one orientation. Little pressure is needed to insert a properly aligned cable connector. After inserting the connector, secure the plug either by tightening its retaining screws or by pulling the two wire clasps over the sides of the plug, whichever method is appropriate to the type of connector provided.

2.3 THE DISK DRIVES

A dual-sided, double-density (DSDD) diskette drive, which can store approximately 1 megabyte of data, is a standard feature of the 2200SVP. A second 1-megabyte DSDD diskette drive, a 2-megabyte fixed disk drive, or a 4-megabyte fixed disk drive are options to supply additional storage. A second disk drive is recommended to facilitate file backup and processing.

The system diskette drive and the optional second diskette or fixed disk drive are mounted directly within the 2200SVP's compact office-style cabinet. There is no separate power source for the drives; when the operator switches the 2200SVP CPU on, the drives are automatically powered on.

System Diskette Drive

The standard DSDD diskette drive quadruples the normal 250-kilobyte storage capacity of previous single-sided, single-density diskettes by providing dual-sided recording and doubling the density at which data is recorded on new diskettes.

There are three different types of Wang diskettes, two of which can be used by the 2200SVP system diskette drive. The characteristics of the three types of diskettes are as follows.

1. **Wang DSDD Soft-Sectored Diskette** (red label) — This is the standard 2200SVP dual-sided, double-density diskette, used in the 2200SVP system diskette drive.

2. **IBM-Compatible SSSD Soft-Sectored Diskette** (green label) — This single-sided, single-density diskette is compatible with both the 2200SVP and 2200LVP system diskette drives and the Model 2270A diskette drive, permitting use of the @MOVEFIL utility (refer to Appendix F) to transfer data between the two drives.

3. **Wang SSSD Hard-Sectored Diskette** (white label) — This is the standard diskette for the Wang Model 2270 and Model 2270A diskette drives. The SVP system diskette drive cannot use a diskette of this format.

The system diskette drive is compatible with IBM 3741 and DSDD diskettes. However, the catalog structure and character sets differ between Wang and IBM, and special software must be used to enable compatible diskettes to be made. Consult Appendix G for more details concerning IBM compatibility.

The DSDD diskette also serves as the medium for transferring system software and applications packages obtained on DSDD diskettes. When used with the optional fixed drive, the DSDD provides an effective backup medium for the 2200SVP (refer to Appendix E).

Fixed Disk Drive

The optional Winchester-style, fixed disk drive provides additional storage to the 2200SVP. When the 2200SVP is equipped with a fixed disk, it is contained within the system casing and utilizes an 8-inch disk that cannot be removed by the user. Because this fixed-only disk is housed in a sealed environment, the disk is immune to environmental problems and the disk drive heads can fly close to the disk surface. The resulting decreased air gap permits a greater data density than was previously

possible, enabling the user to access data faster and store more data in the same space. Additionally, the Winchester technology of the fixed disk drive implements a decrease in head-loading force as well as lubricated disk surfaces, permitting the head to "take-off" and "land" on the platter surface during power-up and power-down procedures. This technology greatly reduces the possibility of a "head crash," ensuring the integrity of the data.

The fixed disk drive is available as a system option in either 2- or 4-megabyte capacities. As the principle drive for the 2200SVP, it can furnish a permanent, fixed address from which the system programs can be loaded. The greater speed, capacity, and convenience of the fixed disk is ideal for data storage. In conjunction with a fixed drive, the removable diskette drive can be used for data transport and backup.

Chapter 3 discusses disk I/O instructions and outlines the procedures for mounting a diskette and formatting a diskette or disk. For detailed information concerning disk operations and BASIC-2 language disk instructions, refer to the *Wang BASIC-2 Disk Reference Manual.*

2.4 THE CRT

The Model 2236DE Interactive Terminal contains a 12-inch (30.4 cm) diagonal CRT with a 24-line, 80 character-per-line capacity (1,920 character positions) for full-screen operator prompting and verification of keyed characters. The terminal may be attached to the 2200SVP at a distance of up to 50 feet (refer to Figure 2-1). Display speed is approximately 1,700 characters per second at 19,200 baud. Brightness and contrast can be adjusted by means of the two controls located on the front panel adjacent to the screen. Lines are displayed sequentially on the screen. If the operator sends a new line to be displayed below the 24th line, that line is displayed at the bottom of the screen, the top line leaves the screen, and all previously displayed lines scroll upward one line.

The CRT displays a full 128-character set, including uppercase and lowercase keyboard characters, some foreign language characters, special symbols, and underlining. The CRT also displays an alternate set of graphic characters and box graphics. In addition, all characters can be displayed using one or more of several character display attributes. A local printer may be connected to the rear panel of the CRT (refer to Figure 2-2) at a distance of up to 50 feet, and can be used to print immediately the contents of the CRT screen. Refer to the *Model 2236DE Interactive Terminal User Manual* for more information on screen dumps.

Figure 2-2. The Model 2236DE Rear Panel

Character Display Attributes

The Model 2236DE terminal defines a character display attribute for each position on the CRT display. While entering a character or string of characters, the user can type in special codes that cause the output to be displayed in bright or normal intensity, blinking or nonblinking, underlined, reversed (dark characters on a light background), or possessing any combination of these attributes. By selecting the appropriate attributes, the user can highlight error messages, input fields, and other special messages. (Refer to the *Model 2236DE Interactive Terminal User Manual* for a detailed discussion of character display attributes.)

Business Graphic Capabilities

The Model 2236DE terminal can use an alternate character set in addition to normally unused portions of each character position to create business graphics characters. Box graphics allow line segments to be drawn at any CRT position. Business graphics are included in an alternate character set that displays geometric designs rather than normal characters.

Box graphics are used to draw horizontal or vertical lines on the screen. This enables the user to depict form lengths or separate fields with lines or boxes. Box graphics may be used to increase the readability of a dense display without greatly reducing the capacity of that display. A special BASIC-2 statement, the PRINT BOX statement, can be used to draw any size box beginning at the current cursor location on the screen.

Business graphics comprise an alternate set of display characters on the Model 2236DE terminal. They are similar to standard characters in that each character graphic occupies one position on the CRT display. Certain character codes then cause one or more areas of a character position to be displayed on the screen at the current cursor position. Adjacent areas of two graphic characters will touch creating continuous light or dark areas on the screen. This characteristic permits the construction of bar graphs and special displays. When combined with display attributes, business graphics are useful for histograms and other similar displays.

The *Model 2236DE User Manual* describes in detail character set and box graphic capabilities.

Cursor

A cursor (resembling an underscore) indicates the location on the display where a character to be entered will appear on the display. As characters are entered, the cursor automatically advances to the next character entry position. In Edit mode, the cursor can be positioned to any location in the field where a character is to be inserted or deleted. The cursor may also be moved to any display position under program control, a useful feature for prompting operator entry of data. In this case, the programmer controls the cursor movement with the (PRINT) AT function, or the PRINT HEX function with special hexadecimal codes called cursor control codes.

The available cursor control codes are listed below.

Hex Code	Command
HEX 01	Home Cursor
HEX 03	Clear Screen, Home Cursor
HEX 05	Cursor On
HEX 06	Cursor Off
HEX 08	Cursor Left
HEX 09	Cursor Right
HEX 0A	Cursor Down
HEX 0C	Cursor Up
HEX 0D	Carriage Return

Cleaning the CRT Screen

The CRT screen should be cleaned periodically with mild soap and water using a soft cloth. *Do not use* an alcohol pad or an abrasive compound; this could cause damage to the screen and adjacent areas.

WARNING

Due to the danger of high voltage, do not attempt to remove the cover of your console for any reason. Call your Wang Service Representative if any maintenance is required.

2.5 THE KEYBOARD

The 2236DE keyboard is designed for users who are familiar with the standard typewriter keyboard and 10-key numeric keypads. The keyboard is the operator's means of communicating with and controlling the system. It permits the operator to enter data, write programs, perform calculations, and issue commands to the processor (refer to Figure 2-3).

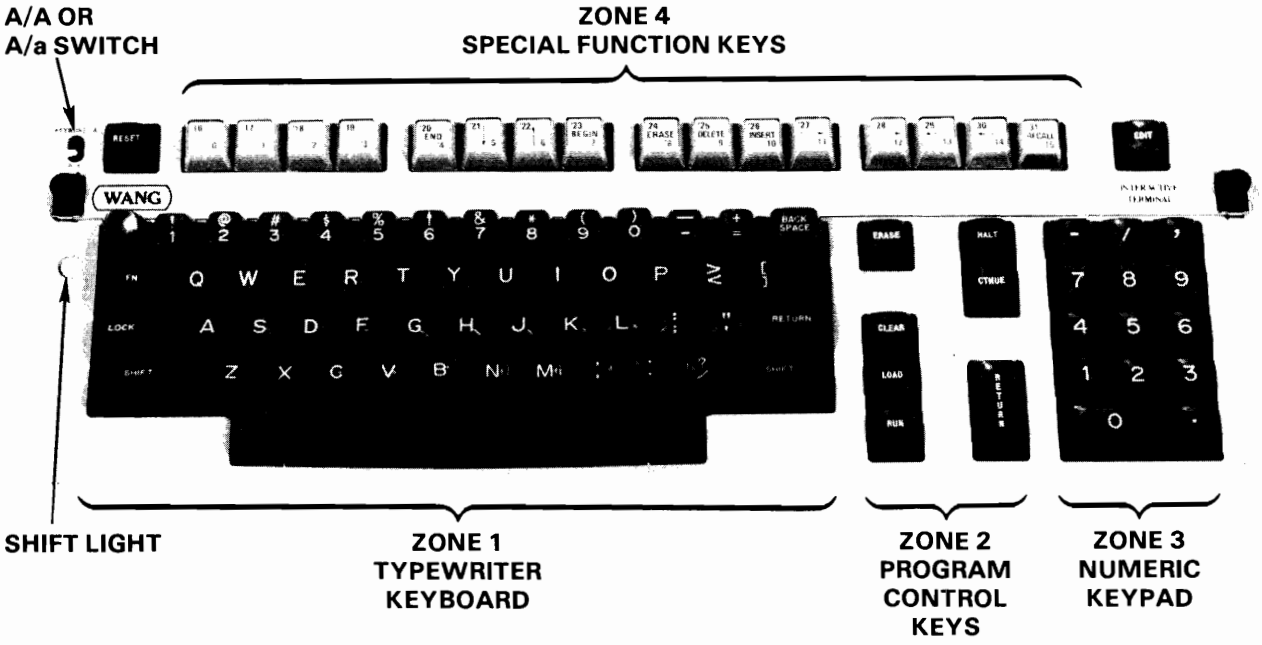

Figure 2-3. Model 2236DE Interactive Terminal Keyboard

The keyboard has two modes of operation, selected by means of a toggle switch, labeled A/A and A/a, on the upper left corner of the keyboard. (See Zone 1 in Figure 2-3.) While in the A/a mode, the keyboard functions in the same way as a standard uppercase/lowercase typewriter keyboard. Pressing SHIFT and the desired character simultaneously yields an uppercase character, and illuminates the shift indicator lamp on the left panel of the keyboard. A lowercase character is produced if SHIFT is not pressed. This mode must be used if lowercase data entry is desired. To lock the keyboard in the uppercase mode, press LOCK once. The shift indicator will remain on while the shift is locked. Pressing SHIFT disengages the lock mechanism.

While in the A/A mode, all alphabetic keys, when pressed, yield uppercase letters, regardless of the use of the SHIFT key. Other keys function normally.

The keyboard is divided into four zones as follows.

The alphanumeric zone is designed for rapid entry of alphanumeric and special-character expressions. Similar to a standard typewriter, this zone contains alphanumeric and special characters (e.g., #, $, %, etc.), the numeric operators (+, *, /, -, ↑), and the FN, RETURN, and SHIFT keys. The RETURN key is equivalent to the EXEC key on some other Wang keyboard models. The FN key provides Special Function '126 when unshifted and '127 when shifted (refer to the description of Zone 4).

