

SVI·328

PERSONAL COMPUTER USER'S MANUAL



SVI
SPECTRAVIDEO

SPECTRAVIDEO'S USER'S MANUAL STATEMENT

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

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

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful:

"How to Identify and Resolve Radio-TV Interference Problems" This booklet is available from the U.S. Government Printing Office, Washington, DC 20402. Stock No. 004-000-00345-4.

WARNING:

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

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INTRODUCTION

Welcome to the world of tomorrow. You have just made a purchase that will reward you for a long time to come. The SV-328 Personal Computer that you have purchased will open the doors to the future both today and in the future. The SPECTRAVIDEO family of personal computers contain features that will allow you to take advantage of all current computing technology and will also allow you to expand your horizons as new technology evolves.

The SV-328 is the tool that will allow you to deal with the computer revolution of the 1980's and this is the manual for the operation of this tool.

Again, welcome to tomorrow. Make it what you want it to be with your SV-328. Just keep one thought in mind as you progress on your journey: "A Computer is only as smart as you make it. Without you, it's only a rather complex bunch of wires, chips, metal and plastic. You are the most important component of your new computer system.!"

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SYSTEM OVERVIEW

1

SYSTEM OVERVIEW

The terms in the following system overview might not be familiar to those of you who are just beginning to learn about computers. But don't worry. This manual was written especially for first time computer users to teach them the powerful BASIC language that is built into the SV-328. The overview is intended to give the beginner as well as the experienced user an appreciation of the power and beauty of the SV-328: the first affordable and expandable personal computer.

Your SV-328 computer contains 3 powerful processors that allow you to display exciting pictures, play music or sound effects and control a program all at the same time!

A Z80A 8-bit Microprocessor controls all the system components. It is responsible for storing, retrieving, and executing programs. A video display processor (VDP) serves to generate all necessary video, control, and synchronization signals. The VDP is capable of displaying 16 colors in high resolution mode. It also supports manipulations of 32 sprites (shapes) and a 40 column text mode. In addition, there is a programmable sound generator (PSG) which can produce songs or a wide variety of complex sounds.

The BASIC language is stored in the 32K bytes of Read Only Memory (ROM). Your instructions (or "programs" in computerese) to command the computer are stored in one

64K bytes of Random Access Memory (RAM). The remaining 16K is strictly for use by the VDP to store information with which it creates colorful graphic displays.

SUPER SV EXTENDED BASIC

The powerful SV Extended BASIC language written by Microsoft® is an extension of the same BASIC language that is available on computers costing three times as much as the SV-328.

If you are new to programming, you will find SV BASIC to be a versatile, easy to learn and easy to use language. Experienced programmers will appreciate its powerful features and the flexibility it permits when writing, editing, debugging, and running programs.

The SV BASIC has the following powerful built-in features:

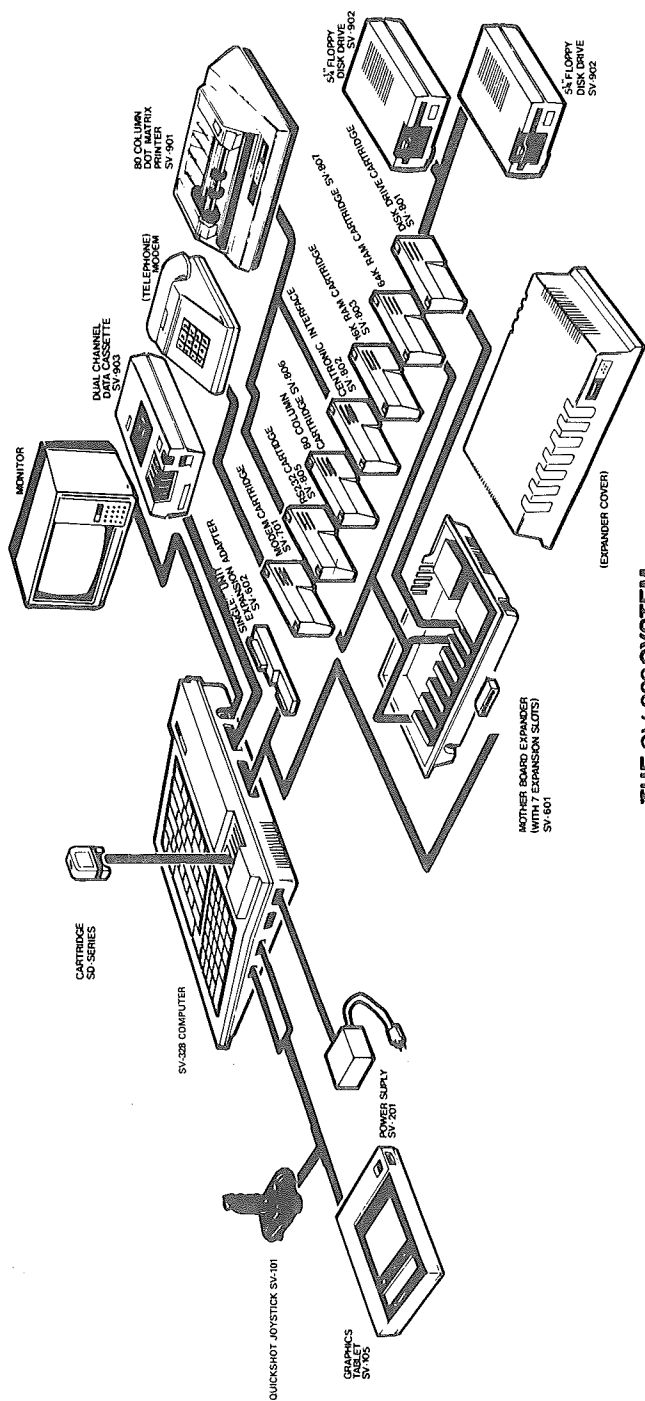
- (a) Screen editor.
- (b) Full graphic and sound manipulation.
- (c) New SPRITE commands.
- (d) Default double precision math package for business application programs.
- (e) Special machine interrupt handling commands for real time BASIC programming.
- (f) Special function keys often used commands (user programmable).
- (g) True upper and lower case display and printing.
- (h) Bank program switching: A BASIC command not currently found on any comparably priced computer. It allows you to run two programs at the same time when the original memory expansion bank is installed. (64K memory expansion cartridge is required)

REMEMBER: The secret to mastering the Spectravideo SV-328's power is to take your time reading

this book and trying out all the exercises on your computer. Like driving a car, you must learn by doing. By correcting your mistakes and learning not to feel bad about them, you will succeed and grow with the Spectravideo's line of expandable and affordable computer products.

EXPANDABILITY

If you need greater computing power, you can easily add more peripherals through the SV expansion interface, a 7 slot super expander unit. This expander unit connects directly to the rear of the basic unit. It is capable of supporting a wide variety of peripheral devices as shown on the following page.

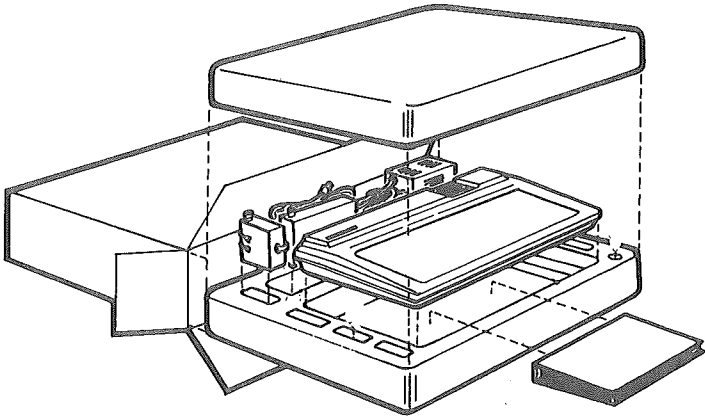


**THE SV-328 SYSTEM
PERIPHERAL MAP**

-
- UNPACKING
 - SYSTEM INSTALLATION
 - POWER SUPPLY AND CABLES
 - POWER-ON SELF-TEST

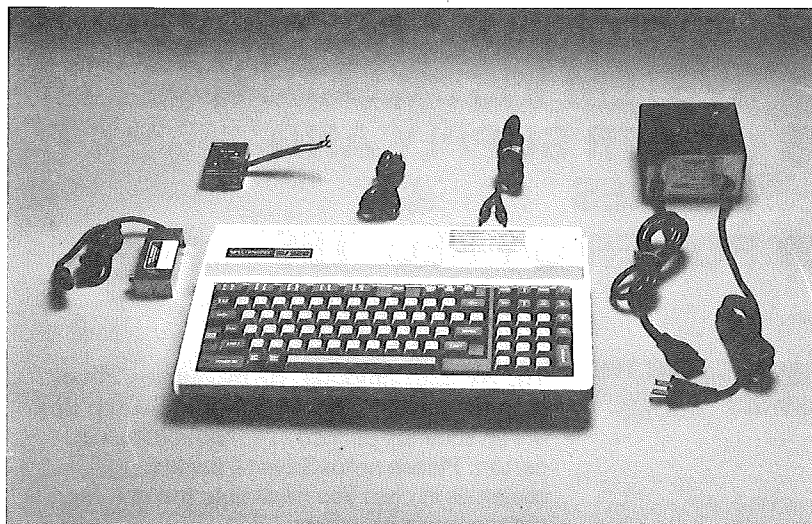
**UNPACKING THE
SV-328**

The SV-328 computer, RF modulator, direct monitor cable, Power Supply and Switch Box are all securely packed in a foam cushioned carton. Please note: Save all packaging materials in case you must ship the unit for maintenance or repairs.



MONITOR CABLE SUPPLIED FOR

U. S. A. MARKET ONLY



Check the contents of your SV-328 package. You should find the following items:

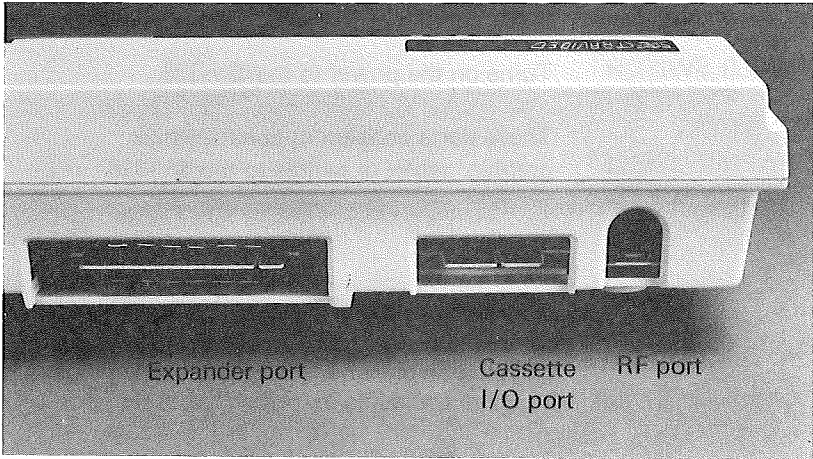
1. SVI-328 Computer
2. Monitor Cable (not included in Valuepak)
3. RF modulator
4. Shielded video cable
5. Switch box
6. Power supply
7. This instruction manual
8. Warranty registration card
9. Quick reference guide

If any items are missing, please check with your dealer immediately.

SYSTEM INSTALLATION

To connect the system, you will need two (2) 110V electrical outlets for your SV-328 Computer and monitor, or television set. Choose a comfortable position for operation, away from any source of extreme heat (sunlight, heaters, etc).

Study the photos below carefully:



RF PORT

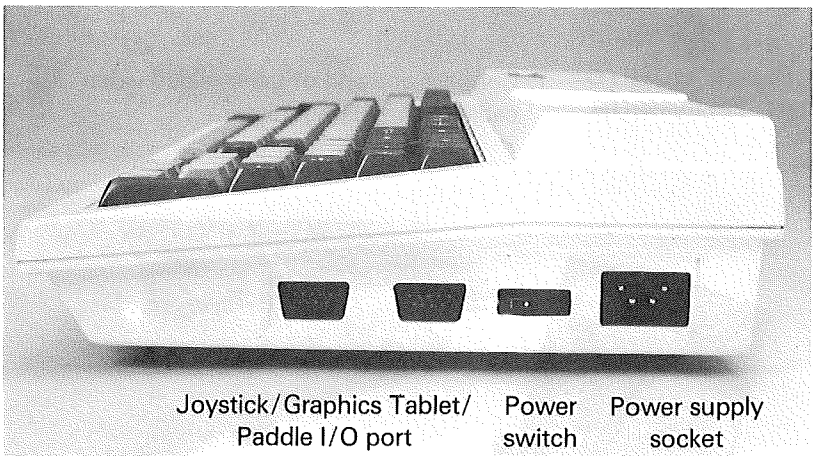
This port connects your TV or monitor to the SV-328

CASSETTE I/O PORT

Connects the SV-328 to the data cassette recorder.

EXPANDER PORT

Connects the 7-slot Super Expander to the SV-328



Joystick/Graphics Tablet/
Paddle I/O port

Power
switch

Power supply
socket

POWER SUPPLY
SOCKET

Connects the power supply unit to the SV-328
The other end of the supply unit is connected
to an electrical wall outlet.

POWER SWITCH

Turns on the power to the SV-328

JOYSTICK/
GRAPHIC TABLET/
PADDLE PORTS

These ports connect optional joystick,
graphic tablet or paddle to the SV-328

CONNECTION TO
A MONITOR

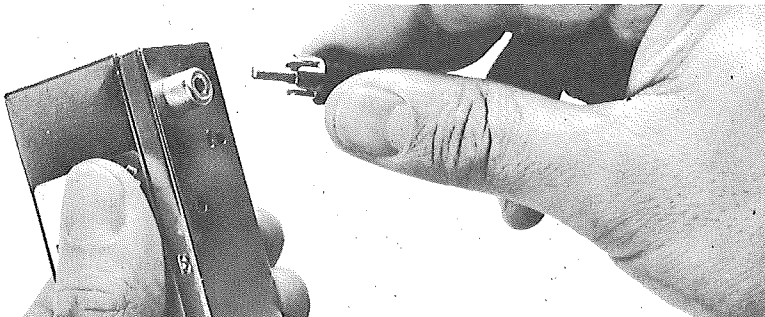
The video cable that is included in the SV-328
computer system consists of a standard 5 pin
DIN plug on one end and 2 RCA phono plugs
for video and audio output on the other end.

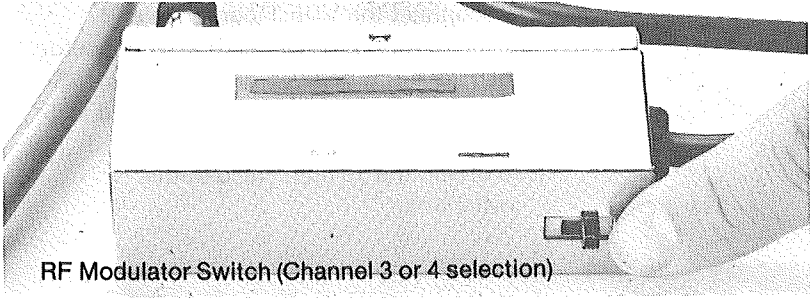
1. Connect the 5 pin DIN plug into the RF port
on the rear of the SV-328.
2. Connect the RCA plug marked "video" to the
video port and the RCA plug marked "Audio"
to the audio port on the rear of the monitor.

NOTE: Some monitors require an inexpensive
adapter to add to the RCA plugs before
connecting them to the monitor. That is
available from your local electronics dealer.
WE recommend the Radio Shack RCA Mini-
Adapter (Model # 274-330)

CONNECTION TO
THE TELEVISION

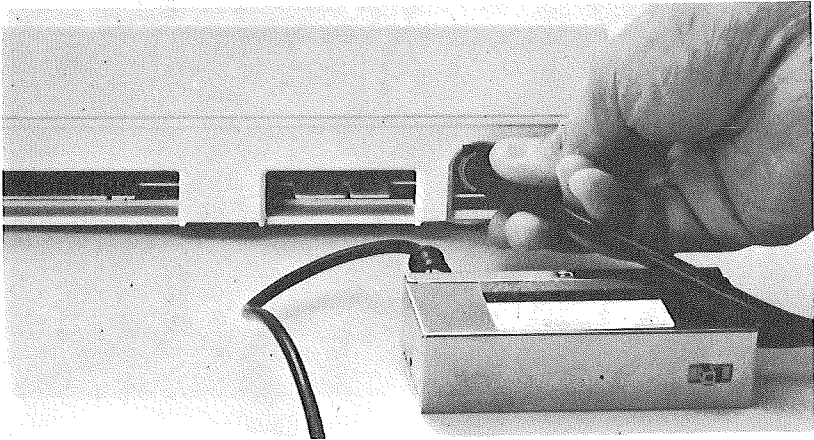
1. Connect one end of the shielded video
cable to the RF modulator.



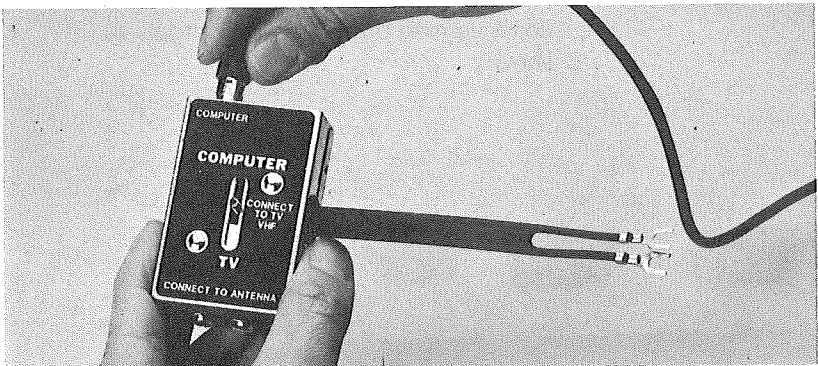


RF Modulator Switch (Channel 3 or 4 selection)

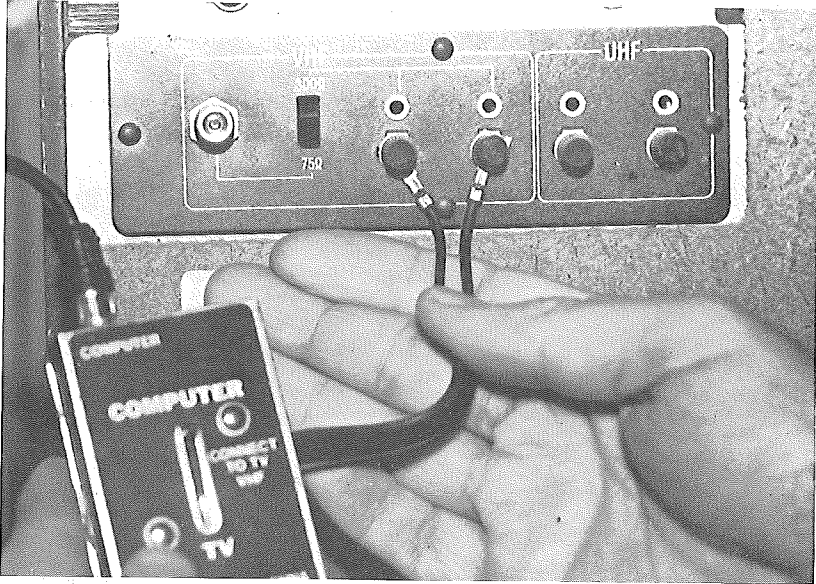
2. Attach the end of the 5-pin DIN connector to the back of the SV-328 Video Port



3. Connect the other end of the shielded video cable to the TV switch box.



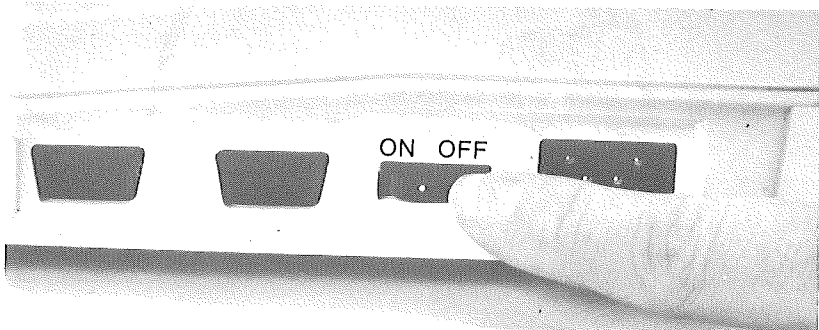
4. Disconnect the VHF TV antenna and reconnect it to the switch box's connector marked TV. If your TV antenna uses a 75 ohm cable (round) then you will need a 75 ohm to 300 ohm adapter (not supplied) to attach the 75 ohm cable to the switchbox.

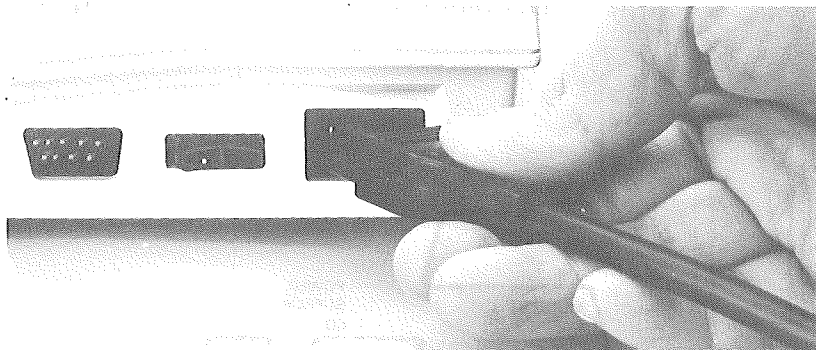


5. Select channel 3 on your television set.

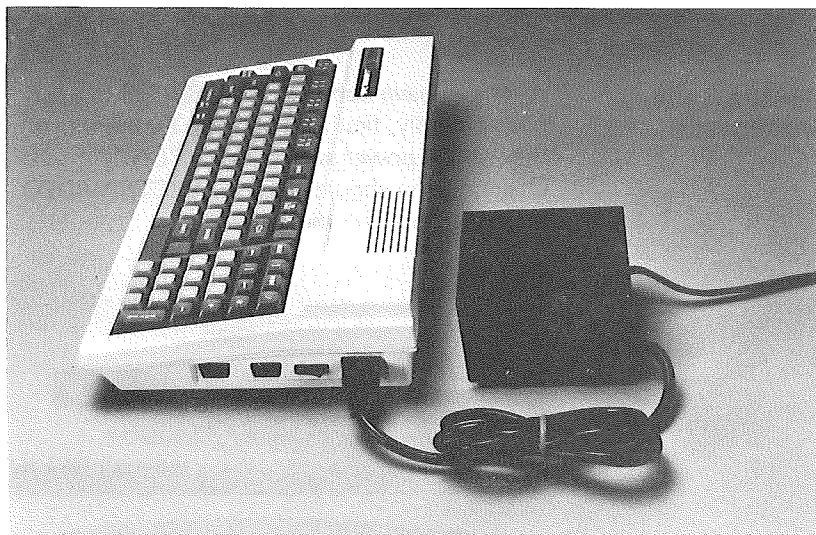
POWER SUPPLY AND CABLE CONNECTIONS.

1. Before connecting the power supply, please check and be sure the power switch on the right side of the unit is OFF. Connect the two cords coming from the power supply as shown.

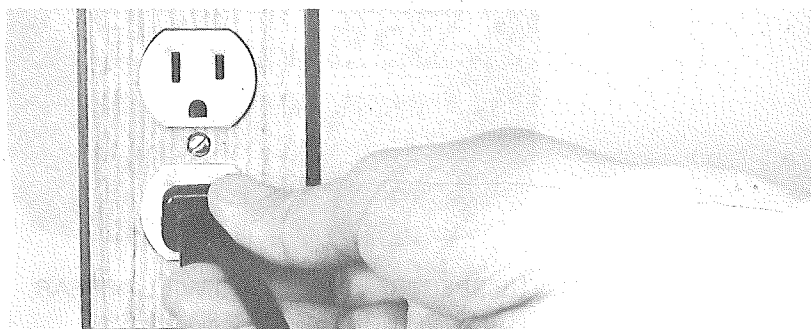




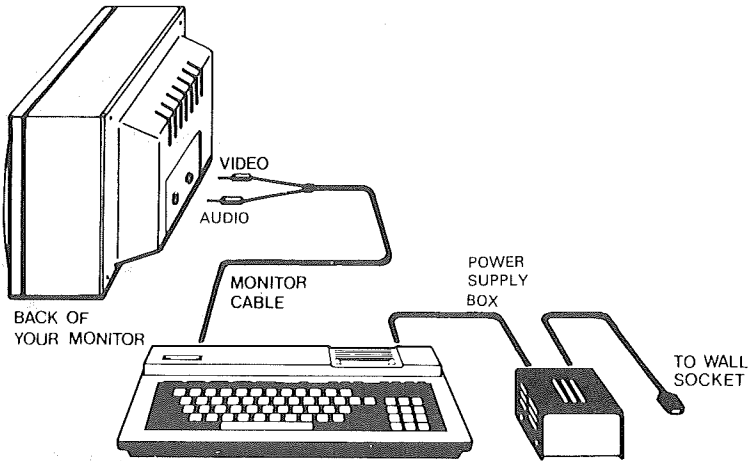
2. Connect the power supply to the SV-328.



3. Connect the other end of the power supply to any wall outlet.

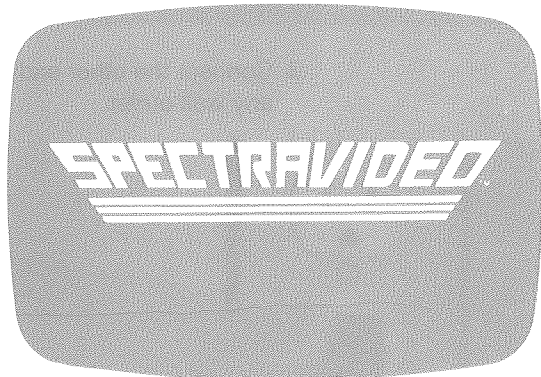
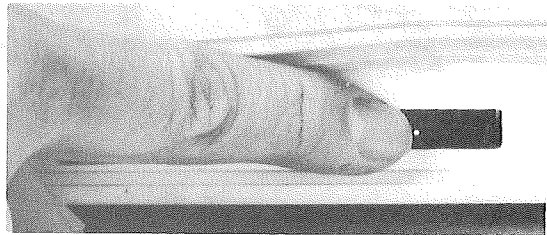


PROPER CONNECTION OF THE SV-328 TO THE TV.



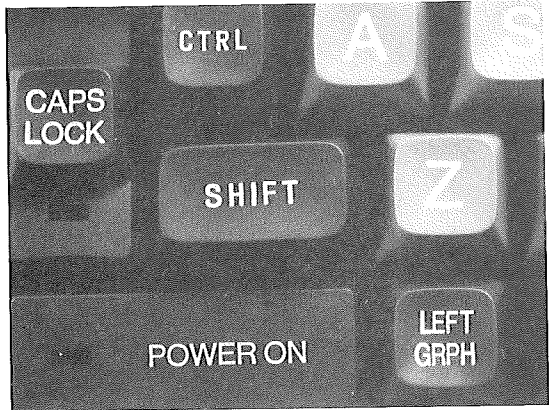
**TURNING ON
THE POWER**

After you have connected the SV-328 to your power supply, first turn on your TV then turn the SV-328 power switch to the "ON" position. You should see the SPECTRAVIDEO Logo displayed on the screen.