Zone 1 — The Alphanumeric Zone

Zone 2 — Program Control Keys

System commands directly control system operations from the keyboard. The program control keys provide single-keystroke entry of some of the more commonly used command verbs (e.g., HALT/STEP, RUN, LOAD, CONTINUE, CLEAR, and RETURN).

Zone 3 — The Numeric Zone

The column of command keys located on the right side of the keyboard permits single-keystroke entry of some of the more commonly used system commands (e.g., HALT/STEP, RUN, LOAD, CONTINUE, and CLEAR). Above these keys and slightly to the right is a lamp which illuminates when the processor is in operation.

Zone 4 — Special Function/Edit Mode Keys

Across the top of the keyboard are 16 user-programmable Special Function keys. The keys are numbered '0 — '15 (lowercase) and '16 — '31 (uppercase). Pressing a key numbered '0 to '15 and the SHIFT key simultaneously accesses an uppercase function. Therefore, 32 special functions are available to the user (in addition to the two special functions the FN key in Zone 1 provides). Special Function keys can be used to start program or subroutine execution, or display a text string. The Special Function keys are also used during Master Initialization to load the BASIC-2 interpreter and operating system.

Pressing the EDIT key (to the right of the special function keys) places the system in Edit mode. In Edit mode, the rightmost special function keys in the Lowercase mode ('4 to '15) are changed from *user-defined* Special Function keys to *system-defined* Edit keys. Edit mode provides powerful editing capabilities for program lines, Immediate mode lines, and data: characters can be altered, inserted, or deleted without retyping the entire line. Once the altered text line is entered (by pressing the RETURN key), the system automatically leaves Edit mode. (Edit mode can also be entered under program control by execution of the LINPUT statement from BASIC-2.)

The following keys control the Edit mode functions.

EDIT	when pressed once, used to enter Edit mode. A second pressing causes the keyboard to exit from Edit mode.
RECALL	recalls the last entered Immediate mode statement or any specified program line from memory for editing.
<- - - - -	moves the cursor five spaces to the left.
<-	moves the cursor a single space to the left.

- - - - ->	moves the cursor five spaces to the right.
->	moves the cursor a single space to the right.
INSERT	inserts one space character at the current cursor position, thereby allowing additional text and data entry within an Immediate mode or program line.
DELETE	deletes the character at the current cursor position.
ERASE	erases that portion of the line from the current cursor position to the end of the line.
BEGIN	moves the cursor to the beginning of the current text line.
END	moves the cursor to the end of the current text line.
↑	moves the cursor up to the previous CRT line (when the current text occupies more than one line on the CRT).
↓	moves the cursor down to the next line on the CRT (current text must occupy more than one line on the CRT).

The RESET key is located to the left of the Special Function keys. RESET immediately stops the current operation (program execution, listing or I/O operations), clears the CRT, returns the cursor to its home position at the top left of the display, displays a READY message and returns control to the console user (Console Input mode). Use the RESET key to terminate program execution only as a last resort. RESET is also used during Master Initialization and execution of the hardware diagnostics.

CHAPTER 3
MASTER INITIALIZING THE SYSTEM

3.1 MASTER INITIALIZATION

Master Initialization is the process of turning on all components of the system, loading the operating system and BASIC-2 interpreter, and exercising the CPU to determine if any malfunctions exist. In the 2200SVP, a small bootstrap ROM contains the only resident (hardwired) microcode. Neither user memory nor control memory contains any information when the system is simply powered on. Before any meaningful operations can be performed by the system, the operating system and BASIC-2 interpreter must be loaded from the diskette to control such processes as interpreting and executing the BASIC-2 text, overseeing variable and program storage in user memory, and controlling I/O.

The bootstrap performs the functions of loading the operating system. Its routines are invoked automatically whenever the system is powered on. Essentially, the operator's only responsibilities are to ensure that the system diskette is properly mounted in the diskette drive, and to instruct the bootstrap routine, via the Special Function keys and the RESET key, which disk address to access and which system program(s) to load.

3.2 WHEN MASTER INITIALIZATION IS REQUIRED

User memory and control memory are cleared when the system is powered off. Therefore, the system must be master initialized following any power-off operation. In general, the system is powered off at the end of the working day, and must be master initialized only once at the start of the next working day. In rare instances, it may be necessary to power off and master initialize to recover from an error condition. Always save any desired programs or data currently in memory on a diskette prior to powering off the system.

Because control memory and user memory are separate, it is possible to clear user memory without affecting control memory. This can be done by pressing the CLEAR key. It is *not* necessary to master initialize the system following execution of a Clear command, because the contents of control memory are not destroyed.

3.3 MASTER INITIALIZATION PROCESS

To master initialize the 2200SVP, perform the following steps.

1. Verify that the 2200SVP, CRT, and printers are properly connected and attached to a source of electrical power.
2. Power on the system. (Always power on the system prior to mounting the system diskette.)
3. Mount the system diskette.
4. Use the RESET and Special Function keys to instruct the bootstrap to load the operating system and BASIC-2 interpreter from the system diskette into control memory. (The bootstrap routines automatically check to determine that the disk is ready and the file exists on the mounted platter, verify control and data memory parity, perform disk cyclic redundancy check (CRC) and longitudinal redundancy check (LRC) checksums, and pass control to the system software once it is loaded in the control memory.)

The following paragraphs describe in detail each of these procedures.

Power On

To power up the system, first turn the CPU's POWER switch on. The diskette drive and the optional drives are automatically powered on when the 2200SVP CPU is powered on. Then turn on the CRT and printers. As soon as it warms up (15 seconds), the CRT displays a self-identification message similar to the following.

2236DE R01 19200BPS 8+O (USA)

where:

2236DE	is the model number
R01	is the revision number of terminal firmware, preceded by R
19200BPS	is the data rate, followed by BPS
8+O	is the number of data bits (7 or 8); E is even parity, O is odd parity, N is no parity
(USA)	is the version of the keyboard and CRT character set, enclosed in parentheses

Press the RESET key. The following message should then appear on the CRT display:

MOUNT SYSTEM PLATTER
PRESS RESET

If this display does not occur, or if only the first part of its message appears, the system diagnostics have detected an error. Try master initializing the system again. If Master Initialization fails, refer to "Master Initialization Error Recovery" in Section 5.1. If recovery is not possible through these procedures, call your Wang Service Representative.

Mounting the System Platter

To mount the system platter, perform the following steps.

1. Remove the system platter from its envelope, and check to ensure that the platter moves freely in the jacket and the write-protect notch in the diskette jacket is *uncovered* (refer to Figure 3-1). When the notch is uncovered, information cannot be written on the disk, and it is therefore protected against accidental destruction.

Write Enabled Write Disabled

Figure 3-1. The Write-Protect Feature on a DSDD Diskette

2. Open the door of a diskette drive by pressing in the door latch button immediately to the left of the door (refer to Figure 3-2). The door will spring open.
3. Insert the diskette into the drive, paying careful attention to the arrows on the diskette jacket which indicate the proper orientation of the diskette for insertion (refer to Figure 2-3). If the diskette is not mounted properly, an error will be signalled when the system attempts to read from it. Push the diskette into the drive slot until it catches and holds in the slot.

CAUTION

Once the diskette catches in the slot, *do not* attempt to remove it diskette manually; this can result in serious damage to the drive and to the diskette. To remove the diskette, close the door until it latches, then press the release button to eject the diskette. As a safety feature, the front access door of the DSDD diskette drive cannot be opened when a diskette is installed in the drive and the heads are being loaded or are engaged. This door remains locked for five seconds after a diskette has been accessed by the system (for example, through a LIST DC command). Pressing the RESET key following such a command overrides this delay and permits immediate diskette removal.

4. Close the drive door by sliding it to the left until it locks in place. Every time a disk access operation is performed, the Disk Access Indicator Lamp (refer to Figure 3-2) is lighted.

5. After the system loading procedure is complete (refer to Figure 3-2), remove the system platter by pressing the drive door latch. The door will spring open, and the diskette will eject about halfway out of the drive slot.

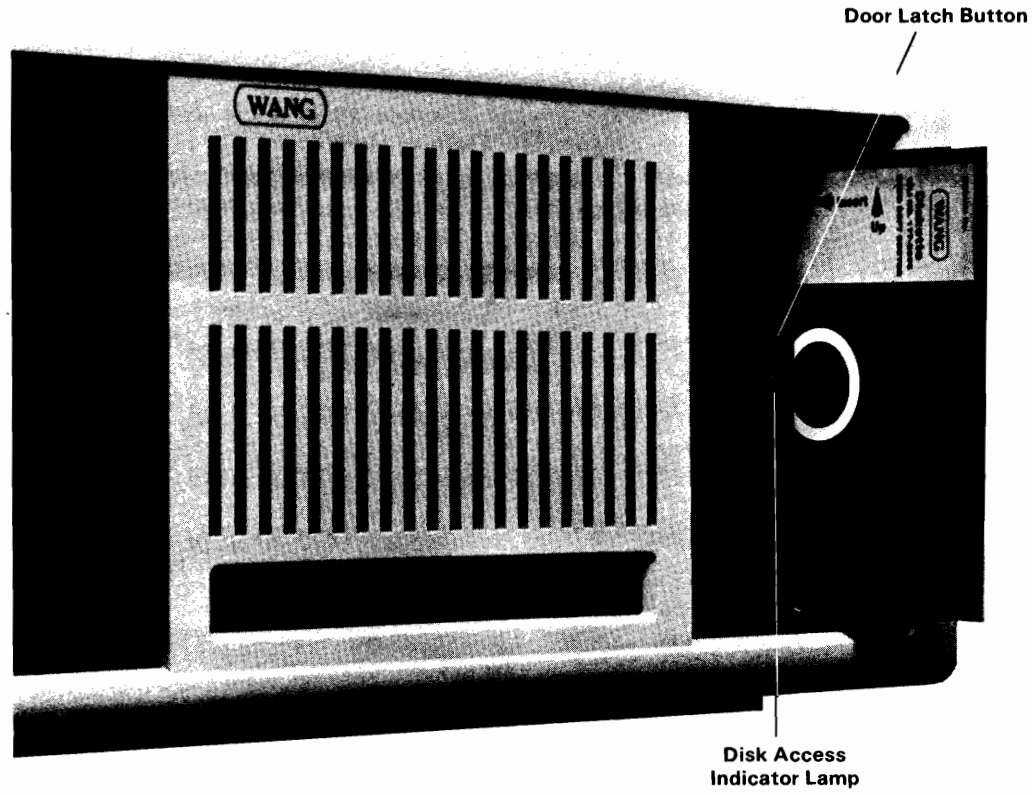

Figure 3-2. Loading and Removing a Diskette

Loading the System Programs

The system platter contains the BASIC-2 interpreter and operating system, as well as a variety of hardware diagnostics that can be loaded using the Special Function keys during Master Initialization. The use of the diagnostics is discussed in Chapter 4.

When the system platter is properly mounted, press the RESET key. The following prompt is displayed.

KEY SF' ?

A Special Function key must be pressed to specify the disk address where the system files are located. (The Special Function keys are arrayed across the top of the keyboard; refer to Section 2.3.)

Normally, if the system contains only the standard removable DSDD diskette drive, it is installed in the rightmost slot and assigned the default address D10 (or B10). A second DSDD drive is installed in the leftmost slot and assigned the default address D11 (or 310). If the system is equipped with the optional fixed disk, the fixed disk is installed in the leftmost slot and assigned the default address D11 (or 310); the standard DSDD diskette drive in this case is installed in the rightmost slot at address D10 (or B10).

The following options are available.