THE SPECTRAVIDEO LOGO WILL APPEAR,
CHANGING COLORS THREE TIMES.

The POWER ON indicator will light up.



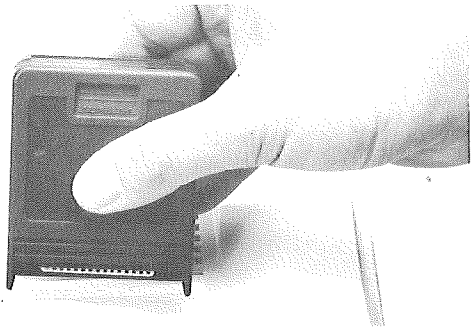
POWER ON SELF-TEST

The SV-328 has a built-in diagnostic check that will automatically check the function of the system and will signal a successful test with one beep. (In the event that you do not hear a beep, first check to be sure the Volume control of your television set has been turned up to an audible level.)

If the system still does not start up properly, refer to the trouble shooting chart. (Appendix G)

PROGRAM CARTRIDGE PORT

The SV-328 Program Cartridge Port is located conveniently on the top right hand corner. To insert a Spectravideo game cartridge, first be sure the power switch is in the OFF position.



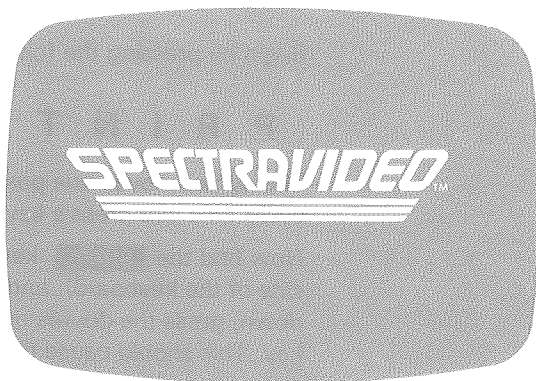
THE KEYBOARD

2

THE KEYBOARD

Programming is generally done by sending instructions to the computer through the keyboard. Your instructions and the computer's responses are visible on a TV screen, which is connected to the keyboard. The computer's keyboard should look somewhat familiar to you because it resembles that of a typewriter. However, the keyboard contains additional keys that are necessary to effectively communicate with the computer.

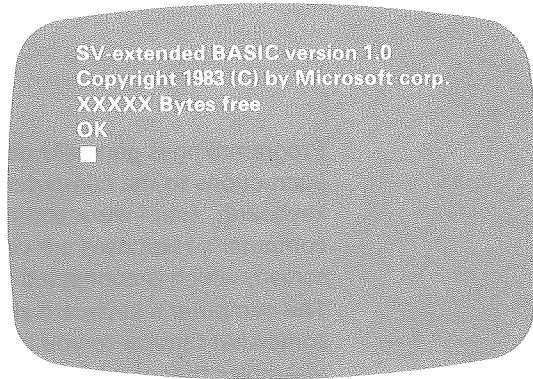
Turn on your computer (remember, the ON/OFF switch is located on the right side of the computer). You are off to a good start if the screen looks like this when you turn the computer on.



If you do not see the SpectraVideo logo on the screen immediately after turning on the

power, turn to the troubleshooting chart in Appendix G for assistance.

After several seconds you will see the following information appear on the screen.



The word "OK" is the message to you from the computer that it is ready to accept your commands. The white square underneath the word "OK" is called the "cursor." Its position on the screen informs you of the location of the next letter you type. Let's start typing and get acquainted with the SV-328 and its special features that aid you in working with the computer.

Begin by pressing the following keys:

P R I N T

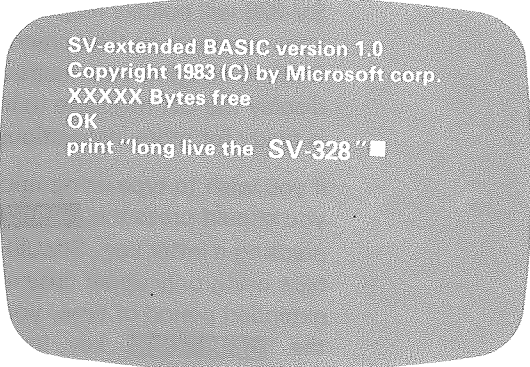
The cursor moves one position to the right every time you press a key.

Now find the **SHIFT** key (on the lower left side of the keyboard), and while holding it down, press the double quotation mark, **"**, key. This should cause the quotation marks to appear as on a typewriter.

Type the following message:

" LONG LIVE THE SV-328 "

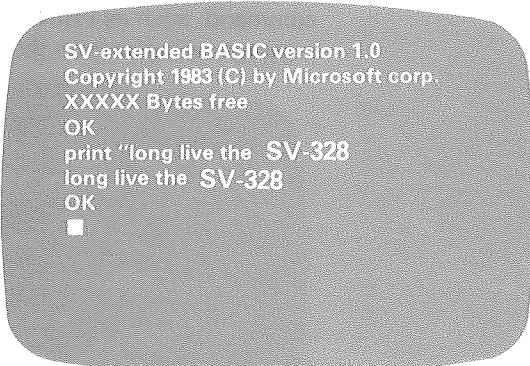
Now make another double quotation mark at the end of the message by pressing **SHIFT** ". The screen should now look like this:



SV-extended BASIC version 1.0
Copyright 1983 (C) by Microsoft corp.
XXXXXX Bytes free
OK
print "long live the SV-328"■

If you ever make a mistake while typing - for example, you accidentally type the single quote mark instead of the double quotation mark - all you need to do is press the backspace key, and retype by pressing the **SHIFT** and while holding it down, press the double quotation mark, **↵** Key. The backspace key permits easy retyping by erasing the character immediately to the left of the cursor.

Now press the **ENTER** key and look at the screen. It will look like this:



SV-extended BASIC version 1.0
Copyright 1983 (C) by Microsoft corp.
XXXXXX Bytes free
OK
print "long live the SV-328
long live the SV-328
OK
■

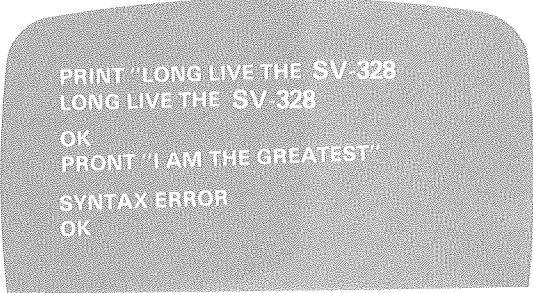
When you press the **ENTER** key while in immediate mode, you are telling the computer that you have finished working and that you want the computer to begin working. The SV-328 will politely respond and "PRINT" your message on the screen. When it has finished obeying your instructions, it will display the OK message to inform you that it is ready for more instructions.

If you wish to type using upper case letters, you should press the **SHIFT** key while pressing a letter key. Should you desire to type using only upper case letters for an extended period of time, you should press the **CAPS/LOCK** key, located on the lower left side of the keyboard.

The **CAPS/LOCK** key toggles between the upper and lower case letters. When you wish to return to lower case letters, press the **CAPS/LOCK** key a second time to unlock it.

Now it's your turn to enter other messages in immediate mode. Don't forget to press the **ENTER** key when you have placed the closing double quotation mark at the end of each message. If a message is longer than a single screen line, the computer will automatically advance to the next screen line, thus alleviating the need for a return key as on a typewriter (more on this last point later).

If you misspell a word that is a BASIC command, such as PRINT, the following message will appear on the screen:



```
PRINT "LONG LIVE THE SV-328  
LONG LIVE THE SV-328  
OK  
PRONT "I AM THE GREATEST"  
SYNTAX ERROR  
OK
```

The SYNTAX ERROR message tells you that you spelled an instruction incorrectly. Don't worry, the computer is very forgiving and patient. We will explain how to correct his mistake in the next chapter.

You can clear the entire screen at once by pressing the **CLS/HM** key, located on the right side of the top row of keys. The abbreviation "**CLS**" stands for ClearScreen.

When you have finished practising entering messages for the computer to print, please continue reading.

KEYBOARD LAYOUT

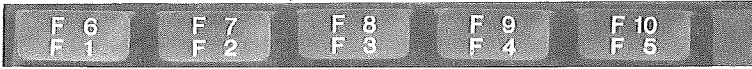
So far we have introduced you to the following keys: letter and number keys, the backspace key, the **ENTER** key, and the **CLS/HM** key. These keys are highlighted below



The SV-328 has many convenient features that are operated by certain keys. You will find these special keys to be both helpful and time saving. The remainder of this chapter will describe these keys, most of which will be new and some of which will be a review.

FUNCTION KEYS

Look at the top row of keys on the keyboard,
the ones highlighted below.



These keys are called "function" keys and each one is marked with the letter "F." They are a labor-saving device because they allow you to instruct the computer to perform a frequently used function by pressing only one key instead of having to type many keys.

Here is a list of each key, the function it performs and a brief description of the function. Most of these functions will be explained in more detail in the coming chapters. Consult the SV Reference Guide for additional information.

KEY	PRE-DEFINED FUNCTION
F1	color
F2	auto
F3	goto
F4	list
F5	run
F6	color 15,4,5
F7	cloud"
F8	cont
F9	list.
F10	Lrun

Function keys **F1** through **F5** are operated by pressing the appropriate key. Function keys **F6** through **F10** are operated by pressing the **SHIFT** key and holding it down while simultaneously pressing the appropriate key.

F1 COLOR

The COLOR command is used to change the text, background and border colors on your TV or monitor.

F2 AUTO

The AUTO command is used to make the computer generate program line numbers automatically. This command is used very often, since all programming statements must be preceded by line numbers.

F3 GOTO

GOTO is a command which provides you with the ability to execute your program from any place (line number) you desire.

F4 LIST

This command instructs your SV-328 to print all of your immediately preceding program statements on the screen. LIST is probably the most often used computer command.

F5 RUN

RUN tells the computer to take the program you have written and perform the commands you have indicated.

F6 COLOR

This tells the computer to print white letters on a blue background with a blue border. These colors are the colors of the screen when you turn the computer on.

F7 CLOAD"

CLOAD instructs the computer to input (load) data from a cassette recorder (which can be easily connected to your SV-328).

F8 CONT

This command is used to tell the computer to "continue" program execution after the last executed line.

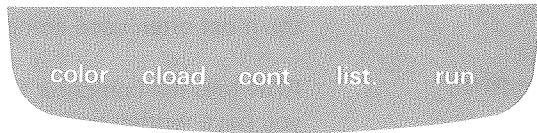
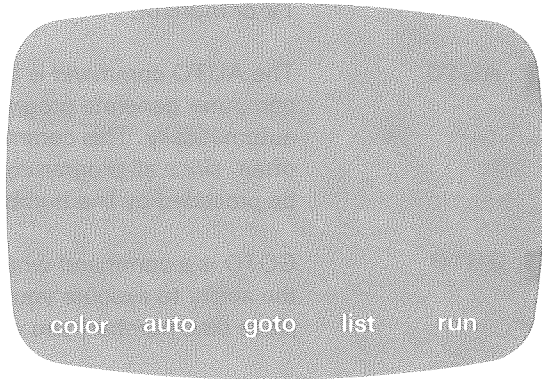
F9 LIST.

With this LIST. (with a period next to it) only the last line you were working on (whether programming, editing, etc.) will be displayed on the screen.

F10 L RUN

This command is similar to the standard RUN command. However this command also clears the screen before it "runs" your program.

On the bottom of your TV screen, the SV-328 lists the function that each key performs.



SHIFT

The SV-328 will normally display the function of keys F1 through F5, and whenever you press the **SHIFT** key it displays the function of keys F6 through F10.

Any of these pre-defined functions can be quickly changed for your own convenience to a function that you frequently use. See the SV Basic Reference Guide for further details.

**NUMERIC
KEYPAD
and CURSOR
CONTROL
KEYS**

The numeric and cursor control keypad contains keys that are primarily used for simple numeric entry, word processing and cursor control. The following are the commands that are accessed by this keypad.



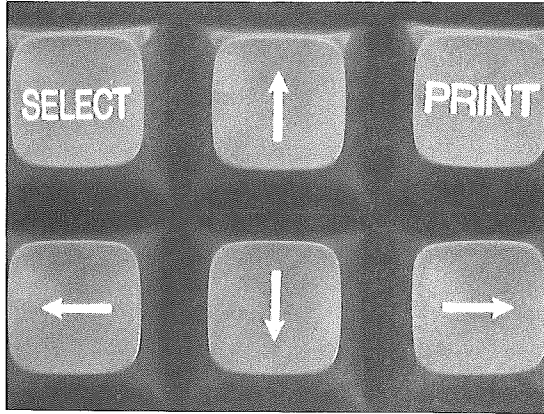
Numeric Keypad

The numeric keys (**1-9**) are the same as the keys on the top of the regular keyboard. These are used when performing rapid entry of numeric data. This keypad also contains the mathematical functions keys (+, -, *, /) which can be used to enter formulas and to perform quick calculations.

SELECT and PRINT Keys

The **SELECT** and **PRINT** keys are also included on this keypad to allow the advantage of using these functions that are often available in word processing and data entry software packages. These keys have no function in BASIC programming and are only accessed from programs such as those mentioned above.

Arrow
Keys
(Cursor
Control)



The arrow keys (**up, down, left & right**) control the movement of the cursor on the display screen. By pressing a combination of the up and left arrow keys, you will cause the cursor to move towards the upper left corner of the display screen. Other combinations will work in the same fashion giving you 8 directions of cursor movement using these keys.

**PROGRAM
CONTROL
KEYS**

The following are the program control keys used to control the operation of computer programs.

STOP

The **STOP** key. Press this key to pause the computer after you have instructed it to RUN or to perform a function (which makes it begin working on your program). Press the **STOP** key a second time to instruct the computer to resume working on your program or a function.

CTRL

The **CONTROL** key. This key is used in conjunction with the STOP key. In effect, this tells the computer to stop what it's doing and turn control back over to you (so that you can issue further instructions). Press the **CTRL** key while simultaneously pressing the **STOP** key.

ENTER

The **ENTER** key. Press this key at the end of each instruction you type. By pressing this key you are telling the computer to enter the instruction you just typed into its work space. As previously mentioned, the **ENTER** key is not used to advance the cursor to the next screen line and therefore should not be confused with the return key on a typewriter. In the event that an instruction contains more characters than can fit on a single screen line, the computer will automatically advance the cursor to the next screen line. For example:

```
PRINT "I WISH WE WOULD HURRY UP WITH THIS  
INTRODUCTION SO THAT I CAN BEGIN TO P  
ROGRAM"
```

This long instruction cannot possibly fit onto a single screen line which has room for only 40 characters. Whenever this happens, the computer will automatically advance you to the next line. In the above example, the **ENTER** key should only be pressed after you have typed the closing double quotation marks that follow the word PROGRAM.

MISCELLANEOUS KEYS

CAPS LOCK

The **CAPS/LOCK** key — pressing this key will toggle the display characters from lower case to upper case or upper case to lower case.

CLS/HM COPY

The **CLS/HM** key — pressing this key will clear the screen and move the cursor to the upper lefthand corner of the screen. When

pressed together with the **SHIFT** key, it will move the cursor to the upper lefthand position (Home) but will not clear the screen.



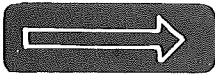
The **INS/PASTE** key — this key is used when you wish to insert characters within a line. Just move the cursor to the location where you wish to insert, then press this key and the text you type will be inserted.



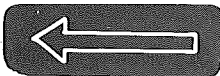
The **DEL/CUT** key — press this key to delete the character under the cursor.



This key is often used in software application programs. Its usual function is to interrupt the operation of a program or to continue operation following an interrupt. (Escape)



This key is not used in BASIC. It is often used in a word processor or similar application program to space forward 5 spaces to begin a paragraph.

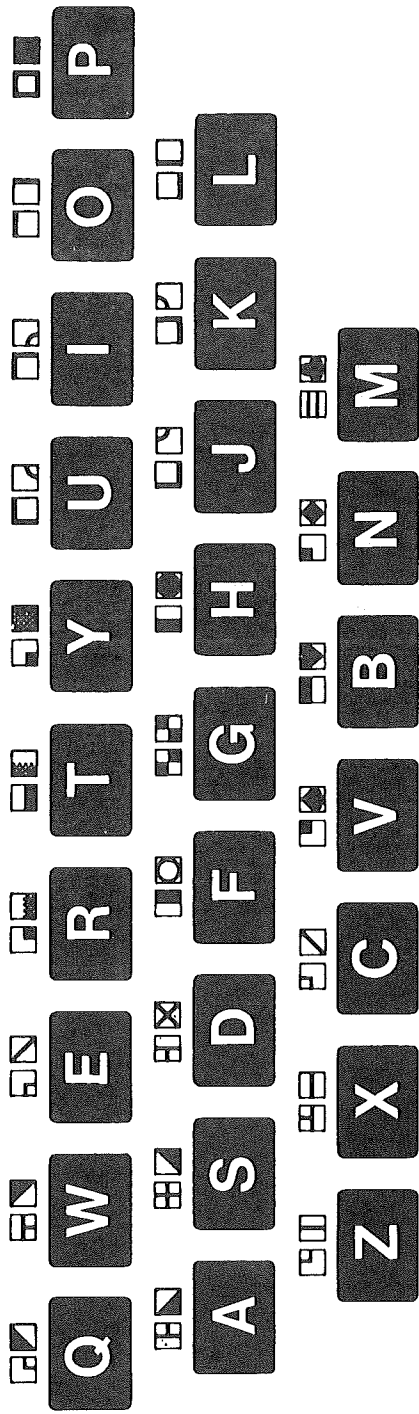


This key backs up the cursor one space. It deletes the character immediately to the left of the cursor prior to the key press.

You will soon have the opportunity to use the **INS/PASTE** and **DEL/CUT** keys.



The **LEFT GRPH** and the **RIGHT GRPH** keys are used to select the graphic symbols that correspond to the keys which are displayed on the following chart. If you press the **LEFT GRPH** key and hold it down while simultaneously pressing one of the letter keys, the graphic symbol above and to the left of the corresponding key on the following chart will be displayed. The corresponding symbol on the right side of the letter key can be displayed by pressing the **RIGHT GRPH** key and the corresponding letter.



THE KEYBOARD GRAPHICS CHART

Now that you have learned how to hook up your computer and are familiar with the keyboard, you can proceed further in the manual. However, if you are anxious to begin using your computer, please turn to **Appendix I** for some simple demonstrations.

After completing these exercises, return to chapter 3 to continue.

EASY EDITING

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3

EASY EDITING

The BASIC Screen Editor lets you change a line anywhere on the screen. You can change only one line at a time. The Screen Editor can be used after an OK prompt appears and before a RUN command is issued. By using the Cursor Control Keys and the editing keys, you can move quickly around the screen, making corrections where necessary.

"SCREEN EDITOR"

Here is an example to show you how to use the Screen Editor. A more detailed description of the Screen Editor's syntax can be found in the SV Basic Reference Guide.

Let's enter the following program.

```
10 REM SCREEN EDITOR DEMO  ENTER  
20 PRINT "DEMONSTRATION OF" ENTER  
30 END ENTER
```

Note: Remember that a program line must always begin with a line number. If you make a mistake, just press **ENTER** and retype the line.

After you have finished, press the **CLS/HM** key then type LIST or **F4** and press **ENTER**. You should see:

```
LIST
10 REM SCREEN EDITOR DOMO
20 PRINT "DEMONSTRATION OF"
30 END
OK
```

Now correct the word DOMO in line 10. First use the cursor Key's UP direction key to move to line 10 and then the RIGHT direction key to move the cursor to the top of the letter "O" of "DOMO"

```
10 REM SCREEN EDITOR DOMO
20 PRINT "DEMONSTRATION OF"
30 END
OK
```

Press the letter "E" to change the word to "DEMO," then press **ENTER**. The line will be stored now as:

```
10 REM SCREEN EDITOR DEMO
```

You have just replaced the character "O" with the character "E." To verify this, press **CLS/HM**, **F4** (list), **ENTER**. You should see:



```
10 REM SCREEN EDITOR DEMO
20 PRINT 'DEMONSTRATION OF'
30 END

OK
```

The next step is to insert the two words SCREEN EDITOR into line 20. We do this by moving the cursor with the cursor control to the second quote of Line 20.



```
10 REM SCREEN EDITOR DEMO
20 PRINT 'DEMONSTRATION OF '
30 END

OK
```

"INSERT"
mode

Now press the **INS/PASTE** key and the cursor will become half as tall as before. This means you are in the "INSERT" mode. Type SCREEN EDITOR, bring the cursor back to the beginning of line 20, and press **ENTER**.

You have just inserted the words "SCREEN EDITOR." Follow the steps you used to verify line 10 and you will see:



```
10 REM SCREEN EDITOR DEMO
20 PRINT "DEMONSTRATION OF
   SCREEN EDITOR"
30 END

OK
```

Besides using the Screen Editor, you can also change a line by entering a new one with the same line number. BASIC will automatically replace that line.

A BASIC INTRODUCTION

4

A BASIC INTRODUCTION

ABOUT THIS BASIC TUTORIAL GUIDE

To be able to control a computer, you must be able to communicate your instructions in a language that the computer understands. The SV-328, like most personal computers, understands a language called BASIC (Beginner's All Purpose Symbolic Instruction Code). This language, which is built right into the SV-328, is a set of English words with which you can instruct the computer to perform certain functions.

This manual differs in many ways from other manuals written to teach BASIC. One of the major differences is that most of the information presented in this tutorial has already been used successfully to teach BASIC in the classroom.

This guide begins by describing those BASIC commands which allow you to design simple pictures and see them displayed on the TV screen. Our reason for introducing you to BASIC through graphics is simple. Learning BASIC is like learning a foreign language. If we can relate the new words of BASIC to the knowledge that you already possess about drawing, you can move smoothly into the computer age and have fun at the same time.

In the next few chapters we will explain several commands which allow you to create pictures. But there is much more to learn about the SV-328's graphic capabilities. It will be explained in greater depth in the latter

chapters of this manual and on the BASIC tutorial cassette tape.

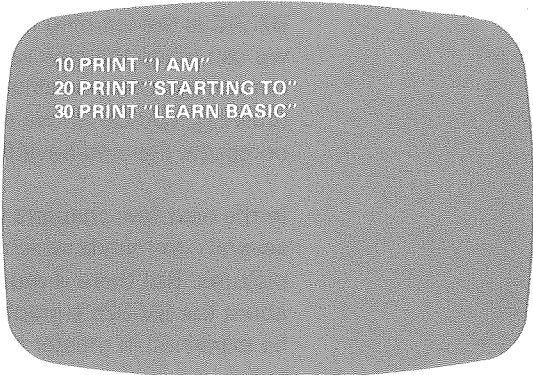
WHAT IS PROGRAMMING?

Programming is the act of writing the instructions and information that must be given to the computer in order for it to perform a task. Programs differ from one another in that the instructions and information necessary for managing a household's checkbook, for example, are different from the instructions and information needed to control a video game.

Programs written in one computer language will not contain the instructions and structure that a program in another computer language possesses. That is why professional programmers generally must specialize in one or two languages. It is the rare individual who is even aware of all the different computer languages that have been developed in the past twenty years.

There are two different ways to type a BASIC instruction into your computer: In "program" mode or in "immediate" mode.

As its name implies, you are in "program" mode when you write a program. A BASIC program is a set of instructions typed one instruction after the other with a line number beginning each instruction line. For example:



```
10 PRINT "I AM"  
20 PRINT "STARTING TO"  
30 PRINT "LEARN BASIC"
```

Line numbers are generally in intervals of ten to allow for easy reference when corrections are required or when additional lines need to be inserted. The computer executes your program after you type the word RUN.

The second way of instructing the computer is called "immediate" mode, because after each instruction is typed and the **ENTER** key is pressed, the computer will immediately respond. Do not precede the single line of instructions with a line number when you are in "immediate" mode.

ONE WORD BEFORE WE BEGIN

For most of the time spent with this tutorial, you will be in program mode. If you are serious about programming, then you will continue to write programs and very infrequently be in the immediate mode. The immediate mode is generally reserved for housekeeping details like saving programs on a cassette tape or disk, requesting a catalog of your programs stored on a disk and loading information from a cassette or disk into the computer.

We realize that these words and concepts are new for many of you, but don't worry. These ideas will become clearer as you continue reading.

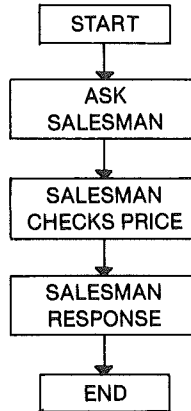
The model that we are about to present is critical to your fully understanding how a computer works and what it does with the program you type in.

Your interaction with the computer is similar to the following scenario.

If you were interested in buying a car you would probably call a car dealer for a price on a particular model. You might ask the salesman for a price on a Cadillac with power windows, power steering, leather seats, deep pile carpeting, and tinted windows.

The salesman will then proceed to check his price lists, write the numbers down on a worksheet, add the numbers together and quote you the total price.

Procedures to get information about a car.



By the same token, when you work with a computer, the computer is the salesman. You tell the computer exactly what you want just as you tell the salesman and in both cases you get an answer. Similarly, in both instances you do not see the many calculations that both the salesman and the computer perform before informing you of their answer. The instructions you give to the salesman or to the computer is the 'INPUT' they need to act on.

The calculations done on the salesman's worksheet are analogous to the work performed in the computer's erasable memory (called RAM), and the answer you get is called, the 'OUTPUT'.

By reading and practising the new language you have started to learn, you will be entering the ever expanding computer world. BASIC is only the beginning.

ENJOY.

WRITE YOUR FIRST PROGRAM

5

WRITE YOUR FIRST PROGRAM

GETTING STARTED The easiest way to draw pictures on the computer is similar to the way one plays the game Battleship.™

The goal of Battleship is to try to guess the positions of your opponent's ships. The game board for Battleship looks like this:

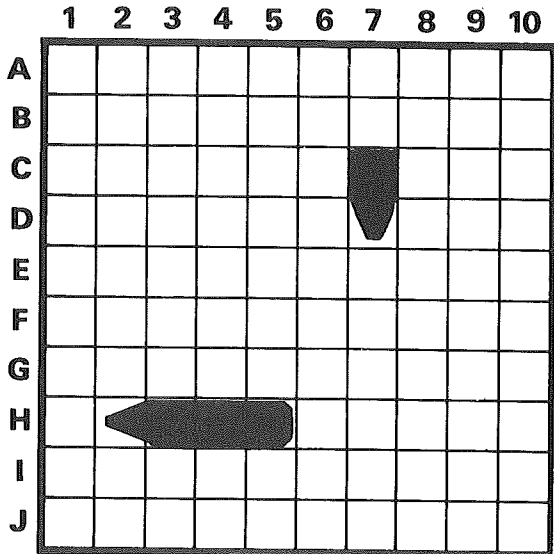


Figure 1 Battleship Game Board

FIGURE 1 shows how your opponent has his board set up. One of his ships is at positions H-2, H-3, H-4, and H-5. His other ship is at positions C-7 and D-7.

You must seek out his ships by calling the names of positions on the board. In this example, if you were to call H-2 he would reply that you hit his ship, but if you said, H-1, he would have told you that you missed.

The important lesson to learn here is the way you give names to each of the positions on the board. In essence, each position on the Battleship game board is a point on a graph.

**“GRID” and
“COORDINATES”**

To draw on the SV-328 you must also give a name to each box of the grid that is shown in Figure 2.

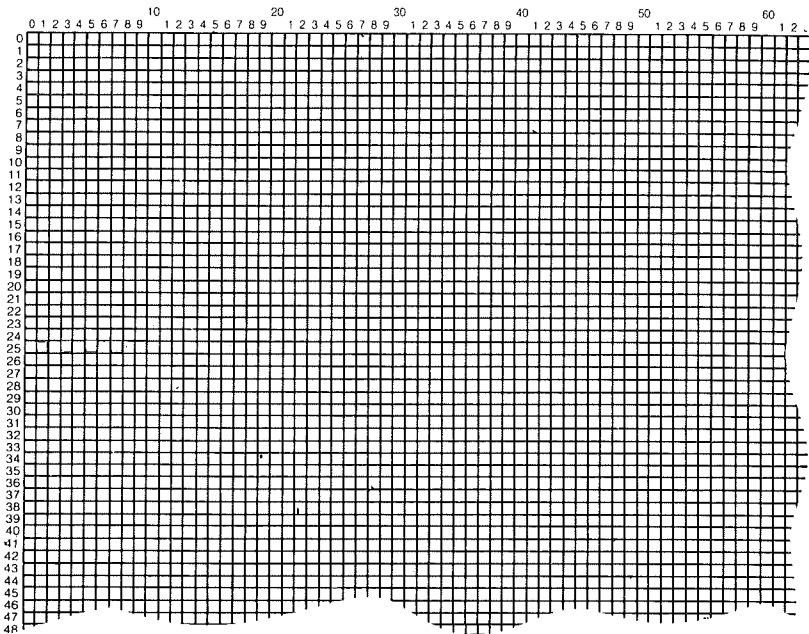


Figure 2

Each box has a name. The name is composed of two numbers: the number at the top of a column, and the number at the side designating each row. The first number is the horizontal location and the second number is the vertical location. These two numbers are called: the coordinate numbers of a point.

Understanding how to name boxes is very important for creating simple pictures. It is especially important because we are going to introduce you to many more BASIC instructions through which pictures can be created. Spend a moment on the following exercise before proceeding to the next section.

In FIGURE 3, several boxes are darkened. This signifies that they have been lit. Do you know the names of these boxes? Write them down on a piece of paper.

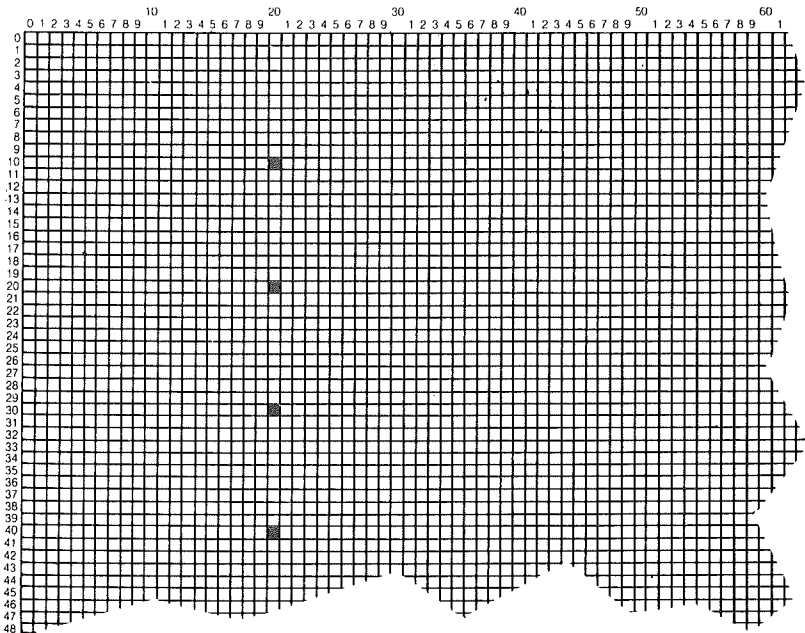


Figure 3

Your answers should have been

- A: (20,10)
- B: (20,20)
- C: (20,30)
- D: (20,40)

Now we will use these names in a program which will light the boxes in FIGURE 3. Type on the keyboard exactly what is listed below.

Don't forget to press **ENTER** at the end of each line. We will not always remind you from this point on. Pressing **ENTER** after each instruction should become second nature to you by the time you finish this book.

```
10 SCREEN 2
20 PSET (70,50)
30 PSET (66,54)
40 PSET (74,54)
50 PSET (62,58)
60 PSET (78,58)
70 PSET (66,62)
80 PSET (74,62)
90 PSET (70,66)
100 END
```

After you have checked to make certain that your program matches our program, type RUN.

What's the matter? Did the picture flash by too quickly? Don't worry we expected that little problem to occur. Do the following:

1. Type LIST **ENTER**

LIST

Your program is displayed again on the screen. As its name implies, LIST will list your whole program from beginning line number to the last number you used. If you typed LIST when you were in *immediate mode* and not using the line numbers, you would not see a program listed.

2. Type in the following new line.

```
95 GOTO 95
```

3. Type LIST **ENTER**

Notice that line 95 was inserted between lines 90 and 100 automatically by the computer. Remember what we had said earlier in this guide about line numbers and why we usually use numbers with an interval of ten between them. The insertion of additional lines is a natural occurrence when you write programs.

4. Type RUN **ENTER**

The computer not only draws the shape we want, but it also keeps the picture on the screen forever and does not allow you to type in anything at the keyboard. Try typing. The characters you type don't appear on the TV. Why? Because the machine is still RUNNING your program and will continue to do so until you press the **CTRL** - **STOP** keys simultaneously. Let's look at the program again.

```
10 SCREEN 2
20 PSET (70,50)
30 PSET (66,54)
40 PSET (74,54)
50 PSET (62,58)
60 PSET (78,58)
70 PSET (66,62)
80 PSET (74,62)
90 PSET (70,66)
95 GOTO 95
100 END
```

Before we added line 95, the picture appeared momentarily and then disappeared because the program did exactly what it was supposed to do (very quickly) and then disappeared. By adding Line 95, we told the computer to stay right where it is. To stop the program, press the **CTRL** - **STOP** keys simultaneously.

The **CTRL** - **STOP** key combination breaks the computer out of its continuous loop, and will stop the computer from whatever program happens to be RUNNING.

You will see whatever you type appear on the TV. Remember to press **ENTER** after you finish each line.

```
10 SCREEN 2
20 PSET (10,20)
30 PSET (20,20)
40 PSET (30,20)
50 PSET (40,20)
60 GOTO 60
70 END
```

Line 10 tells the computer that you are going to draw a picture on SCREEN 2.

SCREEN

There are 3 screens:

SCREEN 0 - Is the screen the computer displays when you turn it on. - This screen allows you to communicate with your computer and tell him what to do for you: type in your commands in the immediate mode, or type in your programs.

This screen allows you to enter 24 lines of text with a maximum of 40 characters on each line before the display starts to "scroll" or move up.

SCREEN 1 - Is the High Resolution graphics screen which you use to draw High Resolution graphics.

SCREEN 2 - Is the Low Resolution graphics screen which you use for drawing Low Resolution graphics.

(More about High and Low Resolution you will find in Appendix F)

Whenever you CTRL-STOP a RUNNING program which uses SCREEN 1 or SCREEN 2, the computer will automatically return to SCREEN 0 prompting you by displaying the "OK" message and the cursor. This will allow you to review (LIST) your program and make your modifications.

PSET

Line 20 introduces the PSET instruction. PSET tells the computer to turn on the box that is named (10,20). Remember, the first number in parentheses refers to the column and the second number refers to the row of the box.

Lines 30-50 continue to turn on the boxes we see darkened in FIGURE 3. Line 60 will soon be explained.

Now type RUN **ENTER** and your picture will be displayed. When you finish viewing your work, press the **CTRL** and **STOP** keys simultaneously to stop the program.

What you typed into the computer was your first program. Giving several instructions to the computer at once is generally more efficient than giving the computer one instruction at a time in immediate mode. (Remember that in *immediate mode* the computer executes the command you type immediately after you press the **ENTER** key.) If we didn't use line numbers to signify that we were writing a program but rather told the computer to turn on one box at a time, it would be like going to a supermarket ten times in one day and each time buying only one item. That would be a terrible waste of gas and time.

MAKE A DIAMOND

After all this talk, it is time for you to practise what we have been preaching.

Type NEW **ENTER**

NEW tells the computer to forget about the program you had previously typed

Try to write a program that draws the shape in FIGURE 4.



Figure 4

LET'S ADD SOME COLOR

Each of the boxes you light up can be in one of 16 colors. Here is a list of the 16 colors the computer uses and the corresponding number for each color.

COLOR #	COLOR
0	TRANSPARENT
1	BLACK
2	MEDIUM GREEN
3	LIGHT GREEN
4	DARK BLUE
5	LIGHT BLUE
6	DARK RED
7	CYAN
8	MEDIUM RED
9	LIGHT RED
10	DARK YELLOW
11	LIGHT YELLOW
12	DARK GREEN
13	MAGENTA
14	GRAY
15	WHITE

Before describing how to add colors to your drawings we will first demonstrate your computer's vivid colors.

Press the **CLS/HM** key to clear the screen and type the following:

COLOR 4, 15

[Note that function key #1 (**F1**) can generate the word "Color" for you]

then press **ENTER**. The colors of the background and text are now reversed. The numbers 4 and 15 represent two of the 16 colors listed above.

Let's experiment with the COLOR command. Begin by typing:

COLOR 4,4 **ENTER**

The text disappeared and the only thing you see is the blue background. Now type your name. You should hear the clicking sound but no characters are displayed on the screen. Here is why:

The first number following the COLOR command is the color you are instructing the computer to use for the display of text while the second number is the color the computer will use for the background. Since you instructed the computer to use the same blue color (4) for both the text and the background the text seemed to disappear. In other words, what you type is printed on the screen, you just can't see it! In order to return to "visible" text you need to type a new COLOR command, but it would not be easy without seeing the cursor or what you typed.

F6

Now you could appreciate the usefulness of function key #6.

First make sure that the cursor (which you cannot see) is positioned at the beginning of a "clean" new line. You do this simply by pressing **ENTER**.

You will still not see anything changed, but you will hear a beep. Since the last thing you typed was your name, by pressing the **ENTER** key you caused the computer to generate a "SYNTAX ERROR" message which is always accompanied by a short "warning" beep. (This, of course, wouldn't happen if your name is an actual word in the BASIC language).

Now, press the **SHIFT** key and while holding it down press function key # (**F6**). The display returns to normal and you should see now all the words you previously typed plus the "OK" and "SYNTAX ERROR" messages.

Take a look at the last color command on the screen:

COLOR,15,4,5

this is the command you gave the computer by using F6. (Note that you didn't have to

“ENTER” this command, since F6 “ENTERS” automatically.) You see that there is a third number added to the color command. We already know that the first number (15) is the text color, and that the second number (4) is the background color. The third number (5) is the color the computer uses for the border of the screen. The border is usually not displayed in the text mode (screen 0). That’s why the need to specify a border color exists mostly when you are using SCREEN 1 or SCREEN 2.

**BORDER
BACKGROUND
and
FOREGROUND**

We may think of the screen’s display as of three layers, one on top of the other. At the bottom there is the **Border**, above it there is the **Background** (which in the text mode, or SCREEN 0, covers the Border totally; and in the graphic screen (1 or 2) “grows down” in size and “exposes” the Border at the top and bottom of the screen.)

Above the Background comes the **Foreground** which might be described as a clear acetate layer that “carries” all the images that appear on the screen: on SCREEN 0 it’s the text, and on SCREEN 1 or 2 it’s the graphic image.

If you understood this concept you should feel comfortable with the following format description: the format of the COLOR command is

**COLOR, <foreground color # >
, < background color # >,
< border color # >**

Now, experiment with the numbers to get familiar with all the colors.

O.K. Let’s get back to the PSET command

PSET (10,20), 3 **ENTER**

Now change the color,

PSET (10,20), 8 **ENTER**

The PSET command only scratches the surface of the almost unlimited graphic capabilities of the SV-328. The majority of commands to create exciting pictures on your computer will be described after we have introduced you to the BASIC language.

GOTO

Before we end this chapter, type in this popular little program that uses the GOTO command in a way that is easily understood.

First type NEW **ENTER**

and then

```
10 PRINT "I LOVE MY SV-328  
COMPUTER" ENTER  
20 GOTO 10 ENTER
```

now type RUN

Press the **CTRL -STOP** key combination to stop the runaway program. Do you understand why the machine printed "I love my SV-328 computer" again and again? Here's why.

Line 10 tells the computer to PRINT the message between the parentheses on the screen. And Line 20 tells the computer to go back to line 10 and print the message again. After it is printed a second time, the computer reaches line 20 again and is sent back again to line 10 and then again and again . . . to infinity. Now try inserting other messages in between the parentheses in line 10. The quickest way to change line 10 is as follows:

First type LIST

to see your program. (Don't forget to press **ENTER**.)

Next retype

10 PRINT "

Now add any message you want, such as your name, and put a closing quotation mark at the end of your message. After you have finished retyping line 10 and pressed **ENTER**, the change has been entered in the computer's memory.

Now type RUN

and the revised message should appear on the screen. We will have more to say about the PRINT command in a later chapter.

We suggest that you read appendix F now for some clarification on High and Low Resolution and then continue reading this tutorial in order, even though the material on BASIC, and contain much valuable information to help you utilize the exceptional graphic and sound features of the SV-328.

GOING THROUGH THE LOOPS

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6

GOING THROUGH THE LOOPS

After using the PSET command in the previous chapter, you probably thought: there has to be a way to turn on the lights of particular boxes that is quicker than having to name each box individually. Well there is! But before we show it to you, first type in the following program:

In SV-BASIC there is a nice shortcut that saves you from always having to type out the word command **PRINT** - just type in a **question mark (?)**-it serves the very same purpose!

```
10 CLS
20 PRINT "TELL ME A NUMBER"
30 INPUT Y
40 SCREEN 2
50 PSET (30,Y)
60 PSET (45,Y)
70 PSET (60,Y)
80 PSET (75,Y)
90 GOTO 90
```

Now type RUN

Your program should have disappeared and the message "TELL ME A NUMBER" should suddenly appear on a cleared screen. The screen was cleared thanks to the CLS command which stands for "ClearScreen", which is on line 10.

The message is output to the screen by the PRINT command in line 20, and the cursor should appear just after a question mark.

INPUT

The question mark was put there by the command INPUT. INPUT tells the computer

“CONTAINERS” and “VARIABLES”

The type of a variable container discussed in this chapter is a numeric container. This is used for the storage of numeric values only. Non-numeric (or Alpha-numeric) variables will be discussed in chapter 8.

to wait and not go on to the next instruction of the program until you type something in at the keyboard. Whatever you type in is stored in a “container” in the computer’s erasable memory.

The more technically oriented of our readers will recognize that the container we are referring to is a `variable`. The following explanation about the way a computer uses containers to store information is meant for those readers who aren’t comfortable with the term “variable.”

Before we continue with the description of containers, let’s first observe a container in action. First type in a number between 0-191 and press `ENTER`. (If you press a number greater than 191, an error message will appear.)

If you typed in a number between 0-191 and pressed `ENTER`, a line should have been drawn on the screen. The location of that line depends on the number you typed in. Here is why.

The number you typed is stored in a container called “Y”, as designated in line 30. Think of “Y” as a cup, and the number you typed as a mark on a piece of paper that is placed in the cup. When the computer reaches line 50 and it is time to turn on the box that is specified by the name (30,Y), the computer looks in the cup marked “Y” and substitutes the number you typed in for the letter Y wherever “Y” appears. So if you had typed in 27, the number 27 would be stored in the container “Y”. When the computer reaches line 50 it will light up box (30, 27); at line 60 box (45,27); at line 70 box (60,27); and finally at line 80, box (75,27).

CONTAINERS IN THE COMPUTER'S MEMORY

It would be very difficult to store and retrieve information if we did not have a clear way of referring to the information we use. Thus we have chosen the term "container" to designate a particular location in the computer's erasable memory where information is stored. The letter "Y" is only one of many possible symbols we can use to "name" the containers.

A container's name can be thought of as the number part of the address of your home. If a friend mails a letter to you and the envelope bears only the name of the street you live on but not the specific number of your house, it is quite possible that your mail will be placed in the wrong box. Similarly, if we feed into the computer information that is not "correctly addressed", we will have a hard time finding the information we need later on. Our ability to communicate with the computer will then be severely limited.

ONE LAST WORD ABOUT CONTAINERS

The SV-328, like most personal computers, uses two different sets of containers. One set of containers holds only numbers, the second set holds both numbers and words.

A container whose name begins with the letters A-Z holds only numbers but when a dollar sign, "\$", is placed after the letters it can hold both numbers and words. A container name can be up to 2 characters in length-it can't be a word of BASIC Language-for example, SV, DL, HF, L1, etc, are legal containers names. Type :

```
10 CLS
20 PRINT "WHATEVER YOU TYPE IN
WHEN THE QUESTION MARK
APPEARS AFTER YOU TYPE RUN, I
WILL REPEAT"
30 INPUT A$
40 PRINT A$
50 END
```

Type RUN

Then type a number in response to the dollar sign, and watch the computer echo whatever you typed (remember to press **ENTER** when you finish your input).

Then type RUN

again and this time type in a word or two in response to the question mark (and press **ENTER**).

What happens when you mix both numbers and words in the same container? Is the mixture accepted? Try it by RUNning the program again.

You may store a maximum of 255 characters (letters) in any one container. Likewise, you can type a maximum of 255 characters on any one line of your BASIC program. Experiment to see what happens when you try typing more than 255 characters. RUN the program again, and this time type more than 255 characters after the question mark and then press **ENTER** . You should see that the extra characters were ignored.

CONTAINER STORAGE AND RECALL

There are various commands that tell the computer what information to put into a specific container. We have already seen that INPUT puts the information that you type into a container. Here is another way. Type,

```
10 CLS
20 LET A = 10
30 LET B = 20
40 LET C = A + B
50 PRINT C
60 END
```

Now type RUN

LET

The number 30 should have been printed out on the screen. This program illustrates how one assigns information to containers. The command LET prefaces the name of the container you wish to use and the container is placed on the left side of the equal (=) sign. The information you wish to place into the container is written on the right side of the equal (=) sign. After the number 10 has been placed in "A" and the number 20 has been placed in "B", the computer adds the numbers together and places the sum into container "C". Thus the computer's answer is found in container "C" and the contents of container "C" are printed on the screen. You do not have to use the command LET to assign information to a container. The following program does exactly the same thing:

```
10 CLS
20 A = 10
30 B = 20
40 C = A + B
50 PRINT C
60 END
```

The use of LET generally helps to improve the readability of your program. This is helpful when someone else looks at it, or when you look at it after not reading it for a long period of time.

Now we'll show you another way to use containers...one that allows you to draw quickly.

QUICK DRAW

The following techniques will not only help you to draw quickly—they will also prove to be invaluable in almost any program you write. Type and RUN the following program:

```
10 CLS
20 FOR X = 0 TO 64
30 PRINT X
40 NEXT X
50 END
```

Surprised at the result? You really should not be. This program uses the same kind of loop and container that we have been discussing.

FOR/NEXT

After line 10 clears the screen, line 20 instructs the computer to place all the numbers between 0 and 64 into the "X" container one at a time. The obedient computer begins by putting a 0 in the "X" container. The instruction to PRINT X on line 30 forces the computer to look up the number stored in the "X" container and display it on the TV. Then on line 40 the computer is instructed to take the next number after 0 and place that in the "X" container. Since a container can hold only one item at a time, the 0 is erased from the "X" location in the computer's erasable memory and the number 1 is now placed in the "X" container. Then the computer is sent back to line 20 to begin the process again.

Since the number 1 is one of the numbers designated to be placed in "X", the computer proceeds to line 30 where it finds the number 1 stored in "X", and proceeds to PRINT the number 1 on the screen. Line 40 causes the number 1 to be erased from "X", places the number 2 in the container and returns the computer to line 20 where the same events occur. This loop continues until the number 64 has been placed in "X" and has been displayed on the screen. Since 65 is not one

of the designated numbers on line 20, the computer sees the END command on line 50 and stops.

The FOR-NEXT commands are always a pair. Never use one without the other. The FOR-NEXT loop is fundamentally different from the loop we can create with the GOTO command. As your programming skills develop, you will learn when the use of each is appropriate.

Do you think you can change one line of the program which printed out the numbers between 0-64 to draw a straight line across the whole screen? Before you read how it's done, try it yourself. Hint: One line has to be changed and two lines added.

```
10 SCREEN 2
20 FOR X = 0 TO 255
30 PSET (X,25)
40 NEXT X
50 END
```

Type RUN and watch how effortlessly the computer draws that line!

The computer is told on line 30 to put all the numbers between 0-255 into "X" container one at a time. A 0 is placed in "X" in line 30. And when the instruction to turn on the box named (X,25) is given in line 40, the computer checks to see what number is stored in "X" and substitutes the 0 for the container name in the name of the box, so the first box lit is box (0,25).

NEXT X on line 50 places the number 1 in "X". Since 1 is a designated number, the

second box the computer lights up is box (1,25). The number one stored in "X" is substituted for the "X" in line 40. This loop continues until all 255 boxes in row 25 have been lit.

Now try changing the loop program which drew a horizontal line on row 25 to one that will draw a vertical line at column 30 from the top of the screen. Your program should look like this:

```
10 CLS
20 SCREEN 2
30 FOR D = 0 TO 191
40 PSET (30,D)
50 NEXT D
60 END
```

Notice that this time we told you to use a different container name. "D" is the designated container that will hold all the numbers between 0-191. This looping program works exactly like the program, above, that draws the horizontal line.

We have spent much time explaining to you how containers work in a non-technical way. This was important because the more you know about how the computer works and the precise cause-and-effect of every command in BASIC, the better use you can make of the SV-328's features.

SOME TIME SAVING HINTS

We have seen how loops can save you time. Another little time saving tip is this. You need not always place the END command at the end of every BASIC program. Although it is good practice to do so, you will quickly learn where END is necessary.

```
10 CLS
20 PRINT "I LOVE MY SV-328"
30 GOTO 20
```

END

The END command is not needed at the end of this program because the way the program is structured the computer will never pass line 30. It will be caught in a continuous loop until you press the **CTRL - STOP** key combination.

Similarly, you need not always precede your program with

```
10 CLS
```

You should decide when you have to work with a clear screen and when you don't.

When using the SCREEN command you do not need to use the CLS command because the SCREEN command automatically clears the screen.

SETTING THINGS IN MOTION

7

SETTING THINGS IN MOTION

Now that you know how to use containers to draw a line, let's add one line to the program you did in the previous chapter. This addition will cause a dot to move across the screen.

```
10 SCREEN 2
20 FOR X = 0 TO 256
30 PSET (X,25), 11
40 PRESET (X,25)
50 NEXT X
```

RUN

Was that a bit too quick for you? Before we show you how to slow the bouncing ball down, let's review this program to learn how we create the illusion of motion.

PRESET

The new command **PRESET**, on line 40, acts just the opposite of **PSET**. **PSET** turns boxes on and **PRESET** turns boxes off. In our program above, **PRESET** turns off the very same box that **PSET** turned on. In line 30 we told **PSET** with what color to light the boxes. In line 40 we don't have to tell **PRESET** a color number. **PRESET** merely turns the box off to the background color of the screen.

How can we slow our bouncing ball down? Well, it makes sense to somehow slow down the computer so it will be delayed between line 30 and line 40, because the slower the

boxes get turned off, the longer they will stay on and the easier it will be for an observer to follow the path of the ball. We will add what is known in computer jargon as a time delay between line 30 and line 40.

Add the following lines:

```
35 FOR T = 0 TO 50  
37 NEXT T
```

Now type LIST

and your program should look like this:

```
10 SCREEN 2  
20 FOR X = 0 TO 256  
30 PSET (X,25), 11  
35 FOR T = 0 TO 50  
37 NEXT T  
40 PRESET (X,25)  
50 NEXT X
```

Now type RUN...

Your program should now be considerably easier on your eyes because the dot will move more slowly across the screen. Lines 35 and 37 should look familiar to you. They are an example of your typical FOR-NEXT loop, with an important difference.

In the previous chapter we stuck a command (such as PSET or PRINT) between the FOR X and the NEXT X commands. In the bouncing ball program we did no such thing. Rather, by placing the FOR T and the NEXT T commands on consecutive lines, we caused the computer to wait a certain amount of time before proceeding to line 40. Lines 35 and 37

caused the computer to stop and count from 0 to 50. The computer merely placed the numbers between 0 and 50 into the container called "T" one after the other, and that took up time. Hence, this use of the FOR-NEXT loop is called a "time delay".

To speed up the moving dot, simply change the last number you want to be placed in the "T" container to a number less than 50. For example,

```
35 FOR T = 0 TO 25
37 NEXT T
```

To slow down the bouncing ball, simply increase the last number to be placed in the T container to a number greater than 50. For example,

```
35 FOR T = 0 TO 100
37 NEXT T
```

WALKING BACKWARDS

Now that you have mastered how to make the ball move forward, from left to right, it is time to make the ball move backwards, from right to left. Add the following lines to the bouncing ball program:

```
60 FOR Q = 256 TO 0 STEP-1
70 PSET (Q,25), 11
80 FOR F = 0 TO 10
90 NEXT F
100 PRESET (Q,25)
110 NEXT Q
```

STEP

The new addition to the revised bouncing ball program is the line 60. You are probably wondering where the STEP - 1 came from. Here's why.

The instruction

FOR X = 0 TO 256

means that the computer is instructed to place all the numbers between 0 and 256 into the "X" container one at a time. The "one at a time" instruction need not be written explicitly.

FOR Q = 0 TO 256 is equivalent to FOR Q = 0 TO 256 STEP 1

Which means move from 0 to the next number, one at a time. When you do not specify how many numbers to STEP to, the computer automatically assumes you mean to advance by one number at a time. We could just as easily have instructed the computer to jump from 0 to 2 with the instruction,

FOR Q = 0 TO 256 STEP 2

Therefore, line 60, **FOR Q = 256 TO 0 STEP -1**

is interpreted by the computer to mean placing all the numbers between 256 and 0 into container "Q" one number at a time in descending order. That is how we get the ball to move backwards.

By deleting just one line you can see a drastically different result. The present program bounces the ball back and forth across the screen. Try it. Delete line 100 by typing.

100 ENTER

Now type **LIST**

to prove to yourself that line 100 was erased, type,

RUN

When you deleted line 100, the boxes that are lit up by line 70 are no longer turned off. Now change the program by adding one line which will make it get stuck in a continuous loop. Try it before you read on.

You should have added,

120 GOTO 20

This addition tells the computer to return to line 20 and start drawing the ball and the line again. It looks a little like a yo-yo.