SF key '0 = Load BASIC-2 from disk address D11 (or 310)
SF key '1 = Load BASIC-2 from disk address D10 (or B10)

NOTE

Under no circumstances attempt to change the disk default addresses. Default addresses other than D11 (or 310) or D10 (or B10) are possible, but must be set by a Wang Service Representative. In this event, the address of the system diskette is accessed via the following Special Function keys.

SF key '2
= Load BASIC-2 from disk address D21 (or 320)
SF key '3
= Load BASIC-2 from disk address D20 (or B20)
SF key '4
= Load BASIC-2 from disk address D31 (or 330)
SF key '5
= Load BASIC-2 from disk address D30 (or B30)

After the operator presses the appropriate Special Function key, it takes about 10 seconds for the BASIC-2 interpreter and operating system to be loaded into control memory. While they are loading, the following message will appear.

```
Loading: VP BASIC-2 Release X.X
```

where X.X is the number of the release being used

When the loading operation is complete, the system displays the following message.

```
READY (BASIC-2)
:_
```

The system is now ready for use.

If the wrong Special Function key is pressed (for example, if the system disk is mounted at address D11, but the operator presses Special Function key 1, an error message is displayed of the form:

```
*** SYSTEM ERROR DISK 00XX ***
PRESS RESET
```

To recover, simply press RESET, then the correct Special Function key. If this does not work, turn the system off then on again, and repeat the Master Initialization process.

3.4 PREPARATION OF DSDD DISKETTES

The recording surface of a DSDD diskette is divided into 149 double-density tracks. Each track is divided into 26 sectors yielding a total of 3,874 sectors, numbered from 0 to 3,873. Each of these sectors can store 256 bytes of data or program text and control information.

In addition to 149 double-density tracks, there is one single-density track whose 26 sectors each contain only 128 bytes of storage. The purpose of this track is to allow for IBM 3741 compatibility. For more information on this feature, refer to Appendix G.

Formatting a Diskette

As indicated on the permanent label attached to each diskette, a diskette is protected from accidental over-writing when the write-protect notch is uncovered (refer to Figure 3-1). Before programs or data can be written on a diskette, the notch must be covered to disable the write-protect feature. (Adhesive tabs are provided with the diskettes for this purpose.)

A blank, unused diskette must be formatted before it can be used to store the first program or data file. During formatting, the system writes a header, as well as 256 bytes of data into every sector location. Normal writing does not rewrite the header, but uses it to assure reliable positioning of the data.

Once formatted, a diskette is not formatted again before storing additional files. Formatting destroys any information previously recorded on the diskette. Hence, diskettes containing packaged programs, and especially the system diskette, should never be formatted.

Diskette formatting is accomplished either by using the $FORMAT DISK command in the BASIC-2 language or by running the Wang-supplied @FORMAT utility (refer to Appendix F) from the system diskette. To format a diskette using $FORMAT DISK, follow these steps:

1. Remove the diskette from its envelope. Check the write-protect notch; it must be covered.

2. Properly position the diskette (as indicated by arrows on the label) before inserting it into the diskette drive. Be sure the diskette is firmly seated in the drive. Then close the drive latch.

3. Press the RESET button on the keyboard.

4. To initiate diskette formatting use the $FORMAT DISK command. The general form of the $FORMAT DISK command is:

   $FORMAT DISK platter [file # / disk-address]

   Address D10 (or B10) is given a DSDD diskette unit and address D11 (or 310) is given the fixed drive, unless two diskettes are configured. In this case, address D11 (or 310) is given to the left drive, and D10 (or B10) to the right drive. Refer to the *Wang BASIC-2 Disk Reference Manual* for more information on platter specification and file numbering.

   Examples of valid syntax:

```
10 $FORMAT DISK T/D10
20 $FORMAT DISK T/D11
```

NOTE

Formatting a diskette overwrites all data previously stored on the platter. To prevent accidentally formatting the wrong diskette, it is recommended that the Wang-supplied format utility (@FORMAT) be used (refer to Appendix F).

5. If formatting is unsuccessful, a format error (ERR 193) is returned. Generally, format errors result from three causes:

   a. The drive latch is not tightly closed.
   b. The write-protect notch is not covered.
   c. The diskette is defective.

6. Remove the diskette from the drive and proceed to format another.

> **NOTE**
>
> If a diskette cannot be formatted, it cannot be used for storage and should be discarded.

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

Disk I/O Instructions

When a diskette or disk has been formatted and contains the necessary sector identification information, it is ready to be used for storing data and programs. Files can be maintained on dual-sided, double-density diskettes in one or both of the following two modes.

- Automatic File Cataloging — An indirect method 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 specific location on the disk.

- Absolute Sector Addressing — A direct method in which the address of each sector to be accessed must be provided explicitly by the programmer.

Under Automatic File Cataloging, the operating system maintains a catalog on each diskette 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. When 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 diskette. Only the file names need be remembered, or a LIST DC statement can be used to obtain the names of existing files. Absolute Sector Addressing statements permit the programmer to directly access specified sectors on the disk, and to read or write information in a user-specified format. Refer to the *Wang BASIC-2 Disk Reference Manual* for detailed information on both modes of disk file maintenance. The Automatic File Cataloging mode is the recommended cataloging method; it is used by most Wang software for maintaining data files.

Defining a Catalog Index

Before the *first* program or data file can be stored on a diskette in Catalog mode, the user must create a catalog on the diskette. The process of creating a catalog is called "scratching" the diskette, because the SCRATCH DISK statement is used to perform the operation. Care must be taken not to scratch a diskette containing packaged programs or desired files since a SCRATCH DISK statement overwrites a previous catalog index.

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 diskette (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 diskette.

The size of the Catalog Index is defined with the LS parameter in a SCRATCH DISK statement. For example, 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, END = 3873 indicates that sector 3873 (the last accessible sector on a DSDD diskette, containing a total of 3874 sectors numbered from 0 through 3873) is the last sector to be used for the Catalog Area.

To scratch a diskette, perform the following steps.

1. Insert a formatted diskette in the diskette drive.

2. Enter a statement such as:

   SCRATCH DISK T/D10, LS = 25, END = 3873

   and press the RETURN key. Here, LS = 25 specifies that 25 sectors be reserved for the Catalog Index; END = 3873 specifies that sector 3873 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. (Refer to the *Wang BASIC-2 Disk Reference Manual* for more information.)

3. Repeat Steps 1 and 2 for any other diskette that must be scratched.

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

NOTE

A LIST DC T [/disk address] statement can be used to check the size of the Catalog Index. Entering the statement LIST DC T/D10 after scratching disk D10 in the manner shown above would cause the following to be displayed on the CRT.

```
INDEX SECTORS = 00025
END CAT. AREA  = 03873
CURRENT END    = 00024
```

3.5 USING THE OPTIONAL FIXED DRIVE

The fixed, Winchester-style disk drive is available to the 2200SVP in 2- or 4-megabyte storage capacities. The recording surface of a 2-megabyte disk contains 254 tracks, each containing 32 sectors. Its total 8,128 sectors are numbered 0 to 8,127. The recording surface of a 4-megabyte disk contains 510 tracks, each containing 32 sectors. Its total 16,320 sectors are numbered 0 to 16,319.

When installed, the fixed disk usually is assigned default address D11 (or 310), and the standard DSDD removable diskette is relegated to address D10 (or B10).

The fixed-disk unit is automatically powered on when the 2200SVP is powered on.

Formatting a Disk

Disk formatting is accomplished either by using the $FORMAT DISK command outlined in Section 3.4 or by running the Wang-supplied Format utility (@FORMAT) described in Appendix F. The general form of the $FORMAT DISK command is:

$FORMAT DISK platter [file # / disk address]

Refer to the *Wang BASIC-2 Disk Reference Manual* for information on file numbering and the platter specification.

NOTE

Formatting a disk platter overwrites all data previously stored on the platter. To prevent the accidental formatting of the wrong disk platter, it is recommended that the Wang-supplied Format utility (@FORMAT) be used (refer to Appendix F).

Defining a Catalog Index

The fixed disk unit supports both Automatic File Cataloging and Absolute Sector Addressing to control disk operations. (Refer to "Disk I/O Operations" in Section 3.4.) The Automatic File Cataloging mode is the recommended method for maintaining data files on the fixed disk.

The process of creating a catalog on the fixed disk is identical to that of creating a catalog on the DSDD diskette. Refer to "Defining a Catalog Index" in Section 3.4 for a description of creating a disk catalog. Note that the ending sector of the 2-megabyte fixed disk is 8127 and the ending sector of the 4-megabyte fixed disk is 16319.

CHAPTER 4
OPERATING THE 2200SVP

4.1 INTRODUCTION

The 2200SVP is a versatile system which uses the powerful Wang BASIC-2 language to process program data and to display immediate results of operator-entered calculator functions. BASIC-2 is an interactive programming language which uses many English words (such as PRINT, READ, and STOP). Although such words are given a special and clearly defined meaning when used in a BASIC-2 program, their usage and meaning is similar to that of commonly used English, thus reducing learning time for beginning programmers.

This chapter introduces the user to operation of the 2200SVP, including running preprogrammed software modules, using the 2200SVP in Immediate mode as a calculator, and entering, running, and saving programs in Program mode. Detailed information about the BASIC-2 instruction set is covered in the *Wang BASIC-2 Language Reference Manual*. Programming techniques are discussed in detail in *Programming in BASIC*.

4.2 RUNNING SOFTWARE PACKAGES

Loading the Starting Module

Preprogrammed software packages can be run easily on the 2200SVP. First, insert the program diskette in the DSDD drive. Most Wang-developed software packages contain starting modules named START. Check the manual supplied with your software package for the required module name.

When software packages contain the file START, enter the following command.

LOAD RUN (RETURN)

This will clear memory, load the program called "START" and begin program execution.

If the software package does not contain a program module named START, enter the following command.

LOAD RUN T [/disk address], "xxxxx" (RETURN)

where "xxxxx" is the name of the starting module.

Entering Data

During program execution, operator prompts usually appear on the CRT. Remember the following facts when responding to these prompts.

1. A displayed question mark usually indicates that the system expects a keyboard entry.

2. If a numeric value is requested, the system permits a maximum of 13 digits, a decimal point, a sign, and a signed 2-digit exponent to be entered. (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 system-acceptable numeric entries are:

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

3. If an alphanumeric response is requested, the system accepts any keyboard characters except for some sequences containing commas and double quotes. (Refer to INPUT statement in the *Wang BASIC-2 Language Reference Manual*.) Most software packages remove the restrictions imposed by the INPUT statement by using the KEYIN statement.

4. The Edit mode keys may be used to correct a response before entering a response to a prompt (refer to Section 2.3).

5. When a response has been typed in and appears on the screen in the desired form, press the RETURN key to enter the response and terminate keyboard entry.

6. After a response is entered, the system may signal an error condition with a message in the form of ERR Yxx; where Y represents a letter prefix of the error class, and xx represents the error number (refer to Section 5.1 for a discussion of system execution error messages). The question mark will reappear on the screen. This indicates that the entered response was not acceptable to the system. To continue, check the form of the response and enter another.

4.3 USING THE 2200SVP IN IMMEDIATE MODE

The 2200SVP can perform calculator functions when a BASIC-2 statement is entered without a preceding line number. When such a statement is entered and executed, the SVP is said to be in Immediate mode. To perform quick calculations, a user can enter unnumbered single- or multiple-statement lines in Immediate mode, using the PRINT statement to display the results. If the system detects no syntax errors, it executes an Immediate mode statement immediately when the operator presses the RETURN key. For example:

```
:PRINT 25+273 (RETURN)
298
```

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

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

```
:PRINT 3+8: PRINT 15/9: PRINT 144/4.2
```

Upon execution, the following is displayed on the screen.

```
11
1.666666666667
34.28571428571
```

The Special Function keys along the top of the 2236DE terminal can be used to edit an Immediate mode statement. To activate the editing capabilities of these keys, first press the EDIT key, located in the top right corner of the terminal keyboard. For example, pressing the EDIT key then pressing the RECALL key will cause the most recently entered Immediate mode statement to appear on the screen where it can be edited and reexecuted. The capabilities of these keys are explained in Table 2-1.