FIRST CHALLENGING PROGRAM

Using all the material you have learned up to this point, try writing a program that will create a picture in which a ball tumbles down a staircase. This program is tricky, but remember we have placed it here to really challenge you. It should be easier to tackle if you first instruct the computer to draw a staircase and then concentrate on making a ball move down the stairs. The finished product should resemble the picture in FIGURE 5.

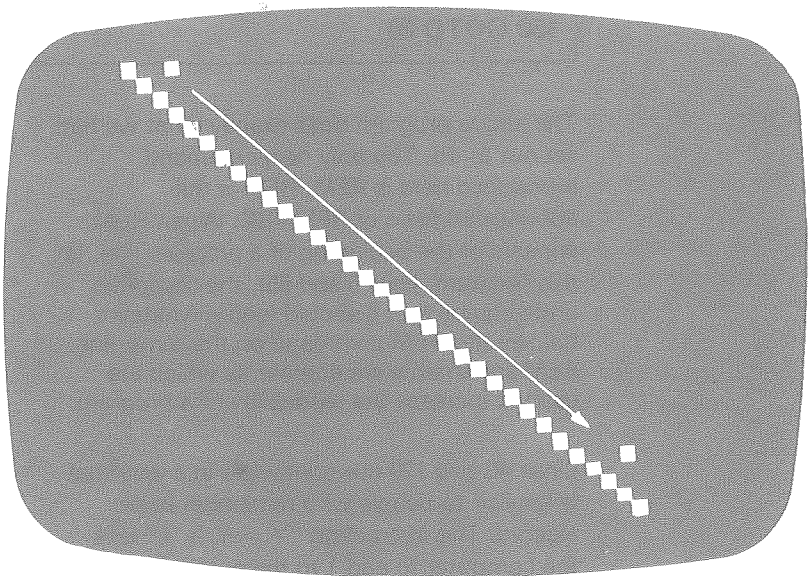


FIGURE 5

Our program to accomplish this task is listed below.

```
5 REM THIS SECTION OF THE
PROGRAM DRAWS A
STAIRCASE
10 SCREEN 2
20 FOR X = 0 TO 191
30 PSET (X,Y), 6
40 Y = Y + 1
50 NEXT X
55 REM THIS SECTION OF THE
PROGRAM DRAWS THE BALL
TUMBLING DOWN THE STAIRS
60 Y = 0
70 FOR X = 4 TO 191
80 PSET (X,Y), 15
100 FOR T = 0 TO 100
105 NEXT T
110 PRESET (X,Y)
120 Y = Y + 1
125 NEXT X
135 CLS
140 Y = 0
150 GOTO 20
```

REM

The above program does exactly what we had set out to do. The only new command introduced here is REM. REM is the abbreviated form of REMARK. When REM appears at the beginning of a program line, (in this program, lines 5 and 55), the computer understands that it should ignore whatever follows the REM command on the same line. REM statements are comments which are used to increase the readability of a program.

Lines 40 and 120 use containers in a way that is familiar to people who remember basic algebra. The instruction "Y = Y + 1" tells the computer to add 1 to the number that is

stored in the "Y" container and then place the new number back in the "Y" container.

If you were not able to complete the staircase program, do not be discouraged. As mentioned at the beginning of this guide, we differ from other tutorial texts in many ways. In addition to offering in-depth, non-technical explanations of the BASIC commands we also supply you with challenging exercises.

DECISION MAKING

8

DECISION MAKING

GETTING SMART

Up until now we have been introducing you to the BASIC language through graphics. Now we will begin to explore many other BASIC commands in different settings.

IF/THEN

In order to program the computer to make decisions, we use the instruction known as the IF-THEN statement. (Note: this is the first time we have used the word "program" as a verb. Previously we used the word as a noun, but the verb for creating a program is programming and we will start using this official term.) Let's see how it works. Enter (this is the verb we will now be using alternatively for the word "type") the following program:

```
10 CLS
20 PRINT "TRY TO GUESS THE
   NUMBER THAT I AM THINKING
   OF. I'LL GIVE YOU A HINT. IT IS
   BETWEEN 0 AND 100:"
30 A = 50
40 INPUT X
50 IF X = A THEN GOTO 100
60 PRINT "SORRY, YOU DID NOT
   GUESS IT. TRY AGAIN:"
70 GOTO 40
100 PRINT "GREAT GUESS. YOU ARE
   CORRECT, THE NUMBER I WAS
   THINKING OF IS 50:"
```

Now RUN the program. The INPUT command in line 40 will cause a question mark to appear on the screen. Enter your guess after the question mark. Line 50 of the program compares your guess that is stored in container "X" with the number that is stored in container "A". If you guessed the number 50 then the computer will jump to line 100. If you did not guess the number 50, and container "X" holds any other number, the computer automatically continues to line 60. There, it informs you of the result and sends you back to line 40 which places another question mark on the screen and waits patiently for your next guess. If you entered 50 as your guess, then the test on line 50 sends you to line 100 which prints out the appropriate message. Let's take a closer look at the IF-THEN statement. Like the FOR-NEXT loop, the IF-THEN command is used very frequently.

The IF-THEN statement performs a test. In our example the command meant: if $X = A$ was true then the computer must jump to line 100. If the test proved to be false (the number stored in "X" did not equal the number stored in "A"), then no action was to be taken (e.g. do not jump to line 100). Instead the computer just continues with the next line in order.

STRING VARIABLE

In chapter 6 we mentioned that your computer uses 2 different types of containers: One kind stores only numbers and is called a "Numeric Variable," while the other store both letters (words) and/or numbers as long as they are placed between double quotation marks. This variable is called a "String Variable" (Because a word is a group of characters that are strung together).

To differentiate between the two types of variables a Dollar sign (\$) is placed after the name you choose for the variable.

Example: A\$ = "VARIABLE"
B\$ = "2 Variables"
C\$ = "1234"

We will now challenge you to write a program that requires the use of a String Variable.

**ANOTHER
CHALLENGING
PROGRAM FOR
YOU TO WRITE**

Listed below is the English description of a program that you should try writing and running. The three steps below describe the three major components of this program. The first two steps can each be translated into one line of BASIC commands that the computer understands. Step 3 will require several lines of BASIC commands to ensure that the computer does what is described. The program you write should behave as described in the three steps.

STEP 1: The computer asks you (by displaying the message on the TV) whether it should list all the numbers between 0 and 100 for you on the screen.

STEP 2: The computer waits for your answer and stores it in the type of container that holds words.

STEP 3: The computer checks your response. If you type in the word "YES" it will proceed to print the numbers between 0 and 100 and if you type "NO" the computer will say "GOODBYE" to you rather than print the numbers.

Try writing and running this program. Remember that very few people ever get a program written 100% correct the first time. Part of the beauty of programming is that it continually allows you to learn from your mistakes. We provided several hints in the description of the three steps. Read the description carefully before you begin. Good

luck. Just in case you get stuck, we wrote our program to meet the requirements of Steps 1-3.

```
5 CLS
10 PRINT "DO YOU WANT ME TO LIST
    ALL THE NUMBERS BETWEEN 0
    AND 100? TELL ME YES OR NO."
20 INPUT A$
30 IF A$ = "NO" THEN GOTO 100
40 FOR I = 0 TO 100
50 PRINT I
60 NEXT I
70 END
100 PRINT "GOODBYE"
```

We wrote END on line 70 so that if you type "YES" and the computer lists all the numbers between 0 and 100, it will not continue onto line 100 "goodbye." The END serves as a barrier to stop the computer from continuing to line 100.

What happens if you enter a word other than "yes" or "no" in response to the computer's question?

Type RUN and find out.

If you just tried this experiment you should have found out that the computer lists all the numbers from 0-100 anyway, because as it stands now the program only checks for the presence of the word "no" in the A\$ container. If any other word is in there, the computer still continues to line 40. Try to repair this program. Here is what we suggest.

Add ,

```
35 IF A$ = "YES" THEN GOTO 40
37 PRINT "YOU DID NOT TELL ME
    YES OR NO, TRY AGAIN!"
38 GOTO 20
```

If you type LIST, your revised program should resemble ours.

```
5 CLS
10 PRINT "DO YOU WANT ME TO LIST
    ALL THE NUMBERS BETWEEN 0
    AND 100? TELL ME YES OR NO:"
20 INPUT A$
30 IF A$ = "NO" THEN GOTO 100
35 IF A$ = "YES" THEN GOTO 40
37 PRINT "YOU DID NOT TELL ME
    YES OR NO, TRY AGAIN!"
38 GOTO 20
40 FOR I = 0 TO 100
50 PRINT I
60 NEXT I
70 END
100 PRINT "GOODBYE"
```

Now, if you type in any words other than "yes" or "no", the computer will tell you that what you typed is not what it expected and will let you keep on trying until you type either "yes" or "no".

MORE DECISIONS

Your computer is capable of making other kinds of decisions, beyond simple IF-THEN tests. Here is another one. Enter the following program:

```

10 CLS
20 REM THIS PROGRAM WILL
   GATHER INFORMATION ABOUT
   FAMILIES
30 PRINT "DO YOU HAVE A
   BROTHER? TYPE YES OR NO"
40 INPUT A$
50 PRINT "DO YOU HAVE A
60 INPUT B$
70 IF A$ = "YES" AND B$ = "YES"
   THEN PRINT "THEN THERE ARE
   AT LEAST THREE CHILDREN IN
   YOUR FAMILY"
80 IF A$ = "YES" OR B$ = "YES"
   THEN PRINT "THERE ARE AT
   LEAST TWO CHILDREN IN YOUR
   FAMILY"
90 IF A$ <> "YES" AND B$ = "YES"
   THEN PRINT "AREN'T YOU
   LUCKY THAT YOU DO NOT HAVE
   ANY BROTHERS"
100 IF A$ = "YES" AND B$ <> "YES"
   THEN PRINT "AREN'T YOU
   LUCKY THAT YOU DO NOT HAVE
   ANY SISTERS"
110 IF A$ <> "YES" AND B$ <> "YES"
   THEN PRINT "YOU ARE AN ONLY
   CHILD"
120 END

```

Now RUN

and answer the questions. If you typed the program in Capital Letters make sure that when you respond to the question mark sign you type the words "YES" or "NO" in capital letters. If you typed the program in Lower case your "yes" or "no" response should also be typed in Lower case letters. Then RUN the program and again type in different responses to see the results.

The program is very straightforward. The new commands AND, OR, < > (Not equal) are used in BASIC the same way they are used in everyday speech.

PRINT IT THE WAY YOU WANT

We can have the PRINT command place information on different parts of the screen by adding a comma or semicolon to the word PRINT. Enter the following program.

```
10 FOR I = 0 TO 100
20 PRINT "HELLO"
30 NEXT I
```

Type RUN. You should recognize this form of the PRINT statement. This is what we introduced to you a few chapters ago. Now change line 20 to read

```
10 FOR I = 0 TO 100
20 PRINT "HELLO",
30 NEXT I
```

Now type RUN again and compare the results you get with those of the previous program.

Now change line 20 again as follows;

```
10 FOR I = 0 TO 100
20 PRINT "HELLO";
30 NEXT I
```

There are three very distinct ways that output can be displayed. Later on, we will apply these different PRINT styles in our programs.

TAB

As we said, the screen can display 40 lines of text at a time before it must "move up" to make room for new lines of text. By using the TAB command, you can tell the computer

where (which line) you want the information to be put. Enter the following lines in immediate mode (without a line number).

PRINT TAB (20); "HELLO"

and now enter,

PRINT TAB (30); "GOODBYE"

TAB starts the printing of the message at the column of text specified in the parentheses. The left most column of the text screen is (0), and the right most column is (39).

SOME "RANDOM" THOUGHTS

8

9

SOME "RANDOM" THOUGHTS

Many games that people play involve an element of chance, from board games like monopoly to the game of craps played in casinos. The excitement and the high risk involved in these games occurs by rolling dice and getting a random, or unexpected number.

It is very easy for us to roll the dice and receive a random number. A random number is one that occurs as if you placed your hand in a barrel full of numbers and picked one out. Unless you were a prophet, you wouldn't know what number to expect, and would be surprised at the result.

Random numbers are important in computer programs especially in game or quiz programs, as well as some mathematic and scientific applications.

While it is easy for us to roll random numbers with dice, it is not so easy for your computer to simulate dice and pick a truly random number. Many microcomputers don't even afford you the opportunity to easily spin a truly random number. When you tell these other machines to pick a random number they will produce a fake random number. Their numbers are not truly random because each time they start picking a number they always begin with the same number. It's as if the barrel that they picked from only had one number in it.

However, your SV-328 can pick truly random numbers. To do so, always insert the following line at the beginning of a program that calls for random numbers.

```
5 N = RND (- TIME)
```

RND, INT
and-TIME

The new commands that are introduced are INT, RND and - TIME.

To pick a truly random number the SV-328 takes a look at its internal clock, which measures the passage of time in microseconds. Each time that the computer receives the instruction -TIME, it looks at its internal clock and uses the time on the clock as the truly random number from which to pick more random numbers. Since time never stands still, each time the computer checks its clock it will report a truly random number.

Type the following short program to see how to use line 5 in a program and what the INT and RND instructions do.

```
10 REM THIS PROGRAM PICKS  
A RANDOM NUMBER  
20 N = RND (- TIME)  
30 X = INT (RND (1) * 10)  
40 PRINT X
```

The new line here is line 30. The first instruction that the computer responds to on this line is RND (1). The number one in parentheses is called a dummy variable (container). Any number could have been used in the parentheses. In each case the computer picks a truly random number that is between zero and one, for example, .2345. The next instruction that the computer performs on line 30 is multiplying the decimal number (.2345) by 10. In our example this would give us 2.345. Since we want a whole number (one that doesn't have any numbers to the right of the decimal point) we then use the INT instruction to chop off the numbers to

the right of the decimal point leaving us with
 $X = 2$.

We can now present the program that
simulates the spinning of dice to achieve truly
random numbers.

**10 REM THIS PROGRAM SIMULATES
THE ROLLING OF DICE**

20 N = RND (- TIME)

30 X = INT (RND (1) * 6 + 1)

40 Y = INT (RND (1) * 6 + 1)

50 R = X + Y

60 PRINT R

Lines 30 and 40 pick the random numbers.
Let's take an example. If the instruction RND
(1) picks the number .9678, we then multiply
this number by 6 and get 5.8068. The
computer then adds 1 to 5.8068 and gets
6.8068. Finally it takes the INT of 6.8068
which is 6. So "X" dice spun a 6. The
computer then repeats this process to get the
number of the "Y" dice and then adds the
"X" and "Y" die together and places the total
in container "R" which is then printed. In all
honesty, the explanation of random numbers
is a little complicated and we suggest that you
review the material a second time if you are
not quite sure how the RND function works.

**JUMPING
AROUND**

The command GOTO was shown to cause the
computer to jump from one line to another.
Right now we will show you another way of
jumping around in your program and then
explain the difference between these two
methods.

Enter the following program:

```

10 REM THIS PROGRAM
   CONVERTS YEARS TO MONTHS
20 CLS
30 PRINT "HOW MANY YEARS OLD
   ARE YOU?"
40 INPUT N
50 GOSUB 200
60 PRINT "HOW MANY YEARS OLD
   IS YOUR FATHER?"
70 INPUT N
80 GOSUB 200
90 PRINT "HOW MANY YEARS OLD
   IS YOUR MOTHER?"
100 INPUT N
110 GOSUB 200
120 END
200 PRINT N; "YEARS IS EQUAL TO";
   N * 12; "MONTHS"
210 RETURN

```

RUN the program and answer the questions. Do you understand how this program works? Let's review it.

After asking you the question on line 30 and accepting your answer on line 40, the computer encounters GOSUB 200, which means GOSUBroutine 200. A subroutine is a section of a program, either one line or several lines, that is referred to frequently by the main part of the program. Therefore, it is called a SUBroutine, since it is subordinate, or secondary, to the bulk of the program.

When the computer sees GOSUB 200 on line 50, the computer jumps to line 200. When the computer completes the conversion of years to months on line 200 and prints it on the screen, the program continues to line 210. There, the command RETURN sends the computer back to the line that follows the one which contained the GOSUB 200. In our

**GOSUB/
RETURN**

program above, that would RETURN the computer to line 60.

The same thing happens when GOSUB 200 is encountered on line 80 and line 110. That is, the computer RETURNS to line 90 and 120 respectively.

What is the difference between the GOTO command and the GOSUB-RETURN command? If we had used the command GOTO 200 instead of GOSUB 200, then line 210 would have had to say GOTO 60 to have the computer continue from where it stopped when it jumped to 200. But line 210 would have also had to say GOTO 90 and GOTO 120 if we had used GOTO 200 on lines 80 and 110. But the computer could not have understood a line 210 that would have said,

210 GOTO 60, GOTO 80, GOTO 120

This problem stems from the fact that when the computer listens to a GOTO command it does not remember the line that it stopped at before it jumped to the specified GOTO line number. On the other hand, the beauty of the GOSUB-RETURN command is that it remembers precisely the point from which it jumped. When it is finished with the subroutine and sees the command RETURN, it knows exactly where to return to without being told again.

The next program employs another command that is a variation of the GOSUB-RETURN statement. Enter,

```

10 REM THIS PROGRAM
   DEMONSTRATES A SIMPLE
   TELEPHONE BOOK HELPER
20 CLS
30 PRINT "IF YOU WANT TO FIND A
   PHONE NUMBER QUICKLY, JUST
   PICK ONE OF THE CHOICES
   BELOW AND I WILL DO THE
   REST"
40 PRINT "1. DOCTOR"
50 PRINT "2. POLICE"
60 PRINT "3. SPECTRAVIDEO"
70 INPUT N
80 ON N GOSUB 100, 200, 300
90 GOTO 10
100 PRINT "THE DOCTOR'S NUMBER
   IS 555-1234"
110 RETURN
200 PRINT "THE POLICE'S NUMBER
   IS 555-1245"
210 RETURN
300 PRINT "SPECTRAVIDEO'S
   NUMBER IS 555-1256"
310 RETURN

```

RUN the program and try it out. The variation of GOSUB-RETURN is on line 80. The command ON N GOSUB 100, 200, 300 means that if "N" (the container that is holding the number you have chosen) is the number 1, then the computer will jump to the subroutine on line 100. If "N" is holding the number 2, then the program jumps to the subroutine on line 200, and if "N" is holding the number 3, it jumps to the subroutine on line 300.

THE COMPUTER AS A CALCULATOR

You can make the computer function as a calculator.

For addition enter
PRINT 6 + 3

and the computer will output

9

For subtraction enter

PRINT 6 - 3

and the computer will output

3

For multiplication enter

PRINT 6*3

and the computer will output

18

For division enter

PRINT 6/3

and the computer will output

2

If you forget to use the word PRINT when you use the computer as a calculator, the computer will not output the answer. The computer will have calculated the answer and placed it into a container in its memory automatically, but it will not inform you of its answer.

ARITHMETIC OPERATIONS

Most of you probably remember the basic rules of arithmetic from your elementary school days, so we will not dwell upon these types of calculations any further.

The following table lists the order of precedence for the mathematical and logical commands that your computer will calculate. That means that if any of these signs or words are used in your programs, the order listed here is the order in which they will be executed (figured out).

1. ()

2. NOT - (for negative rules)

3. * /

4. + -

5. > < = >= <= <>

6. AND

7. OR

If there is more than one operation listed on any line of BASIC commands, and these operations are both listed on the same level in the above table, then the operation closer to the left side of the screen will be performed first. For example, if you entered

PRINT 3 + 2 - 1

the computer will output,
4

because it first added $3 + 2$ and then did $5 - 1$.
Similarly, if you entered,
PRINT 3 - 2 + 1

the computer will output,
2

because it first performed $3 - 2$ and then did
 $1 + 1$

PROCESSING INFORMATION

At the beginning of this tutorial we described a computer program as a set of instructions that processed (acted on) information. The information the program needs to begin processing is called the **input** to the program and the result of the processing is called the **output**.

The following program demonstrates how to tell the computer the information you want it to process. Most of the commands in BASIC, like PRINT, FOR-NEXT, IF-THEN, PSET, etc. tell the computer what to do with information. We have already shown you some words that tell the computer what information to work on—commands like INPUT and LET X = 20. Now we will introduce you to a new set of words, READ and DATA, which as the names imply, tell the computer that what follows is the information to process.

Enter the following program.

```
5 CLS
10 REM THE FOLLOWING PROGRAM
    WILL READ AND PRINT THE
    NAMES OF THE FIRST FIVE
    MONTHS OF THE YEAR.
20 FOR X = 1 TO 5
30 READ F$
40 PRINT F$
50 NEXT X
60 DATA JANUARY, FEBRUARY,
    MARCH, APRIL, MAY
```

Type RUN.

Your program should have output the names of the first five months of the year. Now let's take a closer look and see how the program works.

READ/ DATA

Line 20 prepares a loop that will do something 5 times. That something is told to the computer in line 30, where we instruct the computer to READ some information and place it in container F\$. When the computer comes across the READ command, it immediately searches the whole program for the first line that begins with the command DATA. Since DATA appears on line 60, the computer READs the first word, "January," and places it in container F\$. Then the program continues to line 40 and PRINTs the word in F\$ (January). NEXT X on line 50 sends the computer back to line 20 to begin this process of READING and PRINTing again.

The second time around, the computer looks again for the DATA statement that tells the computer that on this line it will find the information it needs to READ. So the computer goes to the information listed on the DATA line after the place where it previously stopped and stores in F\$. When the computer

puts the word "February" into container F\$, it first erases the word "January," which was previously stored in F\$. So when the instruction PRINT F\$ is encountered on line 40, the only word in F\$ is "February" and so it is PRINTed on the TV.

The Line that begins with the command DATA and contains the information we want the computer to READ, can be placed anywhere in the program. The READ command searches the whole program, starting at the beginning, for the first line in which the command DATA appears. Therefore, our READ/DATA program could have been written in the following way:

```
5 CLS
10 REM THE FOLLOWING PROGRAM
  WILL READ AND PRINT THE
  NAMES OF THE FIRST FIVE
  MONTHS OF THE YEAR.
15 DATA JANUARY, FEBRUARY,
  MARCH, APRIL, MAY
20 FOR X = 1 TO 5
30 READ F$
40 PRINT F$
50 NEXT X
```

OR

```
2 DATA JANUARY, FEBRUARY
  MARCH, APRIL, MAY
5 CLS
10 REM THE FOLLOWING PROGRAM
  WILL READ AND PRINT THE
  NAMES OF THE FIRST FIVE
  MONTHS OF THE YEAR.
20 FOR X = 1 TO 5
30 READ F$
40 PRINT F$
50 NEXT X
```

The information that is placed on the DATA line is separated by commas. The words or numbers between commas are treated as one piece of information. Enter and RUN the following program to see what we mean.

```
10 CLS
20 REM THIS PROGRAM READS
   AND PRINTS OUT THE NAMES
   OF FIVE STATES
30 FOR X = 1 TO 5
40 READ F$
50 PRINT F$
60 NEXT X
70 DATA NEW YORK, NEW JERSEY,
   NORTH DAKOTA, NEW
   HAMPSHIRE, NEW MEXICO.
```

How does the following program, which reads and prints the name of 5 states, differ from the program that did the same thing above?

```
10 CLS
20 FOR X = 1 TO 5
30 READ F$: READ G$
40 PRINT F$, G$
50 NEXT X
60 DATA NEW, YORK, NEW, JERSEY,
   NORTH, DAKOTA, NEW,
   HAMPSHIRE, NEW, MEXICO
```

You should be able to tell the difference from just comparing the two programs without even having to enter the second version and running it.

The first program, which read and printed the names of 5 states, did so by reading each set of two words into one container, F\$. In the second program, the name of each state was

**"OUT OF
DATA"
message**

broken into two parts. The first half of the name was stored in container F\$ and the second half of the name was stored in container G\$.

Enter the above revised program into the two containers F\$ and G\$, if you have not yet done so. RUN the program. Now add line 70: 70 GOTO 20 and RUN the program again. Did you get OUT OF DATA message? That error message resulted from the fact that you tried to READ information again but since the computer finished READING the list after you ran the program the first time, the computer did not find any more information on the DATA line after the name NEW MEXICO.

The way to fix that problem is to tell the computer to return to the beginning of the DATA before it is time to read the names again. The command you use to do this is RESTORE. Here is how the repaired program looks.

```
10 CLS
20 CLEAR 500
30 FOR X = 1 TO 5
40 READ F$: READ G$
50 PRINT F$, G$
60 NEXT X
70 RESTORE
80 GOTO 30
90 DATA NEW, YORK, NEW, JERSEY,
    NORTH, DAKOTA, NEW,
    HAMPSHIRE, NEW, MEXICO
```

CLEAR

Here is how this program works. We have added another command called CLEAR on line 10. Whenever you use a READ-DATA command you should also use CLEAR, which CLEARs away a lot of room (i.e., 500 spaces) in the computer's memory. Then you can

work with the containers that store words without running out of space, because the containers that store words and text generally take up much more room than the containers that store only numbers.

RESTORE

Then on line 70, the RESTORE command instructs the computer to return to the beginning of the list of information on the DATA line before the GOTO 30 command on line 80 sends the computer back to the beginning of the loop on line 30. The program should print out the names of the states without receiving an OUT OF DATA message.

ANOTHER TIME SAVER

Our programs are beginning to get larger. That is we are writing more lines of instructions in each program. Some people like to tell the computer to automatically write the line number for each line of the program. This is accomplished by typing:

AUTO **ENTER**

AUTO

In immediate mode, the computer will respond with the number 10 and it will wait for you to begin typing on line 10. When you have finished line 10 and pressed **ENTER** the computer will automatically print line 20 and wait for you to continue.

You can make the computer start the automatic line numbers from a number other than 10, and it can increase the number for the next line by more than or less than 10. In other words, the AUTO command can be told what line number to start with and how much the increase should be for each subsequent line.

For example;
AUTO 20, 40

This will start the first line number at 20 and cause the second line number to be 60 and the third line number to be 100.

As with all the commands we have introduced to you in this tutorial guide, it is necessary for you to read the material in other parts of this manual to get a full understanding of each BASIC command. And don't forget that the cassette tape "Introduction to BASIC" is an excellent way to interact with your computer as you improve your programming skills.

ARRAYS - A WAY OF ORGANIZING MANY CONTAINERS

10

ARRAYS - A WAY OF ORGANIZING MANY CONTAINERS

We hope that you are beginning to feel comfortable with the concept of containers and how your computer uses them to store and manipulate information. Previously, we have always used a container as an individual unit. That is, we have thought of each container as a distinct unit. "A", "B", "C", and "D" are examples of individual containers into which we put numbers and words. However, we did not have the need to group several individual containers into one set.

There are times when it is necessary to arrange a series of containers into a larger unit. If you wanted to keep track of 5 test scores for each of the 25 students in your class, it would make sense to organize the containers that hold the scores into a larger unit. Then you work with 25 sets of containers, rather than with 125 individual containers. (Each set would be a table with 5 lines of information.) Here is an example of what the table for a student named John might look like.

JOHN

- (1) 75
- (2) 82
- (3) 94
- (4) 68
- (5) 100

Thus if we had before us 25 different tables representing the scores of all 25 students, we

could then refer to John's first test score as John (1), his second test score as John (2) etc.

The following program demonstrates how we can instruct the computer to group John's 5 test scores into a table.

```
10 REM THIS PROGRAM
    ORGANIZES THE JOHN'S TEST
    SCORES INTO A TABLE
20 CLS
30 DIM J (5)
40 FOR X = 1 TO 5
50 READ J (X)
60 NEXT X
70 PRINT "WHICH TEST GRADE DO
    YOU WANT?"
80 INPUT Z
90 PRINT J (Z)
100 DATA 75, 98, 94, 68, 100
```

Enter this program and RUN it. This is how it works.

DIM

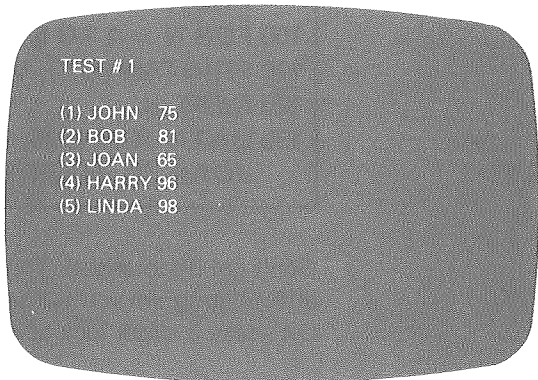
Line 30 DIMensions a block of five containers for the set of containers called "J". That means the computer is instructed to set aside enough room to store 5 numbers in 5 different containers. "J" is the name for this group of containers. On line 50 the computer READs in one test score at a time from the data line and places it into one container.

When the program reaches line 70, it has already placed all 5 test grades into 5 different containers. This information is organized in the computer in a way that is similar to the table of John's test scores. So when we INPUT the test score that we want in line 80, the computer is told on line 90 to print that particular line of the table.

Oh, we almost forgot to tell you: The official computer term for the set of containers that we just worked with is an **“array.”**

WORKING WITH A LARGER SET OF CONTAINERS

It is a little trickier to work with a large set of containers that can store two items each than it is to work with the simple container we demonstrated above. If you wished to store the scores of 5 students for one test, you would need to have one set of containers that stores their names, and one that stores their respective grades. The table that represents this information looks like this:



```
TEST # 1
(1) JOHN 75
(2) BOB 81
(3) JOAN 65
(4) HARRY 96
(5) LINDA 98
```

FIGURE 7

The program that will READ and PRINT out a table just like the one in FIGURE 7 is listed below. Enter the program, RUN it and try to understand it before reading our explanation.

```

10 REM THIS PROGRAM
   ORGANIZES NAMES AND
   SCORES FOR ONE TEST
20 CLS
30 DIM V$(5,2)
40 FOR N = 1 TO 5
50 FOR S = 1 TO 2
60 READ V$(N,S)
70 NEXT S: NEXT N
80 REM THIS SECTION PRINTS OUT
   THE TABLE
90 PRINT "NAME", "GRADE":
   PRINT
100 FOR N = 1 TO 5
110 PRINT V$(N,1), V$(N,2)
120 NEXT N
130 DATA JOHN, 75, BOB, 88,
   JOAN, 71, HARRY, 96, LYNDA, 98

```

Don't get discouraged. This is the most difficult program you will see in this tutorial! Let's take a closer look at it.

Line 30 DIMENSIONS, or sets aside 5 containers that will store the number corresponding to the student's names listed in FIGURE 7, and the 2 test scores that correspond to each name or number.

Lines 100-120 PRINT the table on the TV screen in the same form as appears in Figure 7.

The computerese term for this extended container is a **"double array,"** which is a fancy way of describing a two-column table.

Is there another way that we could have written this program? Yes, there is. Generally, almost all programs can be written in more than one way. Different people plan and program according to their own styles. Of course there are important differences among

the various styles. You will learn to discern which option to choose as your knowledge increases with practice.

Here is another way you could have written the program that reads and prints the table in FIGURE 7. This time we use two separate sets of containers: One to store the names, and one to store the grades. Each one uses a one-column array, not the double column array that we just used.

```
10 CLS
20 DIM A$(5), B(5)
30 FOR I = 1 TO 5
40 READ A$(I), B(I)
50 NEXT I
60 PRINT "NAME; " "GRADE": PRINT
70 FOR K = 1 TO 5
80 PRINT A$(K), B(K)
90 NEXT K
100 DATA JOHN, 75, BOB, 81, JOAN,
    65, HARRY, 96, LINDA, 98
```

RUN the revised program to make sure that it does what it is supposed to.

ON THE END OF A LONG STRING

11

ON THE END OF A LONG STRING

"STRING"

Congratulations! You have made it this far and we trust you are doing well. We will now cover what is known in computerese as "String Manipulations." A string is a group of characters that usually is just a word. Accordingly, a word is considered to be a string of characters that can easily be changed and rearranged.

Enter the following program.

```
10 CLEAR 200
20 INPUT "TYPE IN A SENTENCE
   THAT IS NO MORE THAN 10
   WORDS LONG;" S$
30 PRINT "THIS IS THE NUMBER OF
   CHARACTERS IN THE SENTENCE
   THAT YOU JUST TYPED:"
40 PRINT LEN (S$)
```

Now RUN the program. As its name implies, the LEN command calculates the number of characters in a string of characters. In this example, the whole sentence was stored in container S\$.

INPUT

We hope you have noticed that line 20 looks a bit unusual. This is because we used the INPUT command to print the message on the screen without the help of the PRINT command, and placed the container name at the end of the line. This line is a very good

LEFT\$
RIGHT\$
MID\$

example of a short cut in programming that combines several commands on one line.

The following commands manipulate character strings in various ways; RIGHT\$, LEFT\$ and MID\$. The programs below will introduce these commands and their use to you.

```
10 INPUT "TYPE A WORD THAT IS AT  
LEAST 6 LETTERS LONG"; W$  
20 PRINT "THE FIRST LETTER IS:";  
LEFT$ (W$,1)  
30 PRINT "THE LAST TWO LETTERS  
ARE:"; RIGHT$ (W$,2)  
40 GOTO 10
```

The LEFT\$ (W\$,1) command on line 20 told the computer to print the first character to the left of the string of characters stored in container W\$. If we had written LEFT\$ (W\$,3) then the computer would have printed the 3 characters closest to the left.

Similarly, the instruction RIGHT\$ (W\$,2) on line 30 causes the computer to print the 2 characters to the right, or the end of the string of characters to the right, or the end of the string of characters that is stored in container W\$.

The MID\$ is more powerful than the LEFT\$ and RIGHT\$ commands. Enter and run the following program.

```
10 W$ = "SPECTRAVIDEO"  
20 PRINT MID$ (W$,4,3)
```

This MID\$ command on line 20 started at the fourth character from the left of the word Spectravideo (which was stored in container

W\$), and counted the next three characters and printed out these characters, i.e., CTR.

But the MID\$ command can also serve a very useful function.

If you wanted to search through a sentence for a specific word, you could use MID\$. It is demonstrated in the following program. Enter and run the program.

```
10 CLEAR 500
20 INPUT "TYPE A SENTENCE THAT
   IS NO MORE THAN 10 WORDS
   LONG"; S$
30 INPUT "TYPE A WORD THAT
   APPEARS IN THE SENTENCE
   YOU ENTERED:"; W$
40 X = LEN (W$)
50 FOR T = 1 TO LEN (S$)
60 IF MID$ (S$,T,X) = W$ THEN
   GOTO 100
70 NEXT T
80 PRINT "THE WORD YOU
   SEARCHED FOR IS NOT IN THE
   SENTENCE"
90 END
100 PRINT W$ "APPEARS IN THE
   SENTENCE AT CHARACTER
   NUMBER:" T
```

LEN

In this program, MID\$ is used to test various sized groups of characters to see if they are identical to the word we are searching for. The program calculated the LENGTH of W\$, and placed the number of characters in W\$ into the container called "X" (line 40). Then the computer starts at the left position of the characters in W\$ and counts the number of characters stored in "X". If a match is found, you are told that the word has been found in your sentence.

ADVANCED GRAPHICS AND SOUND PROGRAMMING

12

ADVANCED GRAPHICS AND SOUND PROGRAMMING

The material in this chapter will demonstrate the advanced graphics and sound capability that is built into the SV-328 which separate it from its competition. This power is not available and accessible from BASIC in any other personal computer.

This chapter is separated into two parts. The first part expands on the introduction to graphics that you have received earlier. The second part explains the simple approach to sound programming using the PLAY command. A more complicated approach to sound programming is possible using the SOUND command which is explained in Appendix H.

PART ONE - ADVANCED GRAPHICS

CIRCLE

To begin exploring the graphics capability of the SV-328, type in the following lines, pressing **ENTER** after each is completed:

```
10 SCREEN 1
20 CIRCLE (128,80),60,11
30 PAINT (128,80),11
40 GOTO 30
```

Now, RUN the program and you will see the yellow circle appear on the screen and then it will be filled in by the SV-328's yellow paintbrush. To understand how this happens, let's look at each line individually.

```
10 SCREEN 1
```

This line causes the computer to display its graphics screen

```
20 CIRCLE (128,80),60,11
```

Here, you are telling the computer to draw a circle around a center point that is 128 columns from the left side of the screen, 80 rows down from the top of the screen, with a radius (distance from the center of the circle) of 60 points and using the yellow (the number 11) outline.

PAINT

```
30 PAINT (128,80),11
```

This line introduces you to the **PAINT** command. This command tells the computer to use its "paint brush" to fill certain areas. In line 30 the computer is instructed to fill the circle you have just outlined in line 20. In order to paint (fill) an object you must give the

computer the coordinates numbers (in parentheses) which designate any point inside the object (As we just did-giving the coordinates of the center point of our circle). If you had used coordinates which designate a point outside the object, the computer would have painted the whole background but not fill the object itself.

However, the fill color **MUST** be the same as the outline color in our case the number 11 is the same yellow color used for the circle outline from line 20. The **PAINT** "recognizes" outlines of objects as borders only if their color matches the **PAINT** color. A different **PAINT** color will "ignore" the outlines and will paint (fill) the whole screen-covering the object.

```
40 GOTO 30
```

The last line of this program causes the computer to repeat line 30 so the circle will not disappear. To stop the program press the **CTRL-STOP** key combination.

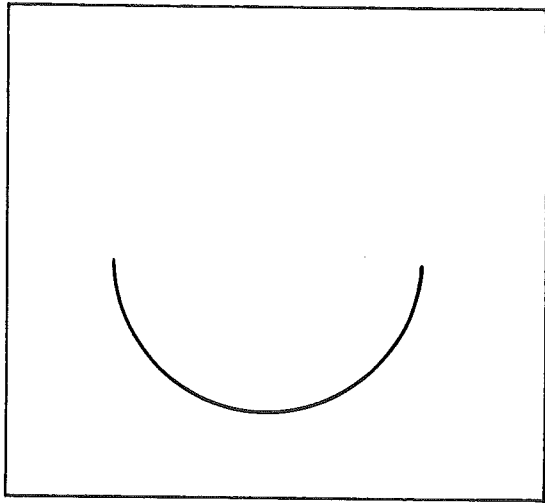
You can experiment with the numbers in this program to vary the location, size or color of the circle being painted.

You can create a vast array of different sized circles and geometric shapes by adding a few more instructions to the **CIRCLE** command. We will give you another example of using the circle command and for additional hints, you should refer to the **BASIC Reference Guide**.

Change the program to read:

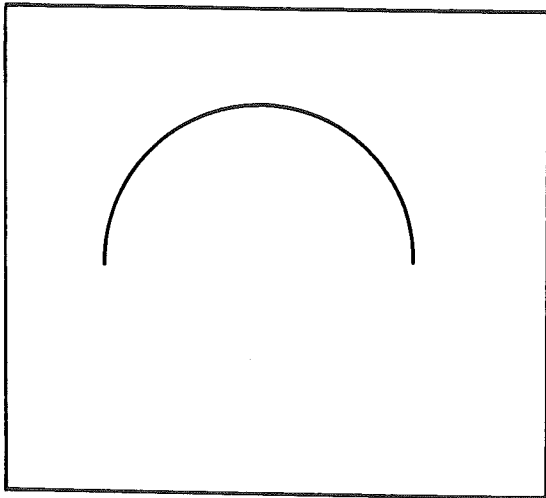
```
10 SCREEN 1
20 CIRCLE (128,96),80,1,3.14,6.28
30 GOTO 30
```

RUNning the program will give you the following result:



You should see the bottom half of the circle:
Should you change line 20 to be:

20 CIRCLE (128,96), 80,13,6.28,3.14



you will see that the top half of the circle is drawn. Another way of constructing a whole circle is with the following changes in line 20:

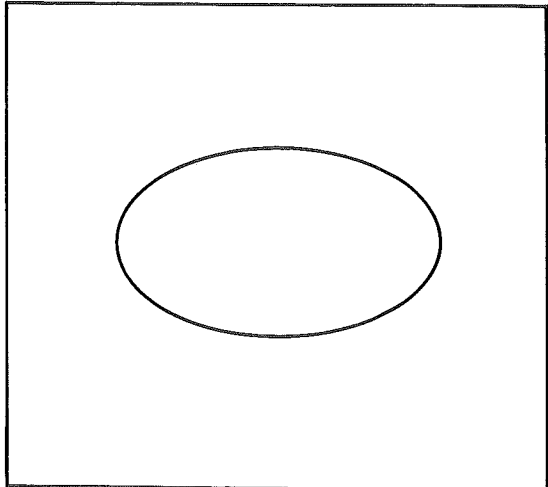
20 CIRCLE (128,96), 80,13,0,6.28

Those of you who remember your geometry will recall that 3.14 is pi and 6.28 is 2pi (approximate). The two pi numbers which follow the color number (#13) on line 20 tell the computer where you would like the computer to begin and end the circle (how much of the circle you want drawn).

Those of you who are not adept at using variants of pi can just overlook this business and consult the BASIC Reference Guide when you are ready to learn it.

You can also specify the kind of shape drawn. For example, you can draw an ellipse (a distorted circle for those of you unfamiliar with geometry) with the following added feature on line 20.

20 CIRCLE (128,96), 80, 13,,,1/4

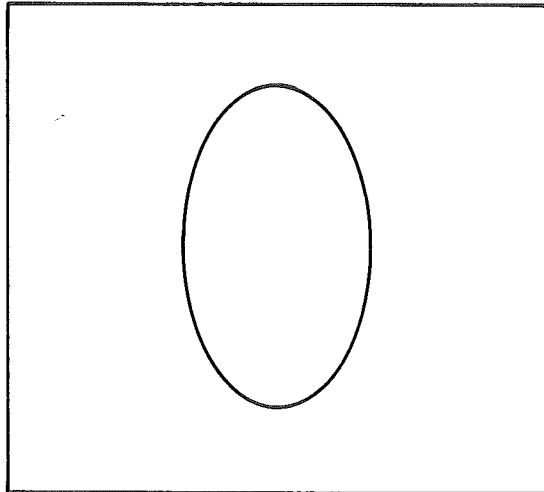


How did we get an ellipse? Well, the three commas after the number 13 are necessary to

inform the computer that we will not be specifying the starting and ending points of the shape and are therefore leaving them blank. The computer knows what to do when we leave it blank. It assumes that we want the whole shape drawn. The 1/4 at the end of line 20 tells the computer the height /width ratio that we want.

Generally, the width of the circle is the same as the radius you specify. However, if the ratio number at the end of the CIRCLE command line is less than one (1), the circle will be wider than it is high, as in the example above where the ratio is "1/4". If the ratio is greater than one (1), the circle will be higher than it is wide, as in the following example:

```
20 CIRCLE (128,96), 80,13,,,2
```



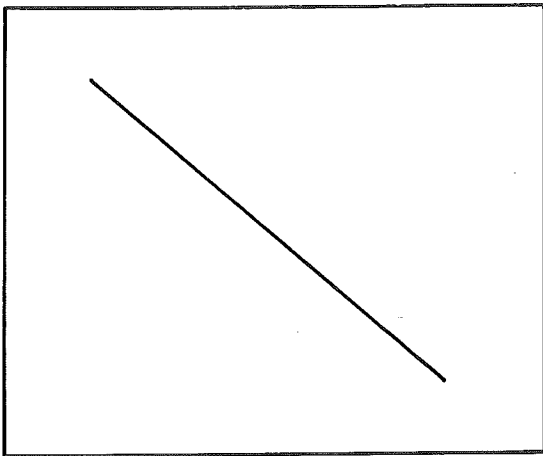
For further information on the CIRCLE command, consult the BASIC Reference Guide.

LINE & BOX DRAWING

LINE

Now that you have seen what your SV-328 can do with circles and its paintbrush, we'll take a look at lines and boxes. The computer has the same simple method for drawing them as it does for circles. First, type NEW to clear the memory of the program we were using before. Now, enter the following

```
10 SCREEN 1
20 LINE (50,40) - (200,150),14
30 GOTO 30
```



When you run this program, you will see that a line has been drawn from high on the left side of the screen to a low point on the right side of the screen. The line that causes this to happen is line 30:

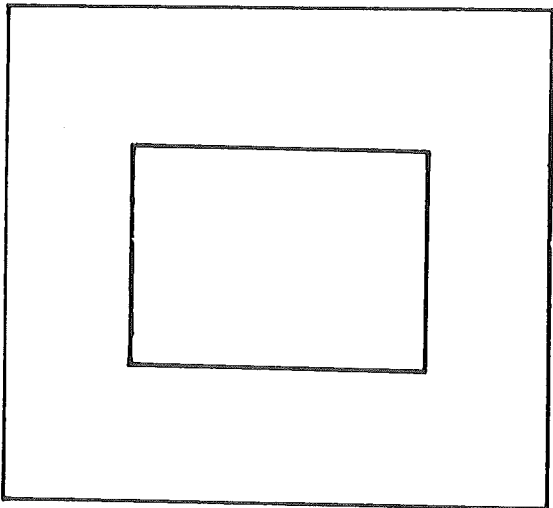
```
30 LINE (50,40) - (200,150),14
```

This line tells the computer to draw a line from a position 50 points from the left margin on the screen and 40 points down from the top over to a position that is 200 points from the left margin and 150 points down from the top. The number 14 designates the color of the line to be white.

**BOX
(B)**

By simply adding the letter **B** following a comma to the end of line 30 you will convert this line into a Box.

```
30 LINE (50,40) - (200,150),14,B
```



RUNning the program now, will show a box (outlined rectangle) on the screen. The "B" tells the computer to draw the box at the same coordinates as the line.

**BOX FILL
(BF)**

To tell the computer to use the paintbrush (fill the box) simply add the letter "F" immediately to the right of the "B" in line 30:

```
30 LINE (50,40) - (200,150),14,BF
```

Now, you will see that the program draws the same box and paints the inside with the same color as the outline.

As an interesting summary of the graphics commands you have learned so far RUN the following program:

```

10 COLOR, 1,9
20 SCREEN 1
30 CIRCLE (126,110),60,9,,,1.3
40 CIRCLE (110,96),10,2
50 PAINT (110,96),2
60 CIRCLE (142,96),10,2
70 PAINT (142,96),2
80 LINE (100,125) - (105,135),14
90 LINE (152,135) - (147,135),14
100 LINE (105,135) - (147,135),14
110 CIRCLE (74,110),25,11,,,5
120 CIRCLE (178,110),25,11,,,5
130 Y = 85:R = 50:C = 1
140 FOR Q = 1 TO 10
150 Y = Y - 5:R = R - 4:C = C + 1
160 CIRCLE (126,Y),R,C,,,,2
170 NEXT Q
180 FOR T = 1 TO 500 :NEXT T
190 N = RND (- TIME)
200 FOR T = 1 TO 30
210 X = X + 10:Y = 100
220 C = INT (RND(1)*15) + 1
230 LINE (X,Y) - (X + 35, Y + 35),C,BF
240 LINE (X,Y) - (X + 35,Y + 35),1,BF
250 NEXT T
260 GOTO 260

```

This program demonstrates all the concepts introduced thus far. We will now continue with some more graphics commands.

DRAW

The **DRAW** command is actually the door to an actual mini-language within BASIC called "Graphic Macro Language (**GML**)" start by clearing the computer's memory.

(type: **NEW** then press **ENTER**)

Then type the following lines:

```
10 SCREEN 1
20 PSET (50,60), 1
30 DRAW "D50 R50 U50 L50"
40 GOTO 40
```

Line 20 positions your graphic cursor at the X,Y coordinates (50,60), and designates the color to be Black (,1)

Line 30 starts the line drawing at the point specified in the **PSET** command. It then moves relative to the point, according to the distance and directional commands specified in the **DRAW** statement.

Example: **DRAW "U50R50"**

is: **Draw fifty units UP then fifty units to the RIGHT.**

The quotation marks around the instructions are in quotes because the **DRAW** command acts on a character string. Remember, a character string is a variable (container) that holds characters. Therefore, we could have written the **DRAW** example used above in the following manner.

```
30 T$ = "U50R50D50L50"
40 DRAW T$
50 GOTO 50
```

This second way of **DRAW**ing first defines the object we wish to **DRAW**, and then places it in **T\$** and then **DRAW**s **T\$**.

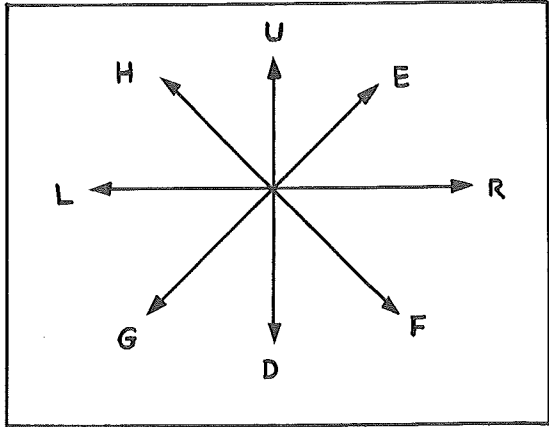
Please note you can draw diagonally using

E = diagonally up & right

F = diagonally down & right

G = diagonally down & left

H = diagonally up & left



Now we will look at several other additional graphic commands you can use to create exciting screen displays. They are **SCALE**, **LOCATE** and **BLANK MOVE**.

SCALE

Type in and RUN the following program:

```
10 COLOR , 1 , 1
20 SCREEN 1 : X = 14 : Y = 120 :
   CO = 2 : Z = 1
30 PSET (X,Y)
40 A$ = "S = Z;C = CO;F15R50E15
   U45H15L30H15U20E10R20F10
   R10U12H15L30G20D35F25R25
   F10D18G10L35H10L10D14S0"
50 DRAW A$
60 X = X + 16 : Y = Y + 8 :
   CO = CO + 1 : Z = Z + 1
70 IF Z > 10 THEN 20
90 GOTO 30
```

In this example, the variable A\$ contains the statement **S = Z** which sets the command

SCALE equal to Z. As the program continues, Z is raised by 1 each time line 60 is reached. This causes the scale to be raised by 1.

LOCATE

Now add lines 21 - 23 so that the program looks like this:

```
10 COLOR , 1 , 1
20 SCREEN 1 : X = 14 : Y = 120 :
CO = 2 : Z = 1
21 REM "LOCATE" IS USED TO
POSITION TEXT
22 LOCATE 10, 170 : PRINT
"THIS IS AN"
23 LOCATE 10,180 : PRINT
"EXAMPLE OF LOCATE"
30 PSET (X,Y)
40 A$ = "S = Z;C = CO;F15R50
E15U45H15U20E10R20E10R20F1
0 R10U12H15L30G20D35F25R25
F10D18G10L35H10L10D14S0"
50 DRAW A$
60 X = X + 16 : Y = Y + 8:
CO = CO + 1 : Z = Z + 1
70 IF Z' > 10 THEN 20
90 GOTO 30
```

BLANK MOVE

Now, type NEW and enter the following program:

```
10 DRAW A$
20 SCREEN 1
30 A$ = "BM30,156C9F15R 50
E15U45H15L30H15U20E10R20
F10R10U12H15L30G20D35F25
R25F10D18G10L35H10L10D14"
40 DRAW A$
50 PAINT (42,154),9
60 LINE (150,171) - (210,171),2
70 LINE (210,171) = (230,34),2
80 LINE (230,34) = (210,34),2
90 LINE (210,34) - (190,151),2
100 LINE (190,151) = (170,151),2
110 LINE (170,151) - (150,34),2
120 LINE (150,34) - (130,34),2
130 LINE (130,34) - (150,171),2
140 PAINT (165,165),2
150 GOTO 150
```

In this example, line 30 contains the statement **BM30,156**. This is the command that causes the cursor to begin drawing at those specified X and Y coordinates. Without using this command, all draw statements will begin executing at the upper left corner of the screen.

SPRITES

Now that we have learned how to deal with the simpler shapes, we will examine the more complex type of graphics generation called **SPRITE** generation. The best way to understand a sprite is to imagine it as a magic genie you can create and easily control.

Unlike the graphic commands we have encountered up till now—which can only create one type of an object, like a line or circle—the manipulation of sprites is a lot more flexible.

In order to see a sprite on the screen you must do the following:

STEP 1: Pick one genie "to talk to" (There are 32 different genies available to do your bidding).

STEP 2: You must tell the genie "what you want it to wear" (In other words, what shape you want it to assume).

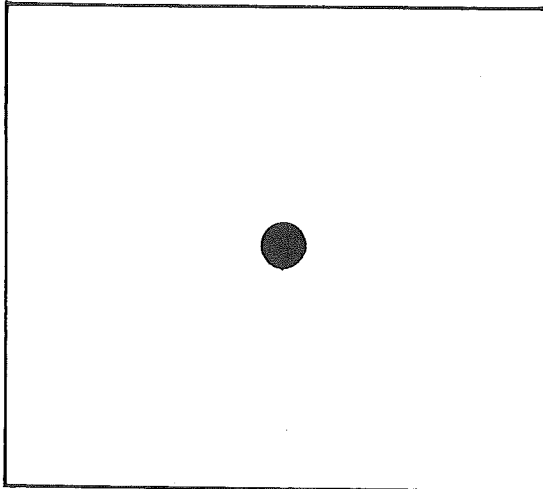
STEP 3: You must tell it what color to make the shape that it will wear.

STEP 4: You must tell it where to appear on the screen.

The importance of this genie metaphor cannot be overstated. Whenever you do not get the results you expected when commanding a genie it is probably because you did not provide all four pieces of information necessary to make the genie appear.

We will now demonstrate how to instruct a genie. Enter the following program and RUN it.

```
10 SCREEN 1
20 FOR T = 1 TO 8
30 READ A$
40 S$ = S$ + CHR$(VAL("&B" + A$))
50 NEXT T
60 SPRITE$(1) = S$
70 PUT SPRITE 0, (128,96),8, 1:
   GOTO 70
100 DATA 00011000
110 DATA 00111100
120 DATA 01111110
130 DATA 01111110
140 DATA 01111110
150 DATA 01111110
160 DATA 00111100
170 DATA 00011000
```

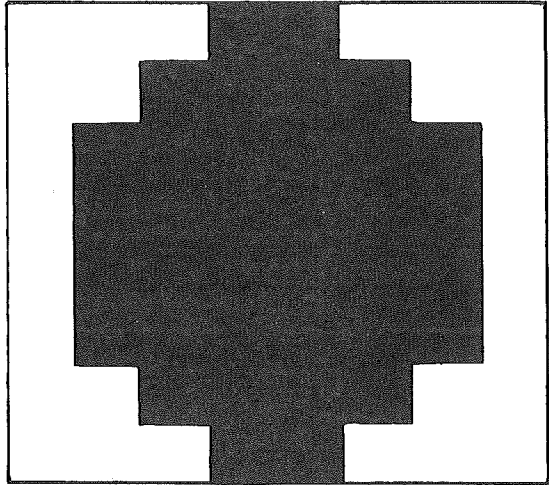


You should see a red ball appear at the center of the screen. This ball is the Sprite that we created in the above program. Here is how it works.