Arithmetic Operations

The 2200SVP can operate on numeric quantities as large as 10^{100} and as close to zero as 10^{-99}. The quantities may be positive or negative. Quantities within this range can be represented by a maximum of 13 digits, a decimal point and sign, and a two-digit positive or negative integer exponent. The letter E in a quantity means "times ten raised to the power of." For instance, 2.22E9 is used to represent 2.22×10^{9}.

The arithmetic symbols, or operators, of BASIC are:

+	addition
-	subtraction
*	multiplication
/	division (5/4 reads "5 divided by 4")
↑	exponentiation (5↑4 reads "5 raised to the 4th power")

In an expression, any number of variables and constants can be linked together by arithmetic symbols. Some simple expressions using arithmetic symbols are underlined below:

```
PRINT 12/7
PRINT 23*110000*32.1*4
PRINT 63/22.5E4
PRINT 4↑23
```

Expressions using the same arithmetic operators are evaluated left to right. For expressions with mixed arithmetic operators, the following priorities of evaluation are observed.

First, all exponentiation (↑) is performed (left to right).
Second, all multiplication and division is performed (left to right).
Third, all addition and subtraction is performed (left to right).

Not all combinations of constants and variables connected by arithmetic operators are valid expressions. For an expression to be valid, it must be capable of being evaluated in the stipulated sequence. This means that at each state of evaluation the operation to be performed must be defined for the given values, and must yield a valid numeric quantity. For example, the following expressions are invalid for the reasons shown.

Expression	Invalid Because
(3.4E26↑4)/9.7E17	(3.4E26↑4) yields an invalid numeric quantity greater than 10^{100}
17/((4*5)-20)	After evaluating ((4*5)-20), the system attempts to divide 17 by 0, an undefined operation.
(-3)↑3.5	The exponentiation (↑) operation is undefined for non-real results

If the result of evaluation, an expression, or a portion of an expression, yields a quantity Q in the range -10^{-99} to 10^{-99}, the value of Q is zero.

BASIC-2 Functions

A BASIC-2 function is a special type of instruction that accepts a given value as an argument and returns a unique value as a result. The result of a function can be displayed in Immediate mode if the function is included in a PRINT statement. PRINT SQR(55), for instance, prints the square root of 55.

Some BASIC-2 functions that may be useful in Immediate mode are as follows.

ARCCOS	Returns the arccosine of an expression.
ARCSIN	Returns the arcsine of an expression.
ARCTAN (or ATN)	Returns the arctangent of an expression.
EXP	Finds the value of "e" raised to the value of the expression.
LOG	Returns the natural logarithm of an expression.
SIN	Returns the sine of an expression.
SQR	Finds the square root of an expression.
TAN	Returns the tangent of an expression.

Other BASIC-2 functions and keywords are explained in detail in the *Wang BASIC-2 Language Reference Manual.*

Numeric Variables

When used in Immediate mode, the 2200SVP can assign values to variables and perform operations on those variables. A numeric variable in BASIC-2 is designated by a letter of the alphabet A, B, C . . . Z, or a letter followed by a single digit (A0, A1 , A2 . . . A9, B0, B1 . . . B9, C0, C1 . . . Z7, Z8, Z9.) The letters in variable designations must be uppercase. Variables such as A and A0 are distinct. There are 286 numeric variables available for use in BASIC-2. A numeric variable may be assigned any legal numeric value.

Variables retain their values until they are explicitly cleared from memory or assigned new values. The commands CLEAR, RUN, and LOAD RUN are some of the commands that cause variables to be cleared from memory.

Care should be taken when assigning values to variables in Immediate mode since Immediate mode commands can change the values stored in variables created by a program. Immediate mode operations involving variables should be performed only at times when it is known that changing the values stored in the program-created variables will cause no harm. When running a program written by someone else, it is best to refrain from performing Immediate mode calculations that involve variables, unless the author of the program has specifically documented that Immediate mode operations will not adversely affect the operation of his program.

For further information on BASIC-2 variables, refer to the *Wang BASIC-2 Language Reference Manual* or *Programming in BASIC.*

4.4 A SIMPLE PROGRAM

It is not difficult to program using BASIC-2 on the 2200SVP. The simple syntactical rules and most frequently used commands can be learned very quickly from reading *Programming in BASIC.* With this knowledge, even a beginner can write simple, functional programs. Further reading and practice will provide facility with the more advanced BASIC-2 commands and features. The *Wang BASIC-2 Language Reference Manual,* the prime source of the wide variety of commands, functions, and statements to which the 2200SVP will respond, discusses the many BASIC-2 programming features which can make programs more powerful and efficient.

This section discusses how to enter and run a simple program, list it on the CRT screen and printer, save it on disk, retrieve it from disk and modify it, and resave it on disk.

An Adding Machine Program

A program is a set of instructions enabling a computer to receive data, manipulate it, and return it to the operator in a desired form. The following program has been written to make the system function as a simple calculator: when the program is executing, the user will enter two numbers on the keyboard and indicate the operation to be performed upon them. The system will display the answer on the CRT screen.

A program line is entered by typing in a line number, followed by one or more BASIC-2 statements and their operands. Each line is terminated by pressing the RETURN key. When the RETURN key is pressed, the entire line is saved in memory.

It is customary to number program lines in multiples of ten; this enables a programmer to insert new lines between existing lines by assigning the new line an intermediate statement number. When the operator enters such a line on the keyboard, the computer will place it in its proper place in the program. The computer normally will execute these statements in sequential order, though several BASIC-2 statements allow the operator to change the order of execution.

Type in the following program on the keyboard, pressing the RETURN key after each line is entered.

```
10 DIM A$1
20 INPUT "WHAT TYPE OF OPERATION (+,-,X,/) DO YOU WANT TO PERFORM", A$
30 INPUT "ENTER FIRST NUMBER", A
40 PRINT A; A$; " ";
50 INPUT B
60 IF A$ = "+" THEN GOTO 170
70 IF A$ = "-" THEN GOTO 180
80 IF A$ = "X" THEN GOTO 190
90 IF A$ = "/" THEN GOTO 200
100 GOTO 20
110 PRINT A; A$; B; " EQUALS "; C
120 INPUT "DO YOU WANT ANOTHER OPERATION", B$
130 IF STR(B$,1,1)="Y" THEN 20
140 IF STR(B$,1,1)="N" THEN 160
150 GOTO 120
160 END
170 REM ADDITION: C=A+B: GOTO 110
180 REM SUBTRACTION: C=A-B: GOTO 110
190 REM MULTIPLICATION: C=A*B: GOTO 110
200 REM DIVISION: IF B < > 0 THEN 220
210 PRINT "DIVISION BY ZERO IS AN ILLEGAL OPERATION. START AGAIN PLEASE": GOTO 20
220 C=A/B: GOTO 110
```

Listing the Program

To review the program entered in memory, use the LIST command. Enter:

```
LIST
```

This will list the entire program on the CRT. The LIST S command lists the program a screen at a time; the operator must press the RETURN key when ready to review each subsequent screen. LIST [line number] lists the specified line only; LIST 10, for example, lists only Line 10.

To obtain a hard copy listing of the program on a printer, turn on and manually select the printer (press its SELECT switch). (When the printer is selected, its SELECT switch indicator lamp is illuminated.) Then, enter the following statement from the keyboard to select the printer for listing.

```
SELECT LIST 215
```

This statement changes the default output address for the I/O class parameter LIST from the primary address 005 (the CRT) to the address 215 (the system printer). Next, enter LIST and press the RETURN key. Program listings formerly displayed on the CRT are now listed on the printer. To again obtain program listings on the CRT, enter the following statement.

```
SELECT LIST 005
```

If a local printer is attached to the rear of the Model 2236DE Interactive Terminal, it may be accessed at Address 204. Further discussion of the SELECT statement and its various parameters can be found in the *Wang BASIC-2 Language Reference Manual* and in the individual printer manuals.

Running the Program

Once the program is saved in memory, it can be executed by pressing the RUN key. When the RUN key is pressed, the screen will display the following.

WHAT TYPE OF OPERATION (+,-,X,/) DO YOU WANT TO PERFORM?

As an example, enter +. The screen will display the following.

ENTER FIRST NUMBER?

Enter 25. The following will be displayed.

25 + ?

Enter 75. The following appears on the screen.

25 + 75 EQUALS 100
DO YOU WANT ANOTHER OPERATION?

Enter YES. The program will once again ask, WHAT TYPE OF OPERATION (+,-,X,/) DO YOU WANT TO PERFORM?

The program has been designed to recognize an attempt to divide by zero. Enter /. When the screen displays ENTER FIRST NUMBER?, type in 100. The following appears on the screen.

100 / ?

Enter 0. The screen will display the following.

DIVISION BY ZERO IS AN ILLEGAL OPERATION. START AGAIN PLEASE
WHAT TYPE OF OPERATION (+,-,X,/) DO YOU WANT TO PERFORM?

The program will continue processing until the user enters NO or N to the question, DO YOU WANT ANOTHER OPERATION?

Explanation of the Program

The adding machine program instructs the computer how and where to store information entered by the operator or produced by processing, send prompts to the operator on the CRT screen, accept operator input from the keyboard, process entered data according to a defined formula, and display results on the screen. The following section examines the program line by line and discusses the use and purpose of each BASIC-2 command.

Line 10:

10 DIM A$1

The DIM statement in Line 10 is a dimension statement, limiting the length of the information which can be stored in variable A$. The only reason the program includes this statement is to guarantee that, if an operator entered an inappropriate response such as '++++++++' to the question,

WHAT TYPE OF OPERATION (+,-,X,/) DO YOU WANT TO PERFORM?, the adding machine program would not generate a prompt on the screen such as the following.

```
44 ++++++++ ?
```

Because of the dimension statement, the system will cut off the six extra plus signs and store a variable of one character only in length. As a result, the screen shows the following.

```
44 + ?
```

There are many other uses of the DIM statement. Refer to Chapter 8 of *Programming in BASIC* and Chapters 1 and 11 of the *Wang BASIC-2 Language Reference Manual* for more information on the DIM statement.

Lines 20 and 30:

```
20 INPUT "WHAT TYPE OF OPERATION (+,-,X,/) DO YOU WANT TO PERFORM",A$
30 INPUT "ENTER FIRST NUMBER",A
```

The INPUT statements in Lines 20 and 30 are the computer's way of receiving information from an operator. The computer stores the information entered by the operator in variables, such as A$ and A in this program. A$ is called an alphanumeric variable. Alphanumeric variable names can be distinguished from numeric variable names by the presence of a dollar sign ($) immediately following the variable name. Alphanumeric variables may contain any kind of character: letters, digits, or special characters, but may not be used in mathematical computations, because they do not necessarily contain numbers. A$ in this program is used to store the character +, -, X, or /. (Refer to Chapter 1 of the *Wang BASIC-2 Language Reference Manual* for more information on variables.)

The phrase in quotes is called a literal; here it is used as a prompt to the operator to enter the first number of the arithmetical operation. The INPUT statement automatically displays a question mark following the prompt. BASIC-2 does not require the literal in the INPUT statement. If the literal is omitted, the INPUT statement simply displays a question mark. A lone question mark is of little use to an operator who does not know the program, so it is a good idea to always provide prompts for the operator. The literal in the INPUT statement is one means of doing this.

Refer to Chapter 3 of *Programming in BASIC* and Chapter 11 of the *Wang BASIC-2 Language Reference Manual* for more information on the INPUT statement.