Lines 100-170: These lines design the clothes that the genie will wear (or in straighter language, they contain the design of the sprite's shape). Each line of the data

statement has eight characters on it. They represent the size of the sprite. The zeros are to make the display transparent at that point of the shape while the ones are the points of the display that are lit.

If we took a grid 8 by 8 boxes, the shape would look like this:



Lines 20-50: These lines complete the design of the shape of the clothes. They set up a loop that will read the set data lines, convert them into binary strings, append each one to the one that follows and then store this one shape unit in S\$.

Line 60: This line picks the sprite that we will command (#1) and tells it to carry the shape contained in S\$.

Line 70: This line tells the sprite what color to make the shape, and where to appear on the screen. This line:

```
70 PUT SPRITE 0, (128,96), 8,1
```

is read like this (It's a long sentence, but you'll be able to follow it):

PUT the SPRITE that is specified at the end of line, which is #1, on plane (surface) 0, at position (128,96) which is the center of the screen, using color #8. The sprite to use is #1.

(Note: In the command, PUT SPRITE (sprite plane), (X,Y), (Color #), (Sprite pattern #) the use of different plane numbers allows the user to place more than one sprite on the screen at once.)

The way we create sprites is very logical . If you are familiar with any other computer's BASIC, you will immediately notice how much easier the sprite manipulation is on the SV-328. That's because other systems force you to go PEEKING and POKING around in their computer's memory.

Sprites are not limited to only 8 by 8 pixels. Sprites can also be placed within a 16 by 16 box.

When SCREEN sizes 0 to 1 are selected (screen 1,1), the sprite size is limited to 8 by 8; however, if sprite size 2 is selected, then the use of a 16 by 16 box is allowed. But, the computer fills the 16 by 16 box differently than it fills the 8 by 8 box. The following program should illustrate how this works:

```
10 screen 1,2
20 for x = 1 to 32
30 read a$
40 restore
50 s$ = s$ + chr$(val("&b"+ a$))
60 sprite$(0) = s$
70 put sprite 0, (128,96), 1,0
80 next x
90 goto 90
100 data 11111111
```

Notice that the computer first fills a box 8 by 16, and then fills another 8 by 16 box alongside this one to make 16 by 16.

Therefore, when making a 16 by 16 sprite, careful manipulation of data statements (32 of them) is required.

This program demonstrates the use of the joystick to move sprites. When run, a small spaceship-like sprite will appear. This sprite can be moved anywhere within the confines of the screen and will also fire a bullet when the trigger is pressed.

```
10 Color 15,1, 1
20 Screen 1,2
30 Rem This section reads in the sprites
40 For T = 1 to 8
50 Read A$
60 S$ = S$ + CHR$(VAL("&b" + A$))
70 Next T
80 SPRITE $(1) = S$
90 For T = 1 to 8
100 Read B$
110 U$ = U$ + CHR$(VAL("&b" + B$))
120 Next T
130 SPRITE $(2) = U$
140 Rem This section sets the initial
    location of the Sprite
150 X = 128 : Y = 96
160 Put SPRITE 1, (X,Y), 9,1
170 D = STICK (0)
180 F = STICK (0)
190 Rem This section takes the given
    joystick information and uses it
    to make the sprite move.
200 If F<>0 then GOSUB 460
210 If D = 1 then X = X : Y = Y - 1
220 If D = 2 then X = X + 1: Y = Y - 1
230 If D = 3 then X = X + 1: Y = Y
240 If D = 4 then X = X + 1: Y = Y + 1
250 If D = 5 then X = X : Y = Y + 1
260 If D = 6 then X = X-1: Y = Y + 1
270 If D = 7 then X = X - 1: Y = Y
280 If D = 8 then X = X - 1: Y = Y - 1
290 GOTO 160
300 DATA 00111100
310 DATA 01000010
320 DATA 10000001
```

```
330 DATA 11111111
340 DATA 01000010
350 DATA 10000001
360 DATA 10000001
370 DATA 10000001
380 DATA 00010000
390 DATA 00101000
400 DATA 00101000
410 DATA 00111000
420 DATA 00000000
430 DATA 00000000
440 DATA 00000000
450 DATA 00000000
460 For I = Y - 3 to - 20 step - 2
470 Put Sprite0, (X,I),9,2
480 Next I
490 Return
```

If you have understood all of the previous graphics examples and concepts, you should be well on your way to creating exciting graphics to enhance the programs you create using your SV-328.

That ends our introduction to extended BASIC graphics. Now it is time to move on to the extraordinary sound capabilities of the SV-328.

PART TWO - SOUND PROGRAMMING

There is also a very powerful music synthesizer built-in to the SV-328 that is easily used by simple BASIC commands to produce music. In addition to the power of this synthesizer, it is most important to realize that it can do its work independently of the main microprocessor. What this means is that you can program the synthesizer to do one thing while the screen, printer, modem or other peripheral is doing something else.

The following figure represents the available musical scale that can be accessed by the SV-328's synthesizer.

The diagram illustrates the available musical scale for the SV-328 synthesizer. On the left, a piano keyboard layout is shown with labels for each key. The notes are grouped into octaves: 0.5 (F, E, D, C), 0.4 (A# = Bb, G# = Ab, F# = Gb, D# = Eb, C# = Db), and 0.3 (B, A, G, F, E, D, C, B, A, G). On the right, a musical staff with a treble clef and a bass clef shows a sequence of notes: C4, D4, E4, F4, G4, A4, B4, C5, D5, E5, F5, G5, A5, B5, C6.

PLAY

The command that opens the door to this synthesizer is the BASIC keyword **PLAY**. For example, Typing the BASIC statement:

```
PLAY "CDE"
```

followed by pressing the **ENTER** key, will produce musical tones from your SV-328 through the speaker on your television or monitor. You could achieve the same results by writing a BASIC program with the following lines:

```
10 PLAY "CDE"  
20 GOTO 10
```

There are numerous other things that can be done with sound using the synthesizer in your SV-328. We will look at the simple ones in this section and progress to the more complex ones in later pages. We will continue to work with the BASIC program listed above and make changes in it as we go along.

"o" (OCTAVE)

First, change line 10 to read:

```
10 PLAY "o1CDE"
```

Now, when you run the program, you will hear that the sounds produced are at a very low pitch when compared with the first ones you made. This is because you have set the **OCTAVE** by adding the "o1" before the "CDE." This is the command that allows you to access 8 octaves with the synthesizer. Now add this line:

```
11 PLAY "o4CDE"
```

When the program is run, you will hear three low notes followed by three higher notes. The octaves you can access using the "o" command can range from 1 (lowest) to 8 (highest).

"T" TEMPO

Now, change line 10 to read:

```
10 PLAY "T32o1CDE"
```

The program will now play the same note you heard before but at a much slower rate. What you did by typing the "T32" before the "o1CDE" was to set the **TEMPO** or speed of the music. The values for "T" can range from 32 (slowest) to 255 (fastest).

You will also notice that the notes in line 11 also play at the slower pace. This is because the synthesizer will play at whatever tempo you set until you tell it to play at a different tempo. To see this in action, change line 11 to read:

```
11 PLAY "T255o4CDE"
```

Now, as you can hear, the notes from line 11 play at a much faster pace than those in line 10.

"L" (LENGTH)

You can also control the length of each note individually. To see this, change line 10 to read:

```
10 PLAY "T255o1CDL1E"
```

This change the "E" note to a much longer duration than "C" or "D" and also causes the notes in line 11 to play for a longer time. This length command can be placed in front of any note to control the length of the note. The lengths of the notes can be varied from 1 (longest) to 255 (shortest).

Two other BASIC commands that can be applied to sound are the "S" command and the "M" command. These two commands determine the tonal qualities of the note being played. These are more commonly referred to as the "ENVELOPE" characteristics of a note. Everything that creates a sound has unique characteristics.

For example: the same note played on a piano and a trumpet may be at the same pitch but will have two distinctly different sounds. These

two commands allow you to shape the notes you are creating in the same way.

"S" (SHAPE)

The "S" command controls the shape of the note. As an illustration of this, change line 10 to read:

```
10 PLAY "S1o4CDE"
```

and eliminate line 11

Now, run the program to see the differences in the sounds you hear. These shape commands can be considered the voices of the synthesizer. There are 14 of them built-in to the SV-328. This means that the numbers used to set the "S" command can range from 1 to 14.

"M" (TONE)

The "M" command controls the tone period or to be more specific, the amount of time that you will hear each note based on its tonal qualities. To see how this works, change line 10 to read:

```
10 PLAY "S10M500o4CDE"
```

As you will hear, this changes the sound dramatically. The values used to set "M" can range from 1 to 65535.

"R" (REST)

You can also insert pauses between notes by using the "R" command. Change line 10 to read:

```
10 PLAY "o4CR1DR10E"
```

This causes the "C" note to play and then silence is heard for a while then the "D" note plays, then a shorter period of silence, then the "E" note followed immediately by the "C" note again.

"V" (VOLUME)

The final command we will examine in this section is the "V" command. This command is used to set the volume of the sound being produced. Change line 10 to read:

10 PLAY "o4V5CV1oDV15E"

You will now hear that each note gets louder than the one before it. You can set the volume form 0 to 15.

**USING
3 CHANNELS
OF SOUND**

So far, we have only used one note at a time to demonstrate the use of the synthesizer. However, the SV-328 has three separate channels of sound that can be programmed individually to play together to create chords. Change line 10 to read:

10 PLAY "o1CDE", "o3EFC", "o5GAB"

What you hear now is three notes being played in combination to create a chord. You can also have each channel play something entirely different from the others to create a melody and harmony part in the music you create.

There are also other ways of addressing the sound and music generation capabilities of the SV-328 and they will be covered in the appendix, which is called "USING THE PROGRAMMABLE SOUND GENERATOR."

APPENDIX A

ASCII CHARACTER CODES

ASCII	DEFINITION	ASCII	DEFINITION
1	[CONTROL]+A	33	!
2	[CONTROL]+B	34	"
3	[CONTROL]+C	35	#
4	[CONTROL]+D	36	\$
5	[CONTROL]+E	37	%
6	[CONTROL]+F	38	&
7	[CONTROL]+G	39	'
8	[CONTROL]+H	40	(
9	[CONTROL]+I	41)
10	[CONTROL]+J	42	*
11	[CONTROL]+K	43	+
12	[CONTROL]+L	44	,
13	[CONTROL]+M	45	-
14	[CONTROL]+N	46	.
15	[CONTROL]+O	47	/
16	[CONTROL]+P	48	0
17	[CONTROL]+Q	49	1
18	[CONTROL]+R	50	2
19	[CONTROL]+S	51	3
20	[CONTROL]+T	52	4
21	[CONTROL]+U	53	5
22	[CONTROL]+V	54	6
23	[CONTROL]+W	55	7
24	[CONTROL]+X	56	8
25	[CONTROL]+Y	57	9
26	[CONTROL]+Z	58	:
27	ESCAPE	59	;
28	CURSOR RIGHT	60	<
29	CURSOR LEFT	61	=
30	CURSOR UP	62	>
31	CURSOR DOWN	63	?
32		64	@

65	A	108
66	B	109
67	C	110
68	D	111
69	E	112
70	F	113
71	G	114
72	H	115
73	I	116
74	J	117
75	K	118
76	L	119
77	M	120
78	N	121
79	O	122
80	P	123
81	Q	124
82	R	125
83	S	126
84	T	127
85	U	128
86	V	129
87	W	130
88	X	131
89	Y	132
90	Z	133
91	[134
92	\	135
93]	136
94	^	137
95	-	138
96	/	139
97	a	140
98	b	141
99	c	142
100	d	143
101	e	144
102	f	145
103	g	146
104	h	147
105	i	148
106	j	149
107	k	150

l
m
n
o
p
q
r
s
t
u
v
w
x
y
z
{
|
} : ^ v

ASCII	DEFINITION	ASCII	DEFINITION
151		194	☐ [RIGHT] + I
152		195	☐ [RIGHT] + J
153		196	☐ [RIGHT] + K
154		197	☐ [RIGHT] + L
155		198	▣ [RIGHT] + M
156		199	▣ [RIGHT] + N
157		200	☐ [RIGHT] + O
158		201	▣ [RIGHT] + P
159		202	▣ [RIGHT] + Q
160	☐ [LEFT] + A	203	▣ [RIGHT] + R
161	▣ [LEFT] + B	204	▣ [RIGHT] + S
162	☐ [LEFT] + C	205	▣ [RIGHT] + T
163	▣ [LEFT] + D	206	☐ [RIGHT] + U
164	☐ [LEFT] + E	207	▣ [RIGHT] + V
165	▣ [LEFT] + F	208	▣ [RIGHT] + W
166	▣ [LEFT] + G	209	☐ [RIGHT] + X
167	▣ [LEFT] + H	210	▣ [RIGHT] + Y
168	☐ [LEFT] + I	211	☐ [RIGHT] + Z
169	☐ [LEFT] + J	212	→
170	☐ [LEFT] + K	213	←
171	☐ [LEFT] + L	214	↑
172	☐ [LEFT] + M	215	↓
173	☐ [LEFT] + N		
174	☐ [LEFT] + O		
175	▣ [LEFT] + P		
176	▣ [LEFT] + Q		
177	▣ [LEFT] + R		
178	▣ [LEFT] + S		
179	▣ [LEFT] + T		
180	☐ [LEFT] + U		
181	☐ [LEFT] + V		
182	▣ [LEFT] + W		
183	▣ [LEFT] + X		
184	☐ [LEFT] + Y		
185	☐ [LEFT] + Z		
186	▣ [RIGHT] + A		
187	▣ [RIGHT] + B		
188	▣ [RIGHT] + C		
189	▣ [RIGHT] + D		
190	☐ [RIGHT] + E		
191	▣ [RIGHT] + F		
192	▣ [RIGHT] + G		
193	▣ [RIGHT] + H		

APPENDIX B

MATHEMATICAL FUNCTIONS

Derived Functions

Functions that are not available in Microsoft BASIC can be derived by using the following formulae:

Function	Microsoft BASIC Equivalent
SECANT	= 1/COS(X)
COSECANT	= 1/SIN(X)
COTANGENT	= 1/TAN(X)
INVERSE SINE	= ATN (X/SQR(-X*X + 1))
INVERSE COSINE	= -ATN (X/SQR(-X*X + 1)) + 1.5708
INVERSE SECANT	= ANT (X/SQR (X*X - 1)) + SGN (SGN(X) - 1)*1.5708
INVERSE COSECANT	= ATN (X/SQR (X*X - 1)) +(SGN(X) - 1)*1.5708
INVERSE COTANGENT	= ATN(X) + 1.5708
HYPERBOLIC SINE	= (EXP(X) - EXP (- X))/2
HYPERBOLIC COSINE	= (EXP(X) + EXP (- X))/2
HYPERBOLIC TANGENT	= (EXP(- X)/EXP(X) + EXP(- X))*2 + 1
HYPERBOLIC SECANT	= 2/(EXP(X) + EXP (- X))
HYPERBOLIC COSECANT	= 2/(EXP(X) - EXP (- X))
HYPERBOLIC COTANGENT	= EXP(- X)/(EXP(X) - EXP(- X))*2 + 1
INVERSE HYPERBOLIC SINE	= LOG(X + SQR(X*X + 1))
INVERSE HYPERBOLIC COSINE	= LOG(X + SQR(X*X - 1))
INVERSE HYPERBOLIC TANGENT	= LOG ((1 + X)/(1 - X))/2
INVERSE HYPERBOLIC SECANT	= LOG ((SQR(- X*X + 1) + 1)/X)
INVERSE HYPERBOLIC COSECANT	= LOG ((SGN (X)*SQR (X*X + 1) + 1)/X)
INVERSE HYPERBOLIC COTANGENT	= LOG ((X + 1)/(X - 1))/2

APPENDIX C

ERROR CODES AND ERROR MESSAGES

Code	Number	Message
NF	1	NEXT without FOR A variable in a NEXT statement does not correspond to any previously executed, unmatched FOR statement variable.
SN	2	Syntax error A line is encountered that contains some incorrect sequence of characters (such as unmatched parentheses, misspelled commands or statements, incorrect punctuation, etc.). Microsoft BASIC automatically enters edit mode at the line that caused the error.
RG	3	Return without GOSUB A RETURN statement is encountered for which there is no previous, unmatched GOSUB statement.
OD	4	Out of data A READ statement is executed when there are no DATA statements with unread data remaining in the program.
FC	5	Illegal function call A parameter that is out of range is passed to a math or string function. An FC error may also occur as the result of:

Code	Number	Message
		<ol style="list-style-type: none"> 1. A negative or unreasonably large subscript. 2. A negative or zero argument with LOG. 3. A negative argument to SQR. 4. A negative mantissa with a noninteger exponent. 5. A call to a USR function for which the starting address has not yet been given. 6. An improper argument to MID\$, LEFT\$, RIGHT\$, INP, OUT, WAIT, PEEK, POKE, TAB, SPC, STRING\$, SPACE\$, INSTR, or ON...GOTO.
OV	6	<p>Math Overflow</p> <p>The result of a calculation is too large to be represented in Microsoft BASIC number format. If underflow occurs, the result is zero and execution continues without an error.</p>
OM	7	<p>Out of memory</p> <p>A program is too large, or has too many FOR loops or GOSUBs, too many variables, or expressions that are too complicated.</p>
UL	8	<p>Undefined line</p> <p>A nonexistent line is referenced in a GOTO, GOSUB, IF...THEN...ELSE, or DELETE statement</p>
BS	9	<p>Subscript out of range</p> <p>An array element is referenced either with a subscript that is outside the dimensions of the array or with the wrong number of subscripts.</p>
DD	10	<p>Redimensioned array</p>

Code	Number	Message
		Two DIM statements are given for the same array; or, a DIM statement is given for an array after the default dimension of 10 has been established for that array.
IO	11	<p>Divison by zero</p> <p>A division by zero is encountered in an expression; or, the operation of involution results in zero being raised to a negative power. Machine infinity with the sign of the numerator is supplied as the result of the division, or positive machine infinity is supplied as the result of the involution, and execution continues.</p>
ID	12	<p>Illegal direct</p> <p>A statement that is illegal in direct mode is entered as a direct mode command.</p>
TM	13	<p>Type mismatch</p> <p>A string variable name is assigned a numeric value or vice versa; a function that expects a numeric argument is given a string argument or vice versa.</p>
OS	14	<p>Out of string space</p> <p>String variables have caused BASIC to exceed the amount of free memory remaining. Microsoft BASIC will allocate string space dynamically, until it runs out of memory.</p>
LS	15	<p>String constant too long</p> <p>An attempt is made to create a string more than 255 characters long.</p>
ST	16	<p>String formula too complex</p> <p>A string expression is too long or too complex. The expression should be broken into smaller expressions.</p>

Code	Number	Message
CN	17	<p>Can't continue</p> <p>An attempt is made to continue a program that:</p> <ol style="list-style-type: none"> 1. Has halted due to an error. 2. Has been modified during a break in execution. 3. Does not exist.
UF	18	<p>Function not defined.</p> <p>A USR function is called before the function definition (DEF statement) is given. Extended Disk Basic and Disk Basic Versions only.</p>
	19	<p>No RESUME An error trapping routine is entered but contains no RESUME statement.</p>
	20	<p>RESUME without error A RESUME statement is encountered before an error trapping routine is entered.</p>
	21	<p>Unprintable error An error message is not available for the error condition which exists. This is usually caused by an ERROR with an undefined error code.</p>
	22	<p>Missing operand An expression contains an operator with no operand following it.</p>
	23	<p>Line buffer overflow An attempt is made to input a line that has too many characters.</p>
	26	<p>FOR without NEXT A FOR was encountered without a matching NEXT.</p>

-
- 29** **WHILE without WEND**
A WHILE statement does not have a matching WEND.
- 30** **WEND without WHILE**
A WEND was encountered without a matching WHILE.

DISK ERRORS

Number	Message
---------------	----------------

- | | |
|-----------|---|
| 50 | Field overflow

A FIELD statement is attempting to allocate more bytes than were specified for the record length of a random file. |
| 51 | Internal error

An internal malfunction has occurred in Disk BASIC. Report to Microsoft the conditions under which the message appeared. |
| 52 | Bad file number
A statement of command references a file with a file number that is not OPEN or is out of the range of file numbers specified at initialization. |
| 53 | File not found
A LOAD, KILL or OPEN statement references a file that does not exist on the current disk. |
| 55 | File already open
A sequential output mode OPEN is issued for a file that is already open; or a KILL is given for a file that is open. |

-
- 56** Disk I/O error
An I/O error occurred on a disk I/O operation. It is a fatal error, i.e., the operating system cannot recover from the error.
- 57** File already exists
The filename specified in a NAME statement is identical to a filename already in use on the disk.
- 58** Disk full
All disk storage space is in use.
- 59** Input past end
An INPUT statement is executed after all the data in the file has been INPUT, or for a null (empty) file. To avoid this error, use the EOF function to detect the end of file.
- 69** Bad record number
In a PUT or GET statement, the record number is either greater than the maximum allowed (32767) or equal to zero.
- 61** Bad file name
An illegal form is used for the filename with LOAD, SAVE, KILL or OPEN (e.g., a filename with too many characters).
- 62** Direct statement in file
A direct statement is encountered while LOADING an ASCII-format file. The LOAD is terminated.
- 63** Too many files
An attempt is made to create a new file (using SAVE or OPEN) when all 255 directory entries are full.

APPENDIX D

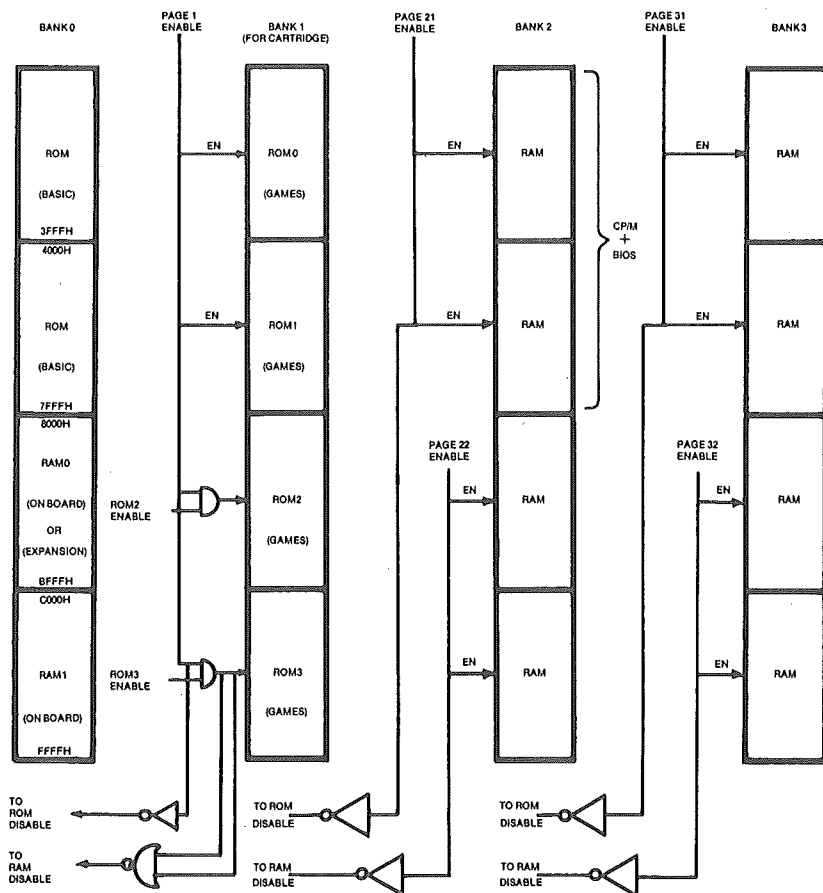
SV BASIC RESERVED WORDS

BASIC statements and function names are reserved. That is, the key words cannot be used in variable names. This appendix lists all of the SV BASIC language words that are reserved. If you attempt to use any of the words listed below as the name of the variable, an error is indicated by the computer.

ABS	DEFSNG	LEFT\$	PAINT	STRING\$
AND	DEF STR	LEN	PDL	SWAP
APPEND	DEFUSR	LET	PEEK	TAB
ASC	DELETE	LFILES	PLAY	TAN
ATN	DIM	LINE	POINT	THEN
ATTR\$	DRAW	LINE INPUT	POKE	TIME
AUTO	DSKI\$	LIST	POS	TO
BEEP	DSKO\$	LLIST	PRESET	TROFF
BIN\$	ELSE	LOAD	PRINT	TRON
BLOOD	END	LOC	PRINT USING	USR
BSAVE	EOF	LOCATE	PSET	VAL
CALL	EQV	LOF	READ	VARPTR
CDBL	ERASE	LOG	REM	VPEEK
CHAIN	ERL	LPOS	RENUM	VPOKE
CHR\$	ERR	LSET	RESTORE	WAIT
CINT	ERROR	MAXFILES	RESUME	WIDTH
CIRCLE	EXP	MERGE	RETURN	XOR
CLEAR	FIELD	MID\$	RIGHT\$	
CLICK	FILES	MKI\$	RND	
CLOAD	FIX	MKS\$	RSET	
CLOK	FOR	MOD	RUN	
CLOSE	FPOS	MON	SAVE	
CLS	FRE	MOTOR	SCREEN	
COLOR	GET	MOUNT	SET	
COMMON	GOSUB	NAME	SGN	
CONT	GOTO	NEW	SIN	
COPY	HEX\$	NEXT	SOUND	
COS	IF	NOT	SPACE\$	
CSAVE	INKEY\$	OCT\$	SPC	
CSNG	INP	OFF	SPRITE	
CSRLIN	INPUT	ON	SPRITE\$	
CVI	INPUT\$	ON STRIG	SQR	
CVS	INSTR	OPEN	STEP	
DATA	INT	OR	STICK	
DEFDBL	INTERVAL	OUT	STOP	
DEFFN	KEY	OUTPUT	STRIG	
DEFINT	KILL	PAD	STR\$	

APPENDIX E

I/O PINOUTS & MEMORY MAPS



*** SV-318/328 EXPANDER BUS SIGNAL DESCRIPTION ***

PIN: NAME: I/O: DESCRIPTION:

1	+5V	O	+5V power supply, 300mA current is available for all peripheral cards.
2	$\overline{\text{CNTRL2}}$	I	Spectravideo game adapter for Coleco™ games. CONTROL signal (normally held HIGH by a 3.3K ohm resistor). This signal, when the game adapter is in use, controls the data transfer between the CPU and the adapter during the external I/O addressing.
3	+12V	O	+12V power supply. Maximum current is 100mA for all peripheral cards.
4	-12V	O	-12V power supply. Maximum current is 50mA for all peripheral cards.
5	$\overline{\text{CNTRL1}}$	I	Spectravideo game adaptor for Coleco™ games CONTROL signal (normally held HIGH by 1K ohm resistor). This signal, when pulled LOW (i.e. when the adaptor is in use), disables all internal (i.e. SV-318/328) I/O address decoding, and inverses A15.
6	$\overline{\text{WAIT}}$	I	Indicates to z80A CPU that the addressed memory or I/O devices are not ready for data transfer.
7	$\overline{\text{RST}}$	I	When this signal is pulled LOW the CPU begins a RESET cycle. During this RESET cycle, the address and data bus enter a high impedance state and the control signals enter the inactive state.
8	CPUCLK	O	Buffered system clock of frequency 3.58 MHz.
9-24	A15-A0		Buffered ADDRESS BUS. This is a 16-bit address bus providing addresses for memory data exchange and I/O device data exchange.
25	$\overline{\text{RFSH}}$	O	Buffered REFRESH signal for the dynamic RAM expanders only. This signal indicates that the lower 7 bits of the address bus contain a refresh address for the dynamic RAM.
26	$\overline{\text{EXCSR}}$	I	This is the external CPU-from-VDP READ select signal, and is used by Spectravideo game adaptor for Coleco™ games only.
27	$\overline{\text{M1}}$	O	Buffered MACHNINE ONE CYCLE signal. This signal indicates that OP code fetch cycle is the current machine cycle.
28	$\overline{\text{EXCSW}}$	I	This is the external CPU-to-VDP WRITE select signal, and is used by Spectravideo game adaptor for Coleco™ games only.
29	$\overline{\text{WR}}$	O	Buffered WRITE signal. This signal indicates

that the CPU data bus holds valid data for storage in the addressed memory or I/O device.

- 30 $\overline{\text{MREQ}}$ O Buffered MEMORY REQUEST signal. This signal indicates when the address bus is holding a valid memory address.
- 31 $\overline{\text{IORQ}}$ O Buffered INPUT/OUTPUT REQUEST signal. This signal indicates the lower 8 bits of the address bus are holding a valid I/O device address, and is at HIGH state (i.e. inactive) during the INTERRUPT cycle.
- 32 $\overline{\text{RD}}$ O Buffered READ signal. This signal indicates that the Z80A CPU is wanting to read data from memory or an I/O device.
- 33-40 D0-D7 Buffered bidirectional DATA bus. This is an 8-bit bidirectional data bus for data exchange between memory and I/O devices.
- 41 CSOUND I AUDIO input signal from the Spectravideo game adaptor for Coleco™ games.
- 42 $\overline{\text{INT}}$ I Generated by I/O devices to request interrupt to Z80A CPU.
- 43 $\overline{\text{RAMDIS}}$ I Pulling this signal LOW disables the SV-318/328 user RAM. This line is held high by a 1K ohm resistor to +5V.
- 44 $\overline{\text{ROMDIS}}$ I Pulling this signal LOW disables the SV-318/328 BASIC ROM on board.
- 45 $\overline{\text{BK32}}$ O Buffered MEMORY BANK CONTROL signal. Pulling this signal LOW enables the bank 32 portion of the memory (32K, Addr. — 8000H-FFFFH), and disables the user RAM on board through the RAMDIS signal.
- 46 $\overline{\text{BK31}}$ O Buffered MEMORY BANK CONTROL signal. Pulling this signal LOW enables the bank 31 portion of the memory (32K, Addr. — 0000H-7FFFH), and disables the BASIC ROM on board through the ROMDIS signal.
- 47 $\overline{\text{BK22}}$ O Buffered MEMORY BANK CONTROL signal. Pulling this signal LOW enables the bank 22 portion of the memory (32K, Addr.— 8000H-FFFFH), and disables the user RAM on board through the RAMDIS signal.
- 48 $\overline{\text{BK21}}$ O Buffered MEMORY BANK CONTROL signal. Pulling this signal LOW enables the bank 21 portion of the memory (32K, Addr.— 0000H-7FFFH) which is the lower portion of SV-328 user addressable memory, and disables the BASIC ROM on board.
- 49-50 GND System electrical ground.

P1 EXPANSION BUS

PIN	NAME	PIN	NAME
1	+5V	2	CNTRL2
3	+12	4	-12V
5	CNTRL1	6	WAIT
7	RST	8	CPU CLK
9	A15	10	A14
11	A13	12	A12
13	A11	14	A10
15	A9	16	A8
17	A7	18	A6
19	A5	20	A4
21	A3	22	A2
23	A1	24	A0
25	RFSH	26	EXCSR
27	M1	28	EXCSW
29	WR	30	MREQ
31	IORQ	32	RD
33	D0	34	D1
35	D2	36	D3
37	D4	38	D5
39	D6	40	D7
41	CSOUND	42	INT
43	RAMDIS	44	ROMDIS
45	BK32	46	BK31
47	BK22	48	BK21
49	GND	50	GND

P2 CASSETTE

PIN	NAME
1	12V
2	CASR
3	CASW
4	AUDIO
5	GND
6	ME
7	READY

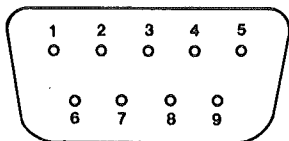
SK1 KEYBOARD

PIN	NAME
1	CAPS
2	5V
3	OUTPUT 10
4	OUTPUT 2
5	OUTPUT 3
6	OUTPUT 4
7	OUTPUT 9
8	OUTPUT 5
9	OUTPUT 8
10	OUTPUT 6
11	OUTPUT 7
12	OUTPUT 1
13	OUTPUT 0
14	INPUT 2
15	INPUT 1
16	INPUT 0
17	INPUT 3
18	INPUT 4
19	INPUT 5
20	INPUT 6
21	INPUT 7
22	POWER
23	GND

**SK2 GAME
CARTRIDGE**

PIN	NAME	PIN	NAME
1	+5V	2	+5V
3	A7	4	A12
5	A6	6	A13
7	A5	8	A8
9	A4	10	A9
11	A3	12	A11
13	A10	14	A2
15	A0	16	A1
17	D0	18	D7
19	D1	20	D6
21	D2	22	D5
23	D3	24	D4
25	CCS3	26	CCS4
27	CCS1	28	CCS2
29	GND	30	GND

SK3 JOYSTICK 1

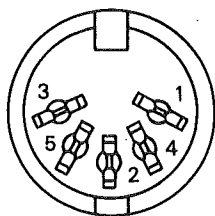


PIN	NAME
1	FORWARD/SCK
2	BACKWARD/SI
3	LEFT/CS
4	RIGHT/SENCTR
5	SENSE
6	TRIGGER
7	+5V
8	GND
9	EOC

SK4 JOYSTICK 2

PIN	NAME
1	FORWARD/SCK
2	BACKWARD/SI
3	LEFT/CS
4	RIGHT/SENCTR
5	SENSE
6	TRIGGER
7	+5V
8	GND
9	EOC

SK5 VIDEO & AUDIO



PIN	NAME
1	+5V
2	GND
3	AUDIO
4	MONITOR VIDEO
5	RF VIDEO

APPENDIX F

NOTES ON HIGH RESOLUTION AND LOW RESOLUTION SCREENS

The 64 x 48 grid you see in figure 2-3 in Chapter 5 can be treated as a separate screen. The 64 by 48 grid is called a "low resolution graphics screen" and the 256 by 192 is called a "high resolution graphic, screen." Every 4 boxes of the 256 by 192 grid is treated as one unit on the 64 x 48 grid. The box numbers in Figure 2 in Chapter 5 should be multiplied by 4 to appear in the proper places on the screens. This will maintain compatibility between the low resolution and high resolution screen.

	0	1	2	3
0				
1				
2				
3				

Each of the four boxes is treated as an individual point on a high resolution screen.

The screen 2 command draws on the low resolution screen, and the screen 1 command draws on the high resolution screen. Thus if you PSET one of these four boxes, on a high resolution screen, only that one will be lit up. But on a low resolution screen, if you turn on any one of these boxes all of them will be lit.

APPENDIX G

TROUBLE SHOOTING CHART

SYMPTOM	POSSIBLE CAUSE	REMEDY
NO POWER	Power Switch not turned ON.	Turn on power switch on the righthand side of the machine
	Power cable not connected	Be sure the power cable is connected to the computer and the wall sockets.
	Blown fuse in the computer	Return the system to an authorized dealer for replacement.
NO SOUND OR PICTURE	Wrong TV channel	Select channel 3 or 4
	Wrong TV hook up	Hook up the computer to the "VHF" antenna terminals.
	Loose video cable	Be sure all video cables are securely fastened.
NO SOUND	TV volume too low	Adjust the volume control of TV.
NO COLOR		Adjust TV color level and fine tune the TV.

APPENDIX H

USING THE PROGRAMMABLE SOUND GENERATOR (PSG)

Other than the **PLAY** statement which allows you to create musical notes, you can use the **SOUND** statement to directly control the various capabilities of the Programmable Sound Generator which we will refer to as the PSG.

A PSG **SOUND** statement takes the form of:

SOUND < REGISTER OF PSG > , <value>

Where < register of PSG > is one of the 13 available registers the PSG uses, and < value > is a number between 1 to 255. The function of creating a specific sound or sound effect logically follows the control sequence listed below:

OPERATIONS	REGISTERS	FUNCTION
Tone generator control	R0 - R5	Program tone periods.
Noise generator control	R6	Program noise period.
Mixer control	R7	Enable tone and or noise on selected channels
Amplitude control	R8 - R10	Select "fixed" or "envelope variable" amplitudes.
Envelope generator control	R11 - R13	Program envelope period and select envelope pattern.

TONE GENERATOR CONTROL

The PSG has 3 tone channels A, B and C. The frequency for each channel is obtained by counting down the input clock by 16 times the value of the frequency wanted.

For example:

```

Desired value = 3579545 /
(16 * frequency)
Low register = <Desired value >
AND 255
High register = <Desired value > / 256

```

The high and low registers correspond to the register pair used by each control.

Channel	Register
A	1,0
B	3,2
C	5,4

Program examples follow:

```

10 Input "Enter frequency";A
20 F = 3579545 / (16 * A)
30 H = F / 256
40 L = F and 255
50 SOUND 0,L
60 SOUND 1,H
70 SOUND 8,15 : PRINT" Volume
control of channel A "
80 SOUND 7,254 : PRINT" Binary
11111110 to enable channel A
90 END

```

AMPLITUDE CONTROL

In the previous example program, you should notice we used register 8 to enable to volume of channel A. The PSG has three separate register to control the amplitude of the different channels.

Channel	Register
A	8
B	9
C	10

Each channel can have a volume form 9 to 15 with 15 being the loudest.

For example:

```

10 SOUND 0, 100
20 SOUND 1,0
30 SOUND 7,254 : REM TURN
   ON CHANNEL A (MIXER)
40 FOR I = 15 TO 0 STEP -1
50 SOUND 8,1
60 FOR J = 1 TO 200 : NEXT J :
   REM DELAY
70 NEXT I

```

You will hear a high pitched sound fading away, because we changed the volume of channel A from 15 through 0.

The Amplitude control register can also be used to direct the envelope period of each channel, by setting the Amplitude channel to a value of 16, the amplitude of the corresponding channel would be controlled by reg 11,12, and 13. For more information on this, refer to Envelope Period Control Registers.

MIXER CONTROL

The **MIXER** register, register number 7, controls the three Noise / Tone channels. The Mixers, as previously described, combine the noise and tone frequencies for each of the three channels. The determination of combining neither, either or both noise and tone frequencies on each channel is made by the state of Bit 0 – Bit 5 of reg. # 7. Bit 6 and 7 are for I/O ports connected through the PSG, and these are ignored by BASIC.

REGISTER 7

B7	B6	B5	B4	B3	B2	B1	B0
Not used		Noise channel			Sound channel		
/	/	/	/	/	C	B	A

Bits logical value

1 if channel is disabled

0 if channel is enabled

For example:

SOUND 7,&B11111110

will turn on tone channel A.

SOUND 7, &B11110110

will enable both noise and tone channel A.

ENVELOPE PERIOD CONTROL REGISTER

The generation of fairly complex envelope patterns can be accomplished two different ways in BASIC. First, it is possible to vary the frequency of the envelope using register 11 and 12 as a 16 bit register; and second, the relative shape and cycle of the envelope can be varied by using register 13.

For example:

$$\langle \text{Desired envelope freq} \rangle = \frac{3479545}{(256 * \text{freq})}$$










Program example:

```
10 SOUND 0,100
20 SOUND 1,0 : REM Tone channel A
30 SOUND 7,&b11111110 :
   REM Enable A
40 SOUND 8,16 : REM Value of 16 to
   enable E/P reg.
50 SOUND 13,14 : REM Shape select
60 S = .5 : REM .5 HERTZ
70 CLOK = 3579545
80 L = CLOK / (256*S) AND 255
90 H = CLOK / (256*S) / 256
100 SOUND 11,L
110 SOUND 12,H
120 END
```

NOTE: REG 13 is the shape register described in the next chapter.

SHAPE REGISTER

You can select 9 different shapes for the envelope period output, by programming the shape register #13.

Selected value	Shape
0,1,2,3,9	
4,5,6,7	
8	
10	
11	
12	
13	
14	
15	

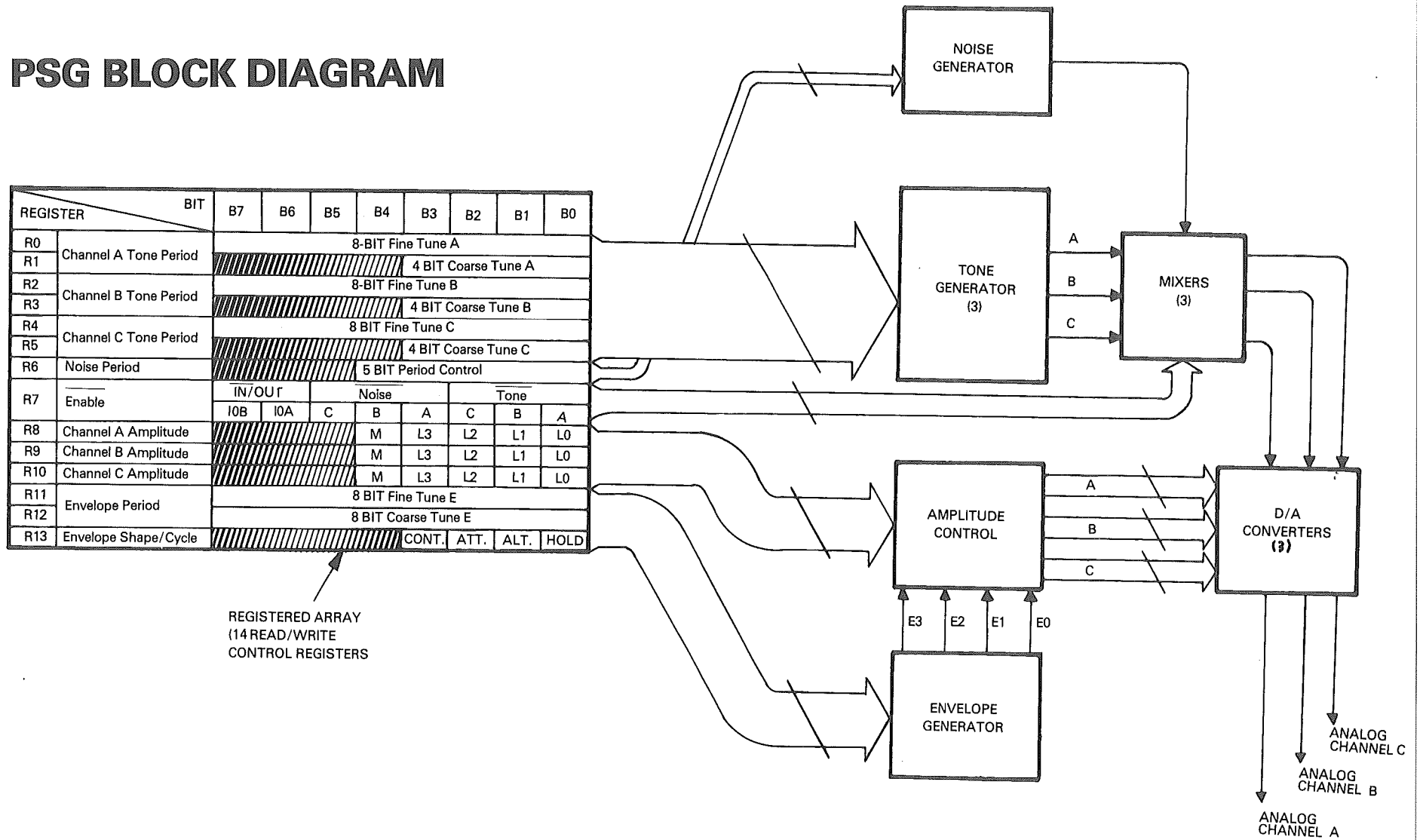
= one cycle

For example:

SOUND 13,14

will create a tone modulating up and down according to the envelope period set in registers 11 and 12, when the enable bit 4 of register 8 (SOUND 8,16) is set.

PSG BLOCK DIAGRAM



APPENDIX I

INTRODUCTION TO BASIC PROGRAMMING

(BASIC GRAPHICS and
BASIC SOUND)

In learning to use your SV-328 computer, you use many different commands and programming techniques. However, if you are like most people, you would like to be able to do something NOW to see your computer in action. To help you do this, we will guide you through some very simple examples to prepare you for the things you will be exposed to later in the user's manual.

We are going to assume that you have read the systems overview and set-up procedures in your SV-328 owner's manual, and have set up your computer properly. First, turn the television or monitor on and then turn on your SV-328. Watch and you will see that the SPECTRAVIDEO logo appears on the screen, changing colors 3 times. The screen then clears and displays the amount of memory available. When the square cursor appears below this information, it is your indication that the SV-328 is waiting for your instructions.

The first command that we will explore is one that controls the color of the screen and the characters that appear on it.

COLOR

This command allows you to vary the colors of the display in any manner you choose. You can choose from 16 colors, denoted by the numbers 0 to 15. As an example, type in the following line:

COLOR 6,1

Now press the **ENTER** key. When you do this, you will see that the screen will change from its normal colors of blue background with white letters to a black screen with orange letters. You can explore the various colors that are available by varying the numbers you type after the "COLOR" command. When you have completed this exploration, turn the computer off and then back on. This will clear all the memory and return the system to its original or "default" condition. There are other ways of accomplishing this, by the way, and they are explained in greater depth in the user's manual.

Now, let's program a line in to the computer that will cause it to print your name on the top of the screen. Type in the following line:

10 CLS

Now, type RUN and press the **ENTER** key. You will see that the screen has cleared and that the word "OK" is printed on line 1 with the cursor (white square) below. The command "CLS" (Clear Screen) is the command that clears the screen anytime the computer finds it in a program.

Now, type this line:

20 PRINT "SPECTRAVIDEO"

Type RUN and press **ENTER** again, and you will see that the word "SPECTRAVIDEO" now appears on the top line of the screen with the word "OK" and the cursor below. What you have just done is to write a two-line program!

Now, we will edit that program. First, type LIST and press the **ENTER** key. This will cause the program that you just wrote to be displayed on the screen. Now, using the joystick cursor control, move the cursor so that it is placed on the "S" of "SPECTRAVIDEO." Press the **INS/PASTE** key on the keyboard and you will see that the cursor is now only half as tall as it was. This indicates that it is in the "INSERT" mode. To begin this edit, simply type in your name. The line should now look like this:

20 PRINT "YOUR NAMESPECTRAVIDEO"

The half-height cursor should still be located over the "S" in "SPECTRAVIDEO." Now, press the **DEL/CUT** key once and you will see that the "S" has disappeared and that the cursor is now located over the "P." You have deleted the "S." Do the same thing for all of the letters remaining until you get to the quotation mark. When the cursor is located over this mark, press the **ENTER** key.

Your edit is now completed. If you have followed all of the above steps, listing the program should cause the screen display to look like this:

10 CLS
20 PRINT "YOUR NAME"

"RUN" the program and you will see that your name is now at the top of the screen. Congratulations! You have created and edited a program using the built-in editor of your SV-328.

BASIC GRAPHICS

Another area that will allow you to quickly explore the power in your SV-328 is that of graphics. To see this in action, type in the following lines, pressing **ENTER** after each is completed:

```
10 CLS
20 SCREEN 1
30 CIRCLE (128,80), 60, 11
40 PAINT (128,80), 11
50 GOTO 40
```

Now, type **RUN** and you will see a yellow circle appear on the screen and then it will be filled in by the SV-328's yellow paint brush. To understand how this happens, let's look at each line individually.

10 CLS

As explained above, this line clears the screen. It is a good idea to place this line near the beginning of any program, so that you begin with a clean screen.

20 SCREEN 1

This line causes the computer to display its graphics screen (#1). You always have a choice of three screens using BASIC and the screen you were using in the first example was screen 0. This is the default screen or the screen that is always displayed when the computer is turned on (which is why you didn't have to add a line to the first program to use this screen).

30 CIRCLE (128,80), 60, 11

Here, you are telling the computer to draw a circle at a point that is 128 points from the left side of the screen, 80 points down from the top of the screen, with a radius (distance from the center of the circle) of 60 points and with a yellow (the number 11) border.

40 PAINT (128,80), 11

This is the line that tells the SV-328 to use its paintbrush to fill in the circle you have just outlined in line 30. You must use the same coordinates (128,80) and the same color (11) as used in the previous line.

50 GOTO 40

The last line in the program causes the program to repeat line 40 until you stop the program by pressing the **CTRL** and **STOP** keys at the same time. You will also notice that when you do this, the screen clears and the cursor moves to the top left hand corner. This is because the display has returned to the default or #0 screen referred to above. You can experiment with the numbers in this program to vary the location, size or color of the circle being painted.

The first number following the "CIRCLE" command (the X axis) may range from 0 to 255 and the second number (the Y axis) may range from 0 to 191.

LINE & BOX DRAWING

Now that you have seen what your SV-328 can do with circles and its paintbrush, we'll take a look at lines and boxes. The computer has the same simple method for drawing them as it does for circles. First, type NEW to clear the memory of the program we were using before. Now, enter the following lines:

```
10 CLS  
20 SCREEN 1  
30 LINE (50,40) - (200,150)  
40 GOTO 40
```

When you run this program, you will see that a line has been drawn from high on the left side of the screen to a low point on the right side of the screen. The line that causes this to happen is line 30:

```
30 LINE (50,40) - (200,150)
```

This line tells the computer to draw a line from a position 50 points from the left margin of the screen and 40 points down from the top over

to a position that is 200 points from the left margin and 150 points down from the top.

Now, you can simply convert this same line into a box command by changing the line to read as follows:

30 LINE (50,40) – (200,150), 10,B

By running the program now, you will see a box on the screen. By adding the 10 following the parentheses, you defined the color of the box border and the "B" tells the computer to draw a box at the same coordinates as the line. To tell the computer to use the paintbrush, change the line to read:

30 LINE (50,40) – (200,150), 10,BF

Now you will see that the program draws the same box and paints the inside with the same color as the border.

BASIC MUSIC

THE "PLAY" COMMAND

There is also a very powerful music synthesizer built into the SV-328 that can be easily used, through simple BASIC commands, to produce music. The key to this synthesizer is the BASIC statement:

PLAY "ABC"

followed by pressing the enter key. This will produce musical tones from your SV-328 through the speaker on your television or monitor. You could achieve the same results by writing a BASIC program with the following lines:

```
10 PLAY "ABC"  
20 GOTO 10
```

There are numerous other things that can be done with sound using the synthesizer in your SV-328. We will look at the simple ones in this section and progress to the more complex ones in later pages. We will continue to work with the BASIC program listed above, and make changes in it as we go along.

THE "O" (OCTAVE) COMMAND

First, change line 10 to read:

```
10 PLAY "o1ABC"
```

Now, when you run the program, you will hear that the sounds produced are at a very low pitch when compared with the first ones you made. This is because you have set the OCTAVE by adding the "o1" before the "ABC". This is the command that allows you to access 8 octaves with the synthesizer. Now add this line:

```
11 PLAY "o4ABC"
```

When the program is run, you will hear three low notes followed by three higher notes. The octaves you can access using

the "o" command can range from 0 (lowest) to 7 (highest).

THE "T" (TEMPO) COMMAND

Now, change line 10 to read:

10 PLAY "T32o1ABC"

The program will now play the same note you heard before but at a much slower rate. What you did by typing the "T32" before the "o1ABC" was to set the TEMPO or speed of the music. The values for "T" can range from 32 (slowest) to 255 (fastest).

You will also notice that the notes in line 11 also play at the slower pace. This is because the synthesizer will play at whatever tempo you set until you tell it to play at a different tempo. To see this in action, change line 11 to read:

11 PLAY "T255o4ABC"

Now, as you can hear, the notes from line 11 play at a much faster pace than those in line 10.

THE "L" (LENGTH) COMMAND

You can also control the length of each note individually. To see this, change line 10 to read:

10 PLAY "T255o1ABL1C"

This changes the "C" note to a much longer duration than "A" or "B" and also causes the notes in line 11 to play for a longer time. This length command can be placed in front of any note to control the length of the note. The lengths of the notes can be varied from 1 (longest) to 255 (shortest).

THE "S" (SHAPE) & "M" (TONE) COMMANDS

Two other BASIC commands that can be applied to sounds are the "S" command and the "M" command. These two commands determine the tonal qualities of the note being played. As an example of this, the same note played on a piano and a trumpet may be at the same pitch but will have two distinctly different

sounds. These two commands allow you to shape the notes you are creating in the same way.

The "S" command controls the shape of the note. As an illustration of this, change line 10 to read:

10 PLAY "S1o4ABC"

and eliminate line 11 by typing 11 and pressing **ENTER**

Now, run the program to see the differences in the sounds you hear. These shape commands can be considered the voices of the synthesizer. There are 14 of them built into the SV-328. This means that the number used to set the "S" command can range from 1 to 14.

The "M" command controls the tone period or to be more specific, the amount of time that you will hear each note based on its tonal qualities. To see how this works, change line 10 to read:

10 PLAY "S10M5000o4ABC"

As you will hear, this changes the sound dramatically. The values used to set "M" can range from 1 to 65535.

You can also insert pauses between notes by using the "R" command. Change line 10 to read:

10 PLAY "o4AR1BR10C"

This causes the "A" note to play, followed by a brief period of silence. Then the "B" note plays, then a shorter period of silence, then the "C" note followed immediately by the "A" note again.

THE "R" (REST) COMMAND

THE "V" (VOLUME) COMMAND

The final command we will examine in this section is the "V" command. This command is used to set the volume of the sound being produced. Change line 10 to read:

10 PLAY "o4V5AV10BV15C"

You will now hear that each note gets louder than the one before it. You can set the volume from 0 to 15.

USING 3 CHANNELS OF SOUND

So far, we have only used one note at a time to demonstrate the use of the synthesizer. However, the SV-328 has three separate channels of sound that can be programmed individually to play together to create chords. Change line 10 to read:

10 PLAY "o1ABC", "o3CDE", "o5FAG"

What you hear now is three notes being played in combination to create a chord. You can also have each channel play something entirely different from the others to create melody and harmony parts in the music you create.

There are also other ways of addressing the sound and music generation capabilities of the SV-328 which will be covered in greater depth in the user's manual.