Lines 40 and 50:

```
40 PRINT A; A$; " ";
50 INPUT B
```

The PRINT statement causes values and literals to appear on the CRT screen. Additionally, its punctuation can determine the spacing of the printed material. A comma will cause elements to be displayed in zones, each 16 characters wide. This is ideal for charts, where figures must be arranged in columns and rows, but it is not convenient for this program. A semicolon is used in this program, because it causes no additional spaces to be placed between printed elements.

In Line 40, the PRINT statement instructs the computer to display on the screen the current value of variables A and A$. As in the INPUT statement, literals (those characters and phrases contained in quotation marks) are displayed on the screen as written in the program line, even if the literal is a blank space as in Line 40.

Refer to Chapter 3 of *Programming in BASIC* and Chapter 11 of the *Wang BASIC-2 Language Reference Manual* for more information on the PRINT statement.

The INPUT statement in Line 50, an example of an INPUT statement not containing a literal, causes the question mark to appear on the screen. For example, when the program is run as in the "Running the Program" section above, 25 + ? appears. 25 is the value of A, and + is the value of A$. The space after the addition sign results from the coding of the literal space, " ", in Line 40. The question mark results from the INPUT statement and is placed immediately after the literal space due to the semicolon in Line 40.

Lines 60-90:

```
60 IF A$ = "+" THEN GOTO 170
70 IF A$ = "-" THEN GOTO 200
80 IF A$ = "X" THEN GOTO 210
90 IF A$ = "/" THEN GOTO 220
```

It is not always desirable to have the computer execute program instructions in statement number sequence. Two ways of altering the sequence of program execution are demonstrated in the adding machine program. Lines 60, 70, 80, and 90 use the IF ... THEN statement to cause execution to be diverted to the portion of the program which handles the appropriate arithmetic operation specified in variable A$. Another statement, the GOTO statement, is used later in the program to redirect the order of program execution.

Lines 60, 70, 80, and 90 test the value entered for the alphanumeric variable, A$; that is, they determine what operation the user wishes to perform on the values assigned to variables A and B. This test enables the the computer to branch to a special routine for each operation. In this routine, it computes the solution of the operation, store it in a variable, and return it to be processed in Line 110 for display upon the screen. When A$ has a value of +, the program will go to the addition routine at Line 170. When A$ has a value of -, the program will go to the subtraction routine at Line 180. When A$ has a value of X, the program will go to the multiplication routine at Line 190. When A$ has a value of /, the program will go to the division routine at Line 200.

Refer to Chapter 3 of *Programming in BASIC* and Chapter 11 of the *Wang BASIC-2 Language Reference Manual* for more information on the GOTO statement.

Line 100:

```
100 GOTO 20
```

If the user enters any value other than +, -, X, or / for A$. The computer will "fall through" statements 60, 70, 80, and 90 to Line 100, where the GOTO statement will send the program back to Line 20. This GOTO statement ensures that an operational symbol has been entered.

Lines 170-190:

```
170 REM ADDITION: C=A+B: GOTO 110
180 REM SUBTRACTION: C=A-B: GOTO 110
190 REM MULTIPLICATION: C=A*B: GOTO 110
```

These three lines are examples of multistatement lines. In each, three short statements are grouped together, separated by colons. This is done to keep the program from growing too large and to aid in program clarity. The purpose of the REM statement is to document the program. Here, REM ADDITION labels the portion of the program which computes addition problems. A REM statement is a nonexecutable statement ignored by the computer when the program is run, but displayed whenever a program is listed.

Refer to Chapter 3 of *Programming in BASIC* and Chapter 11 of the *Wang BASIC-2 Language Reference Manual* for more information on the REM statement.

Lines 200-220:

```
200 REM DIVISION: IF B < > 0 THEN 220
210 PRINT "DIVISION BY ZERO IS AN ILLEGAL OPERATION. START AGAIN PLEASE":
    GOTO 20
220 C=A/B: GOTO 110
```

The division routine is given three lines to ensure that an operator does not enter zero as a divisor. If Lines 200 and 210 did not exist, the computer would cause a Computational error (C62 or C63) to appear on the screen and the program would immediately terminate.

The IF ... THEN statement is another way by which the programmer can instruct the program to process statements out of sequence. Here, Line 200 tests to determine whether the divisor, B, is greater than or less than zero. If the divisor is not zero, this statement is true, and the program skips to Line 220, where the program computes the quotient and is sent back to Line 110 to display it. If the divisor is zero, this statement is false, and the program will fall through to Line 210, the message will be displayed, and control is sent back to Line 20. Thus, the division computation is not performed.

Refer to Chapter 3 of *Programming in BASIC* and Chapter 11 of the *Wang BASIC-2 Language Reference Manual* for more information on the IF ... THEN statement.

Line 110:

```
110 PRINT A; A$; B; "EQUALS "; C
```

In Line 110, as in Line 40, variable values and a literal are included in a PRINT statement. Here, there are three numeric variables (A, B, and C), an alphanumeric (A$), and a literal ("EQUALS").

Line 120:

```
120 INPUT "DO YOU WANT ANOTHER OPERATION", B$
```

Line 120 requests a value for alphanumeric variable B$.

Lines 130-160:

```
130 IF STR(B$,1,1) = "Y" THEN 20
140 IF STR(B$,1,1) = "N" THEN 160
150 GOTO 120
160 END
```

Lines 130 and 140 introduce another function of which BASIC-2 is capable: that is, isolating a particular character from an alphanumeric string. In this case, the program examines the value of the first character in variable B$ for the character "Y" or the character "N". By examining the first character of the string instead of every character, Lines 130 and 140 enable the user to continue the program by entering the abbreviated answer Y or N as well as the answer YES or NO to the question asked in Line 120.

In short, Line 130 means: if the 1st character from the 1st character of alphanumeric variable B$ is equal to Y, then go to Line 20. If the operator enters Y or YES (or, because of first character isolation, any word beginning with Y), the first character will be Y, and will send the program back to Line 20. A similar logic is exhibited in Line 140. In this case, if the first character of the response is N, the program is sent to statement 160, an END statement. This causes the program to end.

However, if the first character of B$ is other than Y or N, the program will fall through to Line 150. There, the program will be sent back to Line 120. This procedure guarantees that the operator responds correctly, at least insofar as the first character of the response is either Y or N.

Refer to Chapter 5 of the *Wang BASIC-2 Language Reference Manual* for more information on the STR function.

Saving the Program on Diskette

To save the program on the system diskette drive, load a new diskette into the diskette slot, format it, and establish a catalog as detailed in Chapter 3 of this manual. Enter the command:

```
SAVE T/D10, "ADDING"
```

Then enter the command, LIST DCT/D10. The following will appear on the screen.

```
INDEX SECTORS = 00030
END CAT. AREA  = 03873
CURRENT END    = 00029

NAME     TYPE  START END    USED   FREE
ADDING     P   00029 00033  00005  00000
```

Listing the Catalog index ensures that the program you saved is in fact contained on the disk.

Refer to the *Wang BASIC-2 Disk Reference Manual* for more information on saving programs on disk.

Retrieving the Program from Diskette

To retrieve the program from diskette, first type in the command, SELECT DISK /D10. The system will select the system diskette drive. Then type the following command:

LOAD RUN "ADDING"

The SELECT DISK /D10 command tells the system that the diskette drive is to be used for future disk statements and commands, until the system is commanded to select another disk. This command makes it possible to load and run the adding machine program with LOAD RUN "ADDING" instead of having to explicitly state what disk ADDING is on by typing LOAD RUN T/D10, "ADDING".

Modifying the Program

There are several ways in which the adding machine program can be improved. One of the program's major difficulties occurs when a user enters something other than +, -, X, or / in response to the request to enter the type of operation to be performed. If, for instance, someone entered 999 in response to WHAT TYPE OF OPERATION (+,-,X,/) DO YOU WANT TO PERFORM?, two things would occur. First, the last two nines are cut off, due to the DIM statement in Line 10. Second, when Line 40 is executed, 9 will actually appear in place of an operational sign on the CRT screen. The program will continue processing until it reaches Line 100. At that point, since the value of A$ is neither +, -, X, nor /, the program loops back to Line 20 to request the type of operation again.

The LINPUT statement is often used to avoid the first situation, the POS function can rectify the second.

First, replace Line 20 with

```
20 LINPUT "WHAT TYPE OF OPERATION (+,-,X,/) DO YOU WANT TO PERFORM"-A$
```

Then, insert Line 25:

```
25 IF POS("+-X/"=A$) = 0 THEN GOTO 20
```

Finally, delete Line 100 by typing

```
100
```

When this version of the program is run, the LINPUT statement in Line 20 causes an underscore to follow the prompt to enter the operational sign. The LINPUT statement also ensures that the operator enter only one character in response to this prompt. This solves the problem of someone entering more than one character.

The POS function locates the first character (left to right) in the literal "+-X/" that matches the first character stored in the variable A$. If the operator enters + for the variable A$, POS("+-X/"=A$) will equal 1, since + is in the first position of the character string in the POS function. Likewise, -, X, and / will equal 2, 3, and 4, respectively. A character other than one of these has no position in the character string and is equal to 0. If the operator enters such a character, the IF ... THEN statement in Line 25 will cause the program to go back immediately to Line 20 and request the operational sign to be entered again.

Refer to Chapter 11 of the *Wang BASIC-2 Language Reference Manual* for more information on the LINPUT statement. Refer to Chapter 5 of the *Wang BASIC-2 Language Reference Manual* for more information on the POS function.

Resaving the Modified Program

To resave the modified program, the old program must first be scratched by entering the following command.

```
SCRATCH T/D10, "ADDING"
```

Next, enter the following command.

```
SAVE T/D10, (  ) "ADDING"
```

This will copy the new version of the program called ADDING over the old version, saving it under the same name. Subsequently, when the command LOAD RUN "ADDING" is executed, the new version of the adding program will be loaded.

CHAPTER 5
SYSTEM ERRORS AND ERROR RECOVERIES

5.1 TYPES OF SYSTEM ERRORS

The 2200SVP CPU performs two types of system error diagnostics: the CPU hardware error diagnostics and the general system error diagnostics. General recovery procedures for errors are outlined in this chapter. If these procedures fail, try the more specific procedures discussed in Appendix D.

The CPU hardware error diagnostics detect and report any malfunction that occurs in the CPU hardware (registers, user and control memory, etc.). Whenever a location in memory is accessed, the system automatically performs a parity check to ensure that the accessed memory contents are valid, and that the accessed location is not faulty. Additionally, whenever a RESET or CLEAR command is executed, all memory is automatically verified, and the operator is alerted to any error condition. If a hardware error is discovered, a SYSTEM ERROR message is displayed. Although there are several courses of action, the hardware errors require some manually performed corrective procedures.

General error messages, by contrast, alert the user that an illegal operation has been attempted or that a desired operation cannot be carried out. Those general system errors which are not hardware related can be handled under program control in a user-application program. General error messages are signaled by a 2-digit number with a letter prefix accompanied by an arrow which points to the approximate location of the error in an Immediate mode or Program mode line. The types of general error diagnostics which are performed by the system, and the techniques for recovering from such errors are described in the *Wang BASIC-2 Language Reference Manual*.

Types of CPU Hardware Errors

There are several possible system error messages that can be reported either during Master Initialization or after, when the operating system is in control. These hardware errors cannot be handled under program control. Since they represent a malfunction in the system hardware which may or may not be transient, hardware errors cast doubt on the validity of any information supplied to or by the system after the point at which they occur. If they persist, such errors require the attention of a Wang Service Representative.

Master Initialization Error Recovery

The general procedure to recover from Master Initialization errors is outlined below. If these general procedures fail, call your Wang Service Representative.

1. When the power is turned on, the bootstrap fails to display the complete message MOUNT SYSTEM PLATTER [CR/LF] PRESS RESET on the CRT. This condition usually indicates a CPU- or I/O-related error. First, check the cabling and device addresses. Wait five seconds while the power is off, then power on the system again.

2. Having responded to KEY SF'? by pressing a Special Function key:

   a. The hexdigit display of the Special Function key does not appear on the CRT. This implies that the Special Function key was not pressed completely or the wrong key was pressed. Press RESET, then the desired Special Function key again.

   b. KEY SF'? reappears on the CRT. This error implies that the specified system file could not be located on the disk specified. Be sure that the system platter is properly mounted at the specified address and press the desired Special Function key again.

   c. ***SYSTEM ERROR DISK 00XX*** PRESS RESET appears on the CRT. This implies that an error occurred while the bootstrap was trying to load the disk file specified by the Special Function key. Be sure the platter is properly mounted and press RESET, then the desired Special Function key. If this procedure fails, see the list of disk errors in Appendix D for a more specific recovery procedure.

3. The CRT displays a SYSTEM ERROR message whenever the operating system detects disk, parity, or verify errors during its normal operation. A memory failure causes the following message to appear.

   *** SYSTEM ERROR MMMM XXXX ***
   PRESS RESET

   where: MMMM = AECM (Addressing Error Control Memory)
   AEDM (Addressing Error Data Memory)
   BECM (Bit Error Control Memory)
   BEDM (Bit Error Data Memory)
   PECM (Parity Error Control Memory)
   PEDM (Parity Error Data Memory)
   REDM (Read Error Data Memory)
   VECM (Verify Error Control Memory)
   VEDM (Verify Error Data Memory)

   XXXX = Location of Error

General Hardware Error Recovery

The general procedures used to recover from system errors in user and/or control memory are outlined below. When the general procedure outlined here fails, refer to Appendix D for more detailed recovery procedures. If these procedures fail or a system error condition is recurrent, call your Wang Service Representative.

Press RESET in response to PRESS RESET on Line 1 of the CRT. Then, choose one of the following three procedures in response to the KEY SF'? message on the CRT.

1. Press Special Function key '16, '17, '18, or '19 to load the diagnostic menu, from which a particular diagnostic can be chosen (refer to Section 4.2). This is the recommended procedure, but it should be used only when the current contents of user memory are reproducible. If the current contents of user memory cannot be reproduced, (i.e., they must be salvaged) follow the third procedure. If no errors are discovered during the execution of the diagnostics, the error condition can be presumed transient. Follow the second procedure. If an error is discovered by the diagnostic, or another failure occurs while attempting Procedure 2 or 3, call your Wang Service Representative.

2. Power off then on. Press Special Function key '0 or Special Function key '1 to load BASIC-2 from disk D11 (or 310) or D10 (or B10), respectively, in order to start over again. Use this option when there is no need to save the current contents of user memory. The system will return to Console Input mode and READY BASIC-2 appears on the screen. The previous contents of user memory are erased. This is the recommended procedure when the system validity has been compromised by an unknown system error, but the condition at fault is suspected to be temporary (e.g., the CPU was jarred or a cable was stepped on or shaken loose).

3. Press Special Function key '15 to resume normal operation, using the operating system and application program currently loaded. Use this option when the user memory contents cannot be duplicated, and must therefore be salvaged. The system will return to Console Input mode and READY BASIC-2 will appear on the screen. At this point, the user can determine where the program was when the system error was encountered (by printing out the key variables), since user memory will not have been erased. However, since a RESET has been performed, program execution cannot be continued. The program must be restarted with a Run command. This procedure is undertaken at the user's risk since the hardware error may recur and the operating system may not function properly. This procedure is not recommended.

5.2 USING THE HARDWARE DIAGNOSTICS

As with Master Initialization, the hardware diagnostics can only be executed at Terminal 1. The hardware diagnostics are a set of programs that exhaustively test the CPU hardware components and attempt to identify any malfunctions. The diagnostics can be run only after Master Initialization or a System Error has occurred. The diagnostics run continuously until RESET is pressed or an error is detected. When an error is detected, diagnostic processing stops or an error message is displayed. For a discussion of possible error causes, see Appendix D. If a hardware error recurs, call your Wang Service Representative.

A hardcopy listing of the diagnostic messages can be obtained by turning on the printer attached to the CPU during diagnostic execution. The printer attached to the CPU must be assigned Address 215 or 204 and selected (press SELECT on the printer). A hard copy trace of the diagnostic run should be obtained because it will help your Wang Service Representative locate and correct any problems. If no errors occur, the output will comprise only the name of the current test. When errors occur, they will be printed under the appropriate diagnostic test title.

Since the diagnostic programs destroy the contents of user memory, the user should save all valuable programs and data on disk prior to running the diagnostics.

The diagnostic programs of this system should be executed:

1. At least once every 60 to 100 hours of light-to-normal operation.
2. Whenever errors cause a hardware malfunction to be suspected.
3. Whenever a Wang Service Representative requests their execution.

It is best to execute the diagnostic routines as quickly as possible after observation of a suspected problem to ensure that the environmental conditions of the test most closely resemble those under which the problem occurred.

Random intermittent problems and permanent component failure are often attributable to static electricity, electromagnetic interference (EMI), temperature and humidity extremes, and excessive airborne dust and dirt. Prolonged operation in a poor environment produces permanent failure. Every effort should be made to secure an environment which, if not optimal, at least provides the operating conditions required for satisfactory system performance.

Refer to Table 5-1 for a functional description of each diagnostic. Press RESET and then press the appropriate Special Function key (SF '16 to SF '19) after each diagnostic to select any other diagnostic. To reselect BASIC-2, press SF '0 to SF '5.

Table 5-1. Functions of the User Diagnostics

Diagnostic	Function
CPU	Tests the 2200SVP processor
Control Memory	Tests control memory
Data Memory	Tests data memory

Loading the Diagnostics Menu

Turn off the system. Then, turn the system on, press RESET, and press one of the following Special Function keys.

SF Key '16 = Load diagnostics from disk D11 (or 310)
SF Key '17 = Load diagnostics from disk D10 (or B10)

The following display appears upon selection of the Diagnostic menu (SF '16 or '17).

```
KEY SF'
USER DIAGNOSTIC MENU
'00 CPU DIAGNOSTIC                    '02 DATA MEMORY DIAGNOSTIC
'01 CONTROL MEMORY DIAGNOSTIC
```

Press the appropriate Special Function key to load the desired diagnostic.

The CPU Diagnostic

The CPU diagnostic tests the 2200SVP processor. This test runs continuously until either an error occurs (the pass number stops incrementing) or RESET is pressed. If an error occurs, call your Wang Service Representative. When a sufficient number of successful test passes have occurred (at least 5 to 10), press the RESET key. The Diagnostics menu can be restored to the screen, or BASIC-2 can be reloaded by pressing the appropriate Special Function key.

The Control Memory Diagnostic

This diagnostic is designed to test the control memory. These control memory diagnostic tests are repeated until the RESET key is pressed. Error messages will be displayed or printed whenever memory failures are discovered. When a sufficient number of successful test passes have occurred (at least 5 to 10 passes), press RESET. The diagnostics menu can then be restored to the screen, or BASIC-2 can be loaded by pressing the appropriate Special Function key.

The Data Memory Diagnostic

This diagnostic is designed to test data (user) memory. The data memory diagnostic tests are also repeated until RESET is keyed. Error messages will be displayed or printed whenever memory failures are discovered. When a sufficient number of successful test passes have occurred (at least 5 to 10 passes), press RESET. At the completion of the diagnostic tests, the operator can pass control to the BASIC-2 operating system by pressing RESET, then pressing the appropriate Special Function key to load the operating system.

5.3 SYSTEM EXECUTION ERROR MESSAGES

The system initially checks each text line for various types of errors when the programmer enters the line during program resolution and during program execution. The system responds to an error condition by immediately terminating the current operation and displaying the erroneous line and beneath it the message ERR followed by an error code, with an arrow pointing to the approximate position of the error. Note that the system stops error scanning when the first error is detected. Thus, if a line contains more than one error, only the first is detected and reported by the system. Some errors can be recovered under program control.

Error codes with a 2-digit number preceded by a letter prefix (e.g., A04) occur once the system program has been given control. The letter identifies the particular class of errors to which the error belongs, while the 2-digit number identifies the specific error condition. (For example, an error commonly encountered during text entry is "S13, Missing Comma." 'S' indicates a syntax error, and the '13' specifically identifies the error as "Missing Comma.") In all, there are seven classes of error conditions, each identified by a unique letter prefix in the error code.

Class of Errors	Letter Prefix
Miscellaneous Errors	A
Syntax Errors	S
Program Errors	P
Computation Errors	C
Execution Errors	X
Disk Errors	D
I/O Errors	I

For a complete list of the errors included in each class and their specific recovery procedures, refer to the *Wang BASIC-2 Language Reference Manual.*

Miscellaneous, syntax, and program errors are detected during text entry or program resolution. These cause the system to terminate the current operation and display an error message. The operator then must correct the error before proceeding with further operations. Errors of this kind are called nonrecoverable errors, as they cannot be recovered under program control.

Computational, execution, disk, and I/O errors typically occur during program execution. They can be recovered under program control without aborting the program or disrupting the display with an error message. Errors that can be intercepted by the program before the system takes over are called recoverable errors. Three BASIC-2 instructions intercept and respond to recoverable errors: the SELECT ERROR statement, the ERR function, and the ERROR statement.

Refer to Chapter 9 of the *Wang BASIC-2 Language Reference Manual* for a discussion of error recovery under program control.

APPENDIX A
2200SVP SPECIFICATIONS

A.1 2200SVP CPU SPECIFICATIONS

Size

Height	12.0 in. (30.5 cm)
Width	21.5 in. (54.6 cm)
Depth	26.0 in. (66.0 cm)

Shipping Weight
75 lb (33.8 kg)

User Memory Size
32K bytes (standard). Expandable to a maximum of 64K bytes.