These are just a few of the exciting things that your SV-328 Computer System can do for you. To begin exploring your machine in greater depth, read each chapter in the owner's manual and follow the examples. Have Fun and Good Luck!!!

GLOSSARY

Although most of the words that appear in the glossary were not used in this manual, we have included them for your future reference:

Access time	The time between the instant that an address is sent to a memory location and the instant data returns.
accumulator	One of several registers which temporarily store, or "accumulate" the results of various operations.
address	The digital number used by the CPU to specify a location in memory.
ALU	<i>Arithmetic Logic Unit.</i> The part of a CPU that adds, subtracts, shifts, ANDs, ORs, and performs other computational and logical operations.
alphanumeric	A device or a system that includes both alphabetical and numerical characters.
architecture	The organizational structure of a computer system.
array	A list of values stored in a series of memory locations.
ASCII	<i>American Standard Code for Information Interchange.</i> Consists of 128 letters, numbers, punctuation marks, and special symbols each of which consists of a binary pattern that uses eight digits.
assembler	A software program which converts symbolic or mnemonic language into machine language.

BASIC

Beginners All-Purpose Symbolic Instruction Code. A high level programming language designed for the beginning programmer.

baud

A unit by which signal speeds are measured. In microprocessing, the baud rate refers to the number of bits per second.

binary

A number system that has 2 as its base, and that uses only the digits 0 and 1. Used by digital computers to perform the tasks in data processing.

bit

Binary digit. Single element of a binary number with a value of either 0 or 1.

Boolean Logic

Mathematical logic processes based on a system of algebra developed in the early nineteenth century by English mathematician George Boole.

bootstrap

A technique or device for loading the first instructions or words of a routine into memory. These instructions are used then to bring in the rest of the routine.

branch

A way of rerouting a program so that it branches to another set of instructions to perform another task.

bug

An error or defect in the hardware or software of the computer, causing a malfunction.

bus

A set of wires or conductors arranged in parallel, used to transmit data, signals, or power between parts of a computer system.

byte

A group of eight bits, operated upon as a unit.

clock

A device or circuit that sends out timing pulses to synchronize the action of the processor.

COBOL	<i>COmmon Business Oriented Language.</i> A high level language used in many business applications.
command	An instruction to the computer that causes something to happen.
compiler	A program to convert a high level language into assembly or machine language (understood by the computer).
controller	An interface which allows the control of an I/O device by the central processing unit.
CPU	<i>Central Processing Unit.</i> The part of the computer that controls all execution of instructions and arithmetic operations.
CRT	Cathode Ray Tube. The display on which information is shown after program execution.
cursor	A symbol displayed on the screen indicating where the next character is to be displayed.
data	Essentially, information that is input to the computer.
data bus	An electrical path along which information passes.
debug	To delete any errors in a program.
DMA	<i>Direct Memory Access.</i> The accessing of memory without intervention of the central processing unit.
disk	A plate resembling a record album with a magnetic surface used to store data or programs. Also known as "floppy disk."
DOS	<i>Disk Operating System.</i> The program used for implementation of a disk drive.
dump	The transfer of information from one piece of equipment to another.

editor	A program used for the creating and/or altering of text in another program.
execute	The final step in running a program. An execution will perform the operation specified in the program.
expression	A particular grouping of numbers, letters, or variables that comprise a single quantity.
fetch	Refers to the reading out of an instruction/data from an addressed memory location.
file	A collection of organized records that are usually on one particular subject.
firmware	The programs that are built into the ROM of a microcomputer.
floppy disk drive	A peripheral device used to store data from and input data to the computer. It is also known as an input/output device.
flowchart	A diagram used in the development of a computer program. A flowchart shows the sequence of steps to take.
format	The way in which characters, fields, page numbers, lines, and punctuation marks are arranged on a single sheet of paper.
FORTRAN	<i>FORmula TRANslation</i> . A high level language using algebraic notation.
gate	An electrical signal circuit, with two (or more) inputs one and output, that behaves as a switch to create a particular state (either a binary one or zero).
hardware	The physical components that make up a particular computer system. Includes all the peripheral devices.

hexadecimal	A numbering system used in computers. Uses the digits 0-9 and the letters A-F.
high level language	A programming language that is easier to understand and more convenient for the programmer. BASIC, FORTRAN, PASCAL and PL-1 are some examples of high level languages.
I/O devices	<i>Input/Output devices.</i> These would include the disk drive, data cassette, keyboard, printer, TV monitor, etc.
instruction	A command telling the computer to perform a specific task.
instruction set	These are the set of instructions built into the firmware of the microcomputer. This instruction set is used by the programmer.
interface	This is the way in which peripheral devices are linked to the mainframe console of the microcomputer.
interpreter	A program that converts one instruction at a time into machine language understood by the computer.
keyboard	This is the console of the computer in which data is input to the Central Processing Unit.
kilobyte or "K"	Equivalent to 1024 bytes.
library	A collection of files or records that a person can access easily.
load	To enter a program into a computer's memory.
location	The portion in memory in which a data word or an instruction is stored.
logic	A particular way of reasoning using thought processes.

loop	A series of instructions that allow the programmer to repeat a particular sequence of events in a program.
LSI	<i>Large Scale Integration.</i> An integrated circuit that has thousands of components packed in one chip.
machine language	This is the language of the computer that is the lowest level the computer itself can accept as a program. This language is used with either binary, octal, or hexadecimal number systems.
memory	The part of the computer that stores data and instructions. Each instruction uses a particular address which tells the CPU where to fetch from.
menu	This is a list much like the one in your local restaurant, except this type of menu lists what the computer is ready to do for you.
microprocessor	This is also known as the Central Processing Unit. It is comprised of one or more LSI circuits that control all the processes of the computer.
mnemonics	These are abbreviated terms for instructions, used so that the programmer can easily remember them.
modem	<i>MODulator DEModulator.</i> This is a device used to convert data to signals that can be transmitted over telephone lines and then back to data again at the receiving end.
octal	A numbering system used in computers employing the digits 0-7.
on-line	Whenever a peripheral device is interacting with its host computer, it is said to be "on line." For example, a printer is said to be "on-line" when it is doing a computer printout.

operating system	The "OS" of a computer system is the program that directs such things as input/output, memory allocation, interrupt processing, and controls the overall operation of the computer.
output	When data is said to be "output" it usually refers to the printout from a printer. Output may also be programs or data saved on a floppy diskette.
page	A grouping of memory locations by higher order address bits. In an 8-bit microprocessor (the one in the SV-318), 256 bytes may comprise a page.
peripheral	Any device external from the host computer but used in conjunction with the computer to perform operations such as printouts, data storage and retrieval, CRT displays, telecommunications, graphics, etc.
pixel	The measurement of one dot on the display screen. The number and arrangement of pixels is what determines screen resolution.
pointer	This is the register in the CPU that contains the memory address.
program	The sequence of instructions that tell the computer what task to perform.
program counter	This is the register in the CPU that specifies the address of the next instruction to be executed.
prompt	This is the symbol on the screen which shows the user that the computer is ready to accept input from the keyboard.
RAM	<i>Random Access Memory.</i> This is the portion of memory that can be written into and read from. When the computer's power is turned off, anything written will be lost.

register	A circuit used to store or manipulate bits or bytes of data in the Central Processing Unit.
ROM	<i>Read Only Memory.</i> This is the part of memory that may only be read from. It is said to be "nonvolatile," meaning that when power is turned off the ROM retains its information.
routine	A specific program designed to do a particular function.
software	Software pertains to the programs that are input to the computer by the user.
source program	A program written in a language that is easily understood.
sprite	This is a shape designed by the programmer when using a computer's graphic capabilities.
subroutine	A routine in a program may be used over again to perform a specific function.
syntax	The rules governing a sentence command line. If the command line is not in proper syntax, a "syntax error" will occur.
terminal	An input/output device usually consisting of a keyboard, CRT and printer used as a work station.
time sharing	The process of (more than one user) sharing the use of a CPU via time robin.
truth table	A truth table shows the different values that an AND, OR, NAND, NOR, or other logic gate will have, according to two select inputs.
utility program	This is a program that helps the user perform various specific utility functions, such as a debug program to find mistakes in programs.

variable

A variable is any number or set of numbers, assigned a particular value, that is to be operated upon in a program.

volatile storage

The type of storage which, when power is removed, the program or data in memory is lost. RAM is said to be volatile.

windows

Several smaller screens displayed on one CRT screen at the same time.

SVI-300 SERIES COMPUTER QUICK REFERENCE CARD

SPECIAL CHARACTERS

(A means CTRL)

A B Move cursor to start of previous word

A C truncate line (clear text from current cursor position to end of logical line)

A E move cursor to start of next word

A F beep

A G backspace, deleting character on the left of cursor

A H tab (8 spaces)

A I cursor home

A L clear screen

A M carriage return, enters current line

A N move cursor to end of line

A R toggles insert/replace mode

A U clear logical line

A V cursor right

A W cursor left

A X cursor up

A Y cursor down

A Z halt program execution

< CLR/HM > same as A L, shift to home cursor

< del > same as A H, use as is to delete character at cursor

< ins > same as A R

< stop > toggles pause or resume program execution

&B prefix for binary constant

&H prefix for hexadecimal constant

&O prefix for octal constant

: separate statements typed on the same line

? same as PRINT

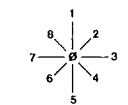
' same as REM but use more memory

~ denotes CURRENT LINE for RENUM, DELETE, LIST, LLIST, RUN commands

PROGRAMMABLE FUNCTION KEYS

Key number	Initial definition
<F1>	color
<F2>	auto <cr>
<F3>	goto
<F4>	list
<F5>	run <cr>
<F6>	color 15, 4, 4 <cr>
<F7>	switch
<F8>	cont <cr>
<F9>	list
<F10>	A L run <cr>

Joystick Cursor Control Pad
control cursor movement in eight directions



VARIABLE TYPE DECLARATION CHARACTERS

Variable \$	Range	No. of Byte
String	0..255 characters	3 + # of characters
% Integer	---32768..32767	2
! Single precision	71 digit floating integer	4
# Double precision	16.8 digit floating point	8

FORMAT NOTATION

Whenever the format of a statement or command is given, the following rules apply:

- Items in capital must be input as shown.
- Items in lower case letters enclosed in bracket () are to be supplied by the user.
- Items in square brackets [] are optional.
- All punctuation except angle brackets and square brackets (i.e., commas, parentheses, semicolons, hyphens, equal signs) must be included where shown.
- Items followed by an ellipse (...) may be repeated any number of times (up to the length of line).
- "string" means a string expression.
- "exp" means a numeric expression either constant or a variable.
- "var" means any variable.
- "line" and "line number" both means line number.
- "file" is a file number or expression that evaluates to a file number.
- "n" means an integer.
- "x", "y" denotes X, Y co-ordinate of the screen.

BASIC COMMAND

Command Function

AUTOI < line > [, < inc >]
generate line numbers automatically

BLOAD "filename" [, < load address >]
load a machine language program into memory

BSAVE "filename", start addr, end addr [, execution addr]
save a section of memory to "filename"

CLEAR [< exp 1 >] [, < exp 2 >]
exp 1 sets the amount of string space, exp 2 sets the end of memory

CLOAD < "filename" >
loads the file from cassette

COLOR [< exp 1 >] [, < exp 2 >]
exp 1, a color number for text display, exp 2, the background color.

CONT continue program execution

CSAVE < "filename" >
save current program to cassette

DELETE < startline > [- < endlines >]
delete program lines

Command Function

KEY LIST list all the programmable function key's contents.

LIST [< line >] [- [< line >]]
list program lines on the screen

LLIST same as list, except to the printer

LOAD < "filename" >
load an ASCII file

MAXFILES = < exp >
Set the maximum number of files BASIC can open during execution

MERGE < "filename" >
merge a BASIC program into memory, current program's identical line numbers will be replaced.

MOTOR [ON] [OFF]
turn cassette motor on or off

NEW delete current program and variables from memory

RENUM [[< newline >] [, < oldline >]] [, < inc >]]
renumber program lines

RUN [< linenumber >]
run a program from (linenumber) default is first line

SAVE < "filename" >
save the program in memory with name "filename" as an ASCII file

SOUND [ON] [OFF]
turn sound of the cassette audio on or off

SWITCH switch into another bank

Command Function

SWITCH STOP switch into another bank and force a CTRL-STOP

TRON turn on trace for program execution

TROFF turn trace off

WIDTH [39] [40]
set the display line width

BASIC STATEMENTS

Statement Function

BEEP make a beep sound

CLICK [ON] [OFF]
turn on or off key click sound

DEF FN x [< exp >]
define an arithmetic or string function

DEF USR < n > [, < addr >]
define the entry address for the nth machine language routine

DEF < var type > [< exp >] [- [< exp >]]
define range of variable begin with letter # exp to default their type notation where "type" is INT, DBL, SNG or STR

DIM < var(n) > [, < var(n) >]
n can be any integer, this allocates n number of elements for array variables and specify their maximum subscript values

END terminate program execution, close all files and return to command level

Statements Function

ERASE < var > [, < var >]
release space which was used by the array name "var"

ERROR < n >
generate error of code n

FOR < variable > = < exp 1 > to < exp 2 > [STEP < exp 3 >]
use with NEXT statement to repeat a sequence of program lines, variable is first set to value of exp 1 then added with exp 3 until the value of exp 2 is reached

GOSUB < linenumber >
call a subroutine in BASIC, see RETURN

GOTO < linenumber >
branch to specified linenumber

IF < exp > THEN < statement > [: [< statement >] [...] ELSE < statement > [: [< statement >] [...]]

If exp is not 0, the THEN clause is executed otherwise the ELSE clause line statement is executed

IF < exp > GOTO < line > [ELSE < statement >] [: [< statement >] [...]]

If exp is not 0 then the GOTO clause is executed. Otherwise the ELSE clause or next statement is executed

[LET] < var > = < exp >
assign a value to a variable

Statements Function

MID\$ < string exp > . < n > [, < m >] = < string exp 2 >

to replace a portion of string exp 1 with string exp 2 starting in string exp 1 nth character with m number of character

NEXT < var > [, < var >] [...]
determines the end of a FOR loop

ON exp GOSUB < line > [, < line >] [...]
the subroutine that will jump to depend upon the value of the exp. and the starting address of the subroutines are indicated by the linenumbers in the GOSUB clause. In the example 1 must be between 1 and 3

ON exp GOTO < line > [, < line >] [...]
same as ON exp GOSUB, see GOTO and GOSUB

OUT < port > , < byte >
puts byte specified to output port specified

POKE < address > , < byte >
puts byte specified into memory location specified. USE WITH EXTREME CAUTION as random poking can cause the system to CRASH!

REM [any text]
the line following the REM will not be executed, allow user to put comments in program

Statements Function.

RESTORE [< linenumber >]
reset DATA pointer so that the previous used DATA statement can be re-read

RETURN [< linenumber >]
return subroutine to statement following last GOSUB executed

STOP stop the program execution, print BREAK message, and return to command level

SWAP < var > , < var >
exchanges value of two variables

WAIT < port > , < mask > [, < select >]
suspends program execution read input a port until (input bit XOR select AND with mask) returns non-zero

SOUND < exp 1 > , < exp 2 >
put value exp 2 into sound generator reg number exp 1

SWITCH function to return a 0 if in BANK 0 a 1 if in BANK 2

GRAPHIC STATEMENT AND COMMAND

Statements Function

CLS clear graphic screen

CIRCLE (< x center > , < ycenter >) , < radius > [, < color >] [, < start >] [, < end >] [, < aspect ratio >]]
draws an ellipse with a center, and radius as indicated by the first of its arguments, the color default is foreground color, start and end is -2π to 2π , the ratio is for Horizontal and Vertical ratio of the ellipse

COLOR [< foreground >] [, < background >] [, < border >]
set the color for the 11st of arguments

DRAW < string > or < string var >
use to draw figure on the screen according to the graphic macro language

GET [(< x1, y1 >) - (< x2, y2 >)] [< arrname >]
read points from the graphic screen or from defined area of the graphic screen. Array must be dimensioned large enough to hold the data

LINE [(< x1, y1 >) - (< x2, y2 >)] [< color >] [, < bfill >]]
draws straight line connecting the two coordinate specified or if (bfill) is present draws or fill rectangle

LOCATE < exp 1 > , < exp 2 >
position the graphic cursor to the starting coordinate pointed to by exp 1 and exp 2, can be used for LINE, POINT, PRINT

PAINT < exp 1, exp 2 > , paint color
fill in an arbitrary graphics figure of the specified fill color. Note: The color employed to paint an object should be the same one as the border color, otherwise, unexpected result occurs

POINT (< exp 1 > , < exp 2 >)
read the color of a pixel in the graphic modes

Statements Function

PSET (< exp 1 > , < exp 2 >) [, < color >]
to draw a dot at the assigned position on the screen using the foreground color or (color) if specified

PRESET (< exp 1 > , < exp 2 >) [, < color >]
same as PSET except draw in background color if (color) not specified

PUT (< exp 1 > , < exp 2 >) [, < arrname >] [< operation >]
output graphic patterns in the array to assigned position on the screen. operation can be: PSET output pattern as is, PRESET reverse pattern, foreground/background color AND combine graphic pattern color with screen pattern OR graphic pattern overlapping the screen data.

XOR perform XOR with screen data. If the matching pixel from the array and the screen are the same then that pixel will be displayed in background color else it will be displayed in the foreground color.

PUT SPRITE (< sprite plane > , (< x, y >) [, < color >] [, < n >])
set up sprite attribute, when a field is omitted, the current value is used, see SPRITES.

SPRITE (< n >) = < string exp >
to define a pattern as sprite, the number of string character depends on the sprite size, n must be less than 256 when size of sprite is 0 or 1 (8 bytes), less than 64 when size of sprite is 2 or 3 (32 bytes)

SPRITE (< n >)
function to return either a 8 byte character string or 32 byte character string of the sprite number n depend on the size of sprite selected

VPEEK (< vram addr >)
return byte value from location in video ram

VPOKE < vram addr > , < byte >
put a byte into video ram address

GRAPHIC MACRO LANGUAGE (GML)

U < n > move up

D < n > move DOWN

L < n > move LEFT

R < n > move RIGHT

E < n > move diagonally up and right

F < n > move diagonally down and right

G < n > move diagonally down and left

H < n > move diagonally up and left

< n > denotes the distance to move times the scaling factor.

S < n >
set scaling factor < n >
The scaling factor multiplied with the distances given in the U, D, L, R, E, F, G, H and M command.

N Move but don't plot

B Move but return to original position.

A < n >
= C: 0 degree
= 1: 90 degrees
= 2: 180 degrees
= 3: 270 degrees
Set color number.

C < n >
Set color number.

X < string > Execute string, must be terminated by a;

Statement Function

ON ERROR GOSUB linenumber
Defines the line number of the subroutine to execute when an error has been detected

ON INTERVAL = < exp > GOSUB linenumber
Sets the line number to execute at every other machine interrupt cycle (60 per second) specified by < exp >

ON KEY [< n >] GOSUB [< line >] [, < line >] [...]
Specify the line number corresponding to the (line) offset n in the statement to execute when ever a function key number n has been depressed

ON STOP GOSUB < linenumber >
Define jump address when a CTRL-STOP key is pressed

ON SPRITE GOSUB < linenumber >
Define jump address when sprites collision occurs

Statements Function

ON STRIG GOSUB < linenumber >
Define the starting line of the subroutine employed when any of the joystick button n = (0) - SPACE BAR, (1) - JOYSTICK 1, (2) - JOYSTICK 2 or < space bar > is depressed. All the ON < interrupt type > GOSUB statement acts much like a GOSUB statement except the execution of these statement are interrupt driven

INTERVAL ON/OFF/STOP
To enable, disable, or terminate the BASIC timer interrupt trapping

KEY (n) ON/OFF/STOP
To enable, disable, or terminate interrupts cause by a function key

STOP ON/OFF/STOP
To enable, disable, or terminate CTRL-STOP trapping

STRING ON/OFF/STOP
To enable, disable, or terminate Joystick button or space bar trapping

SPRITE ON/OFF/STOP
To enable, disable, or terminate the interrupt generated when two or more sprites collide

SOUND COMMAND AND STATEMENTS

Statement Function

SOUND < psg reg > , < byt >
put byte into the psg register, range from 0 to 13

PSG / register Function

0, 1 Tone of channel A

2, 3 Tone of channel B

4, 5 Tone of channel C

6 Noise generator

7 MIXER

Format:

B7	B6	B5 B4 B3	B2 B1 B0
NOT USED	NOISE ENABLE	NOISE ENABLE	TONE ENABLE
C B A		C B A	

Amplitude control of channel A bit 0-3, fixed amplitude control level bit 4, AMPLITUDE MODE:

Amplitude control of channel A bit 0-3, fixed amplitude control level bit 4, AMPLITUDE MODE:

9 Amplitude control of channel B
 10 Amplitude control of channel C
 11, 12 Envelope period control range 0.85535 EP
 : 1789772.5 x lsec / 1536
 Envelope cycle/shape control
 13 SHAPE:
 0-3, 9 4-7, 15
 6 8 10
 11 12
 13 14

PLAY string exp
 to play melody indicated by a character
 string which syntax is described in the
 Music Macro Language

MUSIC MACRO LANGUAGE

A-G [#] [+] [L < n > M < exp >
 Play the note, A "M" or "+" means
 sharp, and "-" means flat. Set the
 length of each note, n maybe ranged
 from 1 to 64
 Set the tone period to exp. <exp> is
 the period of occurrence set by the Sn
 command, this command is disabled if
 the V command is used

Statements Function
 N < n > Play note n, n (0-84) range in 7 octaves,
 n 0 means rest

O < n > Octave — set the octave of the notes to
 be played. Default is 4

R < n > Rest n period range 1 — 64. Rest is the
 same as Ln

S < n > Set the shape of noise output, n can be
 0 — 15, refer to chart below

T < n > Tempo — sets the number of L4's in a
 second. n range is 32 to 255. Default is
 120

V < n > Volume — sets the volume of the tone
 generated. n is in the range of 1: Dot or
 period. After each note causes the note
 to play 3/2 times the period determined
 by L (length) times T (tempo). Multiple
 dots may appear after the note

X Execute substring

OPERATORS

Symbol Function
 = Assignment or equality test
 - Negation or subtraction
 + Addition or string concatenation
 * Multiplication
 / Division (floating point result)
 ↑ Exponentiation
 \ Integer division (integer result)
 MOD Integer modulus (integer result)
 NOT One's complement (integer)
 AND Bitwise AND (integer)
 OR Bitwise OR (integer)
 XOR Bitwise exclusive OR (integer)
 EQV Bitwise equivalence (integer)
 IMP Bitwise implication (integer)
 =, <, >, <=, <=, or FALSE = 0
 >=, >=

ARITHMETIC FUNCTIONS

Function Action
 ABS (exp) Absolute value of expression
 ATN (exp) Arc tangent of the expression (in
 radians)
 COBL (exp) Convert the expression to a double
 precision number
 CINT (exp) Convert the expression to an integer
 COS (exp) Cosine of the expression (in radians)
 CSNG (exp) Convert the expression to a single
 precision number
 EXP (exp) Raises the constant e to the power of
 expression
 FIX (exp) Returns truncated integer of
 expression
 FRE (exp) Gives memory free space not used by
 BASIC
 INT (exp) Evaluates the expression for the
 largest integer calculated
 LOG (exp) Gives the natural logarithm of the
 expression
 RND [(exp)] Generates a random number.
 Expression:
 <0 seed newsequence
 = 0 return previous random number
 >0 or omitted, return new
 random number

Function Action
 SQN (exp) 1 if expression >= 0 if expression
 = 1 - 1 if expression 0
 SIN (exp) Sine of the expression (in radians)
 SQR (exp) Square root of expression
 TAN (exp) Tangent of the expression (in radians)

STRING FUNCTIONS

Function Action
 ASC (string) Returns the ASCII value of the first
 character of string

CHR\$ (exp) Returns a one-character string whose
 character has the ASCII code of exp

FRE (string) Returns remaining memory free space

HEX\$ (exp) Converts a number to a hexadecimal
 string

INKEY\$ Returns all the one-character string read
 from terminal or null string if no
 character pending at terminal.

INPUT\$ (length, [#] m) Returns a string of length characters
 read from console or from a file.
 Characters are not echoed.

INSTR [(exp), string 1, string 2] Returns the first position of the first
 occurrence of string 2 in string 1
 starting at position exp

LEFT\$ (string, length) Returns leftmost length characters of
 the string expression

Function Action
 LEN (string) Returns the length of a string

MID\$ (string, start [, length]) Returns characters from the middle of
 the string starting at the position
 specified to the end of the string or for
 length characters

OCT\$ (exp) Converts a number to an octal string

RIGHT\$ (string, length) Returns rightmost length characters of
 the string expression

SPACES (exp) Returns a string of exp spaces

STR\$ (exp) Converts a numeric expression to a
 string

STRING\$ (length, string) Returns a string length long containing
 first character of string

STRING\$ (length, exp) Returns a string length long containing
 characters with numeric value exp

VAL (string) Converts the string representation of a
 number to its numeric value

I/O AND SPECIAL FUNCTIONS

Function Action
 CVI (string) Converts a 2-character

CVS (string) Integer (CVI). Converts a 4-character

CVD (string) String to a single precision number
 (CVS). Converts an 8-character string
 to a double precision number (CVD).

ERR Error line number

ERR Error code number

INP (port) Inputs a byte from an input port

LPOS (n) Returns carriage position of line
 printer (n is dummy argument)

MKI\$ (value) Converts an integer to a 2-character

MKS\$ (value) String (MKI\$). Converts a single

MDK\$ (value) Precision value to a 4-character string
 (MKSS). Converts a double precision
 value to an 8-character string (MKDS).

PEEK (exp) Reads a byte from memory location
 specified by expression

POS (n) Returns carriage position of terminal (n
 is dummy argument)

SPC (exp) Used in PRINT statements to print
 spaces

TAB (exp) Used in PRINT statements to tab
 carriage to specified position

USR [n] (arg) Calls the user's machine language
 subroutine with the specified argument.
 See DEF USR.

VARPTR (var) Returns address of variable in memory
 or zero if variable has not been assigned
 a value

ATN (exp) PRINT USING FORMAT FIELD
 SPECIFIERS

NUMERIC

Specifier	Possible Digits	Field Characters	Definition Numeric field
.	0	1	Decimal point
+	0	1	Print leading or trailing sign. Positive numbers will have "+", negative numbers will have "-"
-	0	1	Trailing sign. Prints "-" if negative, otherwise blank.
**	2	2	Leading asterisk
\$\$	1	2	Floating dollar sign. \$ is placed in front of the leading digit.
**\$	2	3	Asterisk and floating dollar sign.
,	1	1	Use comma every three digits (left of decimal point only)
	0	4	Exponential format. Number is aligned so leading digit is non-zero.
underscore	0	1	Next character literal
STRING			
			Single character
< spaces >			2 + number of spaces character field
&			Variable length field

INPUT/OUTPUT STATEMENTS

Statements/Syntax/Function
 CLOSE CLOSE [(#)] [(#)] Closes files, if no
 argument, all open files are closed.
 DATA DATA list of constants Lists data to be
 used in a READ statement.