Power Requirements
115 VAC ± 10%, 60 Hz ± 1 cps
230 VAC ± 10%, 50 Hz ± 1 cps
230 W

Fuses
3.0 A (SB) for 115VAC @ 60 Hz
1.5 A (SB) for 230VAC @ 50 Hz

Numeric Range
$-(10^{+100}) <n <= -(10^{-99}), 0, +(10^{-99}) <= n < +(10^{+100})$

Precision
13 digits (standard)

Maximum Data Rate
100,000 bytes/sec

Operating Environment
50° to 90°F (10° to 32°C)
35% to 65% relative humidity, noncondensing (recommended)
20% to 80% relative humidity, noncondensing (allowable)

Heat Output
1,050 Btu/hr

A.2 SYSTEM DISKETTE DRIVE SPECIFICATIONS

1-Mb Diskette Drive — *Option A*

Tracks	149 + 1
Sectors/Track	26
Total Sectors	3874
Bytes/Sector	256
Total Bytes	991,744
Average Access Time	91 msec
Average Latency Time	83.3 msec
Speed	360 rpm
Transfer Rate	500 kilobits/sec

A.3 OPTIONAL FIXED DISK DRIVE SPECIFICATIONS

2-Mb Disk Drive — *Option B*

Tracks	254
Sectors/Track	32
Total Sectors	8,128
Bytes/Sector	256
Total Bytes	2,080,768
Average Access Time	70 msec
Average Latency Time	9.6 msec
Speed	3,125 rpm
Transfer Rate	4 megabits/sec

4-Mb Disk Drive — *Option C*

Tracks	510
Sectors/Track	32
Total Sectors	16,320
Bytes/Sector	256
Total Bytes	4,177,920
Average Access Time	70 msec
Average Latency Time	9.6 msec
Speed	3,125 rpm
Transfer Rate	4 megabits/sec

APPENDIX B
AVAILABLE PERIPHERALS

Model Number	Description
2221W	Line Printer (200 cps, 10 pitch: 132 chars/line)
2231W-1	Line Printer (120 cps, 10 pitch: 112 chars/line)
2231W-2	Line Printer (120 cps, 10 pitch: 132 chars/line)
2231W-3	2282 Graphic CRT Accessory Printer
2231W-6	High-Density Matrix Line Printer (70 cps, dual pitch)
2261W	Line Printer (240 lpm, dual pitch)
2263-1	Line Printer (400 lpm, dual pitch)
2263-2	Line Printer (600 lpm, dual pitch)
2263-3	Line Printer (430 lpm, dual pitch)
2272	Digital Drum Plotter
2273-1	Band Printer (250 lpm)
2273-2	Band Printer (600 lpm)
2281W	Daisy Printer
2281WC	Wide Carriage Daisy Printer
BFT-1	Bidirectional Forms Tractor for 2281W
BFT-2	Bidrectional Forms tractor for 2281WC
TSF-20	Twin Sheet Feeder for 2281W (8.5 x 11- or 14-in. paper)
TSF-21	Twin Sheet Feeder for 2281W (8.25 x 11- or 14-in. paper)
TSF-22	Twin Sheet Feeder for 2281WC (8.5 x 11- or 14-in. paper)
TSF-23	Twin Sheet Feeder for 2281WC (8.25 x 11- or 14-in. paper)

APPENDIX C
PREVENTIVE MAINTENANCE AND ENVIRONMENTAL CONSIDERATIONS

C.1 PREVENTIVE MAINTENANCE

It is recommended that equipment be serviced annually. A Maintenance Agreement is available to assure this servicing automatically. If no Maintenance Agreement is acquired, any servicing must be arranged for by the customer. A Maintenance Agreement protects the investment and offers the following benefits.

Preventive Maintenance — Equipment is inspected annually for worn parts, and is adjusted, lubricated, cleaned, and updated with any engineering changes. Preventive maintenance minimizes "downtime" by anticipating repairs before they are necessary.

Fixed Annual Cost — When a Maintenance Agreement is bought, only one purchase order need be issued for service for an entire year. There is only one annual billing, although more frequent billing can be arranged if desired.

Further information regarding Maintenance Agreements can be acquired from your local Sales-Service Office.

NOTE

Wang Laboratories, Inc. does not honor Maintenance Agreements for, nor guarantees any equipment modified by the user. Damage to equipment incurred as a result of such modification is the financial responsibility of the user.

C.2 ENVIRONMENTAL CONSIDERATIONS

When the recommended temperatures are exceeded, component failure rates and loss of data through distortion of data storage materials are likely to increase.

Airborne contaminants can accumulate rapidly on the circuit boards and their components, forming a film which not only prevents adequate heat dissipation from the electronic elements, but also creates leakage paths, causing errors in the system signals. Additionally, dust causes excessive wear in the disk read/write heads and the oxide coatings of storage media. The filters of all HVAC (Heating, Ventilating, Air Conditioning) equipment should be cleaned or replaced regularly. In areas where these filters do not sufficiently remove airborne contaminants, an electrostatic air filter should be installed.

Low humidity increases the certainty of static build-up and causes oxide shed in data storage materials, and increases the static charge imparted to carpets and clothing. When the operator comes in contact with the system, the resultant static discharge which could be an uncomfortable several thousand volts, might also cause system errors or destruction of data. Humidifiers or dehumidifiers should be installed in the environment's heating, ventilating and air conditioning system as required.

If carpeting is to be installed, it should be a non-static variety. If carpeting already exists, and it is not non-static, it must be treated with non-static spray, or an electrically conductive mat should be installed under the system operating area and be properly connected to an earth ground to prevent static build-up.

Computers and peripherals are susceptible to malfunction due to electromagnetic interference (EMI) from radio transmitters, industrial motors, etc. EMI can enter the system by conduction through wiring and cabling or by direct radiation. An example of EMI is a television, becoming full of "snow" when a car with a poorly tuned engine idles outside (radiated EMI), or when a hairdryer or vacuum cleaner is turned on in the next room (conducted EMI). To minimize such interference, the three prong AC power line should be dedicated to the system, grounded, properly installed in steel conduit, and isolated from interference-generating devices such as office machines, fluorescent lighting, motors, and HVAC units. If these devices are located in close proximity to the system area, they must be relocated, repaired, or filtered to prevent them from disturbing the system. (EMI filters, isolation transformers and line conditioners should be installed on the system's AC power line). In cases of high residual EMI, it may also be necessary to shield all peripheral cables.

The 2200SVP CPU requires 3 amperes @ 115 VAC; therefore, as with most Wang systems, a 20 ampere, 115 VAC power line properly grounded and regulated to within ± 10% should be adequate depending upon the other equipment on the line.

The recommended operating environment is defined by the following parameters.

Temperature: 65° to 75°F (18° to 24°C)
Relative Humidity: 35% to 65%, noncondensing
Dust: No accumulation should be obvious in a 24-hour period
Power: Grounded, noise-free, dedicated 115 or 230 VAC ± 10%, 50 or 60 Hz ± 1 Hz
Interference: All sources of static electricity, extreme magnetism, and EMI should be controlled

The following considerations should also be noted.

- Keep an accurate service history on all equipment.
- Do not eat, drink, or smoke in the system area.
- Avoid touching magnetic disks and tape or exposing them to direct sunlight, strong magnetic fields, or freezing temperatures. If subjected to extremes, allow the media to return to normal operating conditions before use (24 hours recommended) and test thoroughly.

- Return the diskette to its storage envelope whenever it is removed from the drive. Replace the storage envelopes when they become worn, cracked or distorted. The envelopes are designed to protect the disk.

- Date the media when you first use it, as it is advisable to replace media over two years old. Use felt-tip pens to write on the media label. Never use an eraser to alter a label; use a new label.

- Always make a duplicate copy (backup) of tapes and diskettes. Store the backup in a safe place, preferably away from the system.

CAUTION

Most Wang electrical devices are equipped with an exhaust fan and entry vents. These vents and fan should not be obstructed; therefore, never place system equipment immediately adjacent to file cabinets or other surfaces which might impede proper air flow.

APPENDIX D
SYSTEM HARDWARE ERROR MESSAGES AND RECOVERY

The following discussion explains each of the system errors and what may be done by the user to recover from them. When these procedures fail, call your Wang Service Representative.

D.1 GENERAL SYSTEM ERROR MESSAGES AND RECOVERY

*** SYSTEM ERROR PECM XXXX ***

This message signals that a parity error was detected while trying to execute an instruction from control or bootstrap memory. It is usually serious enough to warrant the executing of a Control Memory diagnostic. However, it may be possible to resume execution of the currently loaded application program by pressing RESET then Special Function key '15. If the error occurs again, a Control Memory diagnostic should be run to locate the defective memory location.

NOTE

Sometimes, after a PECM, the system will have to be turned off and master initialized again in order to clear the error condition.

*** SYSTEM ERROR PEDM XXXX ***

This message signals that a parity error was detected during a read of data memory. This error is usually serious enough to warrant executing a Data Memory diagnostic. However, it may be possible to resume execution of the currently loaded application program by pressing RESET, then Special Function key '15. If the error occurs again, a Data Memory diagnostic should be run to locate the defective memory location.

*** SYSTEM ERROR VECM XXXX ***

This message signals that the Bootstrap program is not the expected one, that the loading of control memory from the disk was not successful, or that bad memory locations were detected. It may be possible to resume execution of the currently loaded application program by pressing RESET, then Special Function key '15. If the error occurs again, the Control Memory diagnostic should be run to determine if there are any bad memory locations. If no locations are reported defective, a CPU instruction may be failing requiring a CPU diagnostic to be run.

*** SYSTEM ERROR VEDM XXXX ***

This message signals that the area of data memory used for system constants (e.g., verb tables, math constants, and messages), was not loaded properly when the BASIC-2 interpreter was loaded, or that bad memory locations were detected. It may be possible to resume execution of the currently loaded application program by pressing RESET, then Special Function key '15. Should successive failures occur, run the Data Memory diagnostics to determine if there are any defective memory locations.

D.2 SYSTEM DISK ERROR MESSAGES AND RECOVERY

*** SYSTEM ERROR DISK 00XX ***

Several possible disk errors may occur while loading disk information. The recommended recovery procedure involves consulting the following description of each possible disk error to determine if the problem can be corrected and then attempting to reload. Should successive failures occur, call your Wang Service Representative. All disk errors are more fully documented in the *BASIC-2 Disk Reference Manual* and the *Wang BASIC-2 Language Reference Manual*.

ERR 0082

Error: File Not in Catalog

Cause: A nonexistent file name was specified, or an attempt was made to load a data file as a program file or a program file as a data file.

Recovery: Be sure the correct file name is being used, the proper disk platter is mounted, and the proper drive is being accessed.

ERR 0090

Error: Disk Hardware Error

Cause: The disk did not respond properly to the system at the beginning of a read or write operation; the read or write has not been performed.

Recovery: Press RESET and run the program again. If the error persists, ensure that the disk unit is powered on and that all cables are properly connected. If the error still occurs, contact your Wang Service Representative.

ERR 0091

Error: Disk Hardware Error

Cause: A disk hardware error occurred because the disk is not in file-ready position. For example, if the disk is in a Load mode or if the power is not turned on, the disk is not in file-ready position and a disk hardware error is generated.

Recovery: Press RESET and run the program again. If the error recurs, check to ensure that the program is addressing the correct disk platter. Be sure the disk is turned on, properly set up for operation, and that all cables are properly connected. Set the disk into the Load mode and then back into the Run mode according to the instructions in the appropriate disk reference manual. If the error persists, call your Wang Service Representative.

NOTE

The disk must *never* be left in Load mode for an extended period of time when the power is on.

ERR 0092

Error: Timeout Error

Cause: The device did not respond to the system in the proper amount of time (timeout). In the case of the disk, the read or write operation has not been performed.

Recovery: Press RESET and run the program again. If the error persists, be sure that the disk platter has been formatted. If the error still occurs, contact your Wang Service Representative.

ERR 0093

Error: Format Error

Cause: A format error was detected during a disk operation. This error indicates that certain sector-control information is invalid. If this error occurs during a read or write operation, the platter may need to be reformatted. If this error occurs during formatting, there may be a flaw on the platter's surface.

Recovery: Format the disk platter again. If the error persists, use a different disk platter. If the error continues, call your Wang Service Representative.

ERR 0094

Error: Format Key Engaged

Cause: The disk format key is engaged. The key should be engaged only when formatting a disk.

Recovery: Turn off the format key.

ERR 0095

Error: Device Error

Cause: A device fault occured indicating that the disk could not perform the requested operation. This error may result from an attempt to write to a write-protected platter.

Recovery: If writing, make sure the platter is not write-protected. Repeat the operation. If the error persists, power the disk off and then on, and then repeat the operation. If the error still occurs, call your Wang Service Representative.

ERR 0096

Error: Data Error

Cause: For read operations, the checksum calculations (CRC or ECC) indicate that the data read is incorrect. The sector read may have been written incorrectly. For disk drives that perform error correction (ECC), the error correction attempt was unsuccessful. For write operations, the LRC calculation indicates that the data sent to the disk was incorrect. The data has not been written.

Recovery: For read errors, rewrite the data. If read errors persist, the disk platter should be reformatted. For write errors, the write operation should be repeated. If write errors persist, ensure that all cable connections are properly made and are tight. If either error persists, contact your Wang Service Representative.

ERR 0097

Error: Longitudinal Redundancy Check Error

Cause: A longitudinal redundancy check error occurred when reading or writing a sector. Usually, this error indicates a transmission error between the disk and the CPU. However, the sector being accessed may have been previously written incorrectly.

Recovery: Run the program again. If the error persists, rewrite the flawed sector. If the error still persists, call your Wang Service Representative.

ERR 0098

Error: Illegal Sector Address or Platter Not Mounted

Cause: The disk sector being addressed is not on the disk, or the disk platter is not mounted. (The maximum legal sector address depends upon the disk model used.)

Recovery: Correct the program statement in error, or mount a platter in the specified drive.

ERR 0099

Error: Read-After-Write Error

Cause: The comparison of read-after-write to a disk sector failed, indicating that the information was not written properly. This error usually indicates that the disk platter is defective.

Recovery: Write the information again. If the error persists, try a new platter. If the error still persists, call your Wang Service Representative.

APPENDIX E
BACKING UP THE SYSTEM PLATTER

After loading the system programs it is recommended that the user first make a backup copy of the system platter. *At least one copy should be made of the entire system platter* on another diskette or on a platter in a second drive in case the original is accidently damaged or destroyed. The MOVE statement, which is used to create a backup copy of the system platter, is explained in detail in the *Wang BASIC-2 Disk Reference Manual*.

If the system contains an optional second removable DSDD diskette drive, the system platter can be copied directly to the second diskette, providing a removable floppy as a system diskette backup. If the system contains a fixed drive, the system diskette may be copied directly to the fixed platter, which will provide a permanent address from which to load and unload the system programs. The user is then spared the inconvenience of mounting and dismounting the system platter each time the system is master initialized.

E.1 COPYING THE ENTIRE SYSTEM PLATTER

To copy the system platter, perform the following steps.

1. Be sure the write-protect notch on the system platter is uncovered, and insert the system platter into the removable slot. If the second drive is a second removable DSDD, insert the backup diskette into this unit. Ensure that it is properly mounted and that its write-protect notch is covered.

2. Be sure that the backup platter is formatted. No information can be recorded on an unformatted platter. To format the diskette or disk, follow the instructions detailed in Chapter 3.

NOTE

Never format the system platter. This will erase system software.

3. If BASIC-2 is not currently loaded in the system control memory, load it from the system platter.

4. Enter a statement of the form:

   MOVE T/xxx, TO T/yyy,

   where T/xxx, is the address of the system platter and T/yyy, is the address of the backup platter on which the copy will be made. Be sure to specify these addresses in the correct order. For example, assuming the system platter is mounted at address D10 and the backup platter is located at address D11, the following statement would be entered.

   MOVE T /D10, TO T /D11,

   NOTE

   The trailing comma (i.e., T/D11,) is required by BASIC-2 syntax. Failure to specify the comma yields ERR S13 (refer to Section 5.3). For a detailed explanation of the errors that can occur during BASIC-2 operation, consult Appendix A of the *Wang BASIC-2 Language Reference Manual.*

   A Move command will overwrite and destroy all existing files on the platter to which the move is being made. To avoid losing valuable files, ensure that your backup platter contains nothing that must be saved.

5. When the MOVE statement has been correctly entered, press RETURN (EXEC). The CRT colon will disappear while the Move operation is in progress. When the colon reappears, the Move is complete. The new copy must now be verified.

6. Verify the new platter immediately following the Move operation to ensure that the system programs have been correctly copied. To verify the platter, a statement of the following form is used.

   VERIFY T /yyy,

   where /yyy specifies the device address of the platter to be verified. For example, if the system platter has just been copied to a diskette at Address 310 (or D11), the following statement would be used to verify the new copy.

   VERIFY T /D11,

   If the Verify operation reports an error, repeat the Move operation and verify the platter again. If the backup platter is a diskette, and if Verify still indicates an error, use a new diskette for the copy. If Verify continually reports an error on the backup of a fixed disk or new diskette, contact your Wang Service Representative.

E.2 COPYING THE SYSTEM FILES

The Move utility (@MOVE), which is provided on the system platter, moves specified system files from one disk platter to another. To use this utility, type LOAD RUN and press the RETURN key. The Move utility can then be selected from the displayed menu. The program will provide prompts which require the operator to specify the details of the file transfer. The Move utility can only transfer system files; i.e., files with names which begin with @.

In addition to the previously described system programs, the system diagnostic routines (files @A, @B, @C, @D, @P, and @\) are also located on the system platter. It is recommended that they be copied as well as other files to ensure a complete backup disk.

The Move utility can be used to update system files by overwriting existing system files. The Move utility is recommended for system updates since it overwrites only the specific files being changed and leaves the remainder of the disk intact.

APPENDIX F
2200SVP SYSTEM UTILITIES

Included with the 2200SVP system software are certain programs for general use known as *utilities.* These utilities simplify such commonly performed system tasks as backing up a hard disk onto diskettes and moving files.

Utilities can be accessed through a Utility menu which is available through the system platter. The following two commands will display this menu.

1. SELECT DISK xxx (RETURN)

   where xxx is the device address of the disk on which the system utilities reside

2. LOAD RUN (RETURN)

Utilities that require operator-entered information will display a series of prompts requesting this information. In all cases, type in the necessary response and press RETURN; the utility will then request additional information or perform the required procedure.

The following utilities are available on the 2200SVP system platter.

F.1 MOVE SYSTEM FILES (@MOVE)

This utility enables the installation and update of system files by moving specified system files (files beginning with @) from one disk platter to another. The utility moves one file at a time. The Move utility can be used to update system files by overwriting existing system files. The operator is notified if a file existing on the destination platter has the same name as the file he intends to copy, and the utility requests permission to overwrite.

F.2 FORMAT DISK PLATTER (@FORMAT)

This program formats software-formattable disk platters, such as the dual-sided double-density diskette and 2200SVP fixed platter. Running this utility produces the same results as executing a Format command ($FORMAT), but with operator prompts safeguarding against the formatting of a platter on which data is written. (Refer to the *Wang BASIC-2 Disk Reference Manual* for detailed formatting information.)

F.3 2273 VERTICAL FORMAT CONTROL (@2273VFU)

The 2273 Vertical Format Control utility (@2273VFU) allows the user to define and edit the vertical format of the Model 2273 Band Printer's Direct Access Vertical Format Unit (DAVFU) without the difficulty of programming long code sequences. The user can create, edit, test, and save format data on disk for later loading into the DAVFU. Each time the utility is used, the user indicates whether to load a previously created format file or create a new one.

In creating a new vertical format, the user responds to operator prompts and specifies the number of lines per page, the number of lines per inch, and the location of the bottom of form. Once the operator supplies this information, an N x 12 grid appears on the CRT screen: N representing the specified number of lines, and 12 being the number of channels of the DAVFU. The operator can edit the format by entering tabs indicating top-of-form in Channel 1 of Line 1 and bottom-of-form in Channels 1 and 2 after the last line to be printed. Also, the user can set tabs in the channels of other lines to indicate vertical stops.

F.4 BACKUP PLATTER (@BACKUP)

The Backup utility (@BACKUP) provides the ability to copy the contents of a single-disk platter to another platter or to a series of smaller platters. The source and destination platter may be from any of the several types of disk drives used on the 2200SVP. The primary purpose of @BACKUP is to allow the 2- or 4-megabyte fixed disks on the 2200SVP to be backed up onto several 1-megabyte DSDD diskette platters. This utility moves the entire contents of the source platter, including the catalog index if one is present.

The Backup utility overwrites any information already contained on the platter(s) specified for output. Additionally, the backup platter(s) created by the Backup utility stores file names in a data file instead of a copied catalog index and thus cannot be used for direct file access. To retrieve the contents of the backup platter(s), the Recover utility (@RECOVER) must be used.

F.5 RECOVER FROM BACKUP (@RECOVER)

The Recover utility (@RECOVER), the complementary utility to the Backup utility, retrieves the contents of the platters produced by @BACKUP and writes them onto another platter. The Recover utility provides three options for recovering data.

- Recovers the entire contents of the backup platter(s). If an exact copy of the original source platter is required, or if the source was an uncataloged platter, this option must be used.
- Recovers all the active files on the backup platter(s). This option provides an efficient means of removing all scratched files from the backup platter(s).
- Recovers select files from the backup platter(s). This option provides for the recovery of individual files from the backup platter. The files that are recovered may be added to a cataloged disk which need not be identical to the original source platter. This option also provides the ability to enlarge the size of the file if desired.

The Recover utility can only be used to retrieve information from a platter created by @BACKUP. Other, more general file movement, can be achieved by using the Move File utility (@MOVEFIL).

F.6 MOVE FILE (@MOVEFIL)

The Move File utility (@MOVEFIL) provides a general file move capability. Specified files are moved from one platter to another; if necessary, a file can span more than one output platter. This utility can create a new file, change the new file size of the output file, rename a file, and overwrite an existing file. @MOVEFIL allows for the transfer of data between the 2200SVP system diskette drive and the 2270A diskette drive by providing a facility for conversion of a file form 256-byte sector format (standard Wang format) to 128-byte sector format (IBM3741 format) and vice versa. The SSSD soft-sectored diskette (green label) must be used as the transfer medium between the two diskette drives.

APPENDIX G
WANG IBM COMPATIBILITY SOFTWARE FEATURES

Because of the DSDD diskette drive hardware, IBM 3740 diskette compatibility is possible. However, either Wang- or user-written software must be run to use this compatibility feature. Wang supports optional disk utility programs and subroutines to access, maintain, and create files in IBM 3740 format. These subroutines also allow Wang telecommunications format files to be converted to 3740 format and vice versa, and any number of sectors of an IBM 3740-type diskette, including the catalog, to be read and displayed. When appended to a user-written program, the subroutines require about 4.5K bytes. Use of the entire Wang software system requires about 12K bytes.

If the IBM compatibility feature is to be used, at least two disk drives are recommended. One is needed for mounting the 3740-type diskette, which will be used for data storage and retrieval, and another is needed for mounting the compatibility software. Wang-supported software includes both stand-alone utilities and operational subroutines, which can be inserted into user application programs to fully support all programming and processing operations with the 3740-type diskette structure.

Wang's 3740 Diskette Compatibility Software, designed for use with the IBM 3741 Compatible Diskette Drive, provides a set of utility programs which implement operations such as the following.

- Display of a 3740 diskette catalog, thereby providing the names of stored files and the addresses of each file's reserved and used sectors.
- Display of 3740 sector dumps for the sectors in a specified address range.
- Performance of media conversion of Wang disk/diskette files to 3740 diskette files or vice versa. (All or selected files may be copied, and input and output disk addresses are also selected. The 3740 Diskette Compatibility Software processes Wang telecommunications format data files to a maximum record length of 128 bytes.)
- Display on the CRT or printer of sectors of a 3740 data file that has been converted to Wang format using the above utility.
- Production of hard copy of a specified 3740 diskette file or a Wang diskette file previously converted from a 3740 diskette.

File Maintenance software provides utility subroutines that can be integrated with the user-written BASIC-2 Language application programs where 3740 diskettes are to be accessed directly for file creation or maintenance. The user may invoke these functions either directly through prompts appearing on the console, or indirectly by inserting statements in a BASIC-2 program. These subroutines control the following operations.

- Opening a new or existing file
- Reading, rereading, or writing a sector
- Skipping or backspacing a specified number of sectors
- Writing or updating an end-of-data pointer position
- Closing a file.

Diskette Initialization software is provided for program testing. It may be used to create an image of an initialized 3740 diskette on a Wang diskette.

For detailed information concerning disk operations and BASIC-2 disk language features for all Wang disk models, see the *Wang BASIC-2 Disk Reference Manual.* For more information concerning the IBM compatibility features, obtain the IBM 3740 Compatibility Software Package (part no. 195-1030-3), which contains a software diskette (part number 701-2212) and the *3740 Diskette Compatibility Software User Manual* (part number 700-4369).

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