Hewlett-Packard 9825A Calculator
String Variable Programming

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HP 9825A Calculator

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(For World-wide Sales and Service Offices see back of manual.)

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Chapter 1
General Information

Description

The String Variable ROM (Read Only Memory), when installed in the HP 9825A Calculator, enables you to–

- Do character manipulations, such as editing portions of strings.
- Use portions of strings as variables in arithmetic calculations.
- Perform character by character comparisons of these strings.
- Use alphanumeric data in input and output operations.

The String Variable ROM uses 52 bytes of user RWM (Read Write Memory) when installed in the HP 9825A.

The String Variable ROM is packaged with another ROM in a single ROM card. The String Variable Programming Manual (P/N 09825-90020) is supplied with the String ROM. This manual describes String Variable operations only.

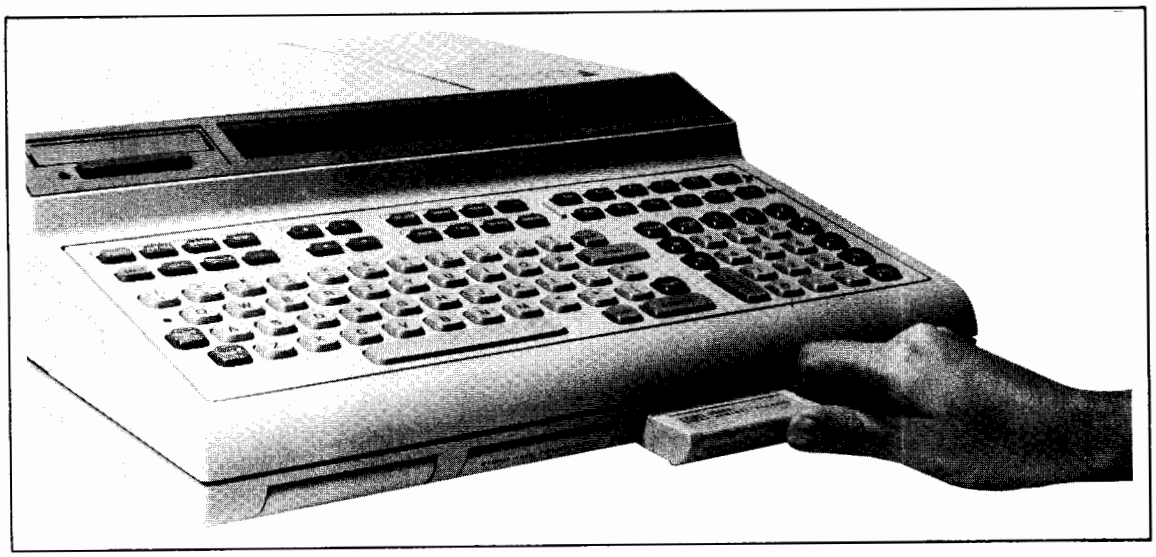
Applications

With the String Variable ROM, conversational programming enables the user to have a two-way conversation with the calculator. Replies such as "yes" or "no" can be accepted by the calculator instead of the numerical codes usually given in response to data requests. In addition, programming routines such as "update", "report" or "edit" can be selected instead of numerical codes representing these operations.

Text editing is made possible using the String Variable ROM. Variable information such as names and addresses can be inserted into a form letter to be printed on a calculator controlled typewriter. Also, a body of text or a manuscript can be edited by changing or deleting certain characters or groups of characters within the text, or limiting each line of text to a certain length.

Inspection and Installation

Refer to the HP 9825A System Test Booklet for the procedure to verify operation of your ROM. Your String ROM can be plugged into any one of the four ROM slots located on the bottom front of the calculator, as shown below.



ROM Installation

To install your ROM card, first turn the calculator off. With the label right side up, slide the ROM through the ROM slot door. Press it in until the front of the ROM card is even with the front of the calculator. Then turn your calculator on.

Syntax

The following conventions apply to the syntax for the functions and operations found in this manual.

`dot matrix` - All items in dot matrix are required, exactly as shown.

[ ] - All items in square brackets are optional, unless the brackets are in dot matrix.

See the Appendix for a list of the syntax of all String ROM functions and operations.

All String ROM functions and operations can be executed from the keyboard, in the live keyboard mode or within a program.

Error Messages

The String ROM adds error messages S0 through S9 to the calculator error message list. Explanations of these errors can be found on the inside back cover of this manual.

Requirements

Before using this manual, you should be familiar with the calculator and the HPL programming language described in the HP 9825A Operating and Programming Manual.

Chapter 2
String Variables

A string is a series of characters, like -ABC! 123*. Any number of characters, within the limits of available memory, can be stored in a string variable. Each character requires one byte of memory and some overhead (as explained in Chapter 7).

Naming Strings

String variables are given names, like A$ or Z$. The dollar sign following the string variable name differentiates strings from numeric variables. Up to 26 string variables, one for each letter of the alphabet, can be used in one program. There are two kinds of string variables – simple strings and string arrays. Each string of a string array can be used in exactly the same way as a simple string.

In the diagram below, A$ is a simple string, nine characters long and Z$ is a 4 (row) by 10 (column) string array containing four strings, Z$[1] through Z$[4]. Each of the strings in this example can be up to ten characters long. Strings have a dimensioned length and a current or "logical" length. The dimensioned length of Z$[1] is 10; its current length is 6.

	1	2	3	4	5	6	7	8	9	10
A$	-	A	B	C	!	1	2	3	*	
Z$[1]	K	e	e	p	e	r				
Z$[2]	F	u	n	c	t	i	o	n		
Z$[3]	C	a	l	c	u	l	a	t	o	r
Z$[4]										

Dimensioning Strings

Before characters can be stored in a string variable, the string variable must be dimensioned. The `dim` statement defines the type of string variable and the size of the string or strings. The `dim` statement also reserves storage space in memory for the string variable. To dimension the strings shown in the previous example, execute –

```
dim A$[10], Z$[4, 10]
```

The subscript 10 indicates that up to ten elements can be assigned to the simple string named A$. The subscripts 4 and 10 indicate that up to 4 strings, each 10 characters in length, (40 elements) can be assigned to the string array named Z$. Exceeding dimensioned limits by assigning more characters than dimensioned, results in `error 59`. Both string and numeric arrays can be included in the same `dim` statement.

Storing Strings

Characters are assigned to string variables in the same way that values are assigned to numeric variables. To store the characters from the previous example in the dimensioned strings, execute –

```
"-ABC!123*"→A$
"Keeper"→Z$[1]
"Function"→Z$[2]
"Calculator"→Z$[3]
```

Printing Strings

Using the print statement, strings and portions of strings can be printed. To print the strings just stored, execute –

```
prt A$, Z$[1], Z$[2], Z$[3]
```

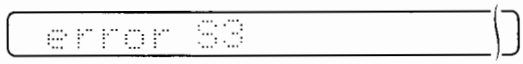
```
-ABC!123*
Keeper
Function
Calculator
```

Each string in the string array must be specified to be printed. To specify an entire array of strings, a program loop of some kind must be used.* Since the Advanced Programming and String ROMs are packaged together in one ROM card, most programs in this manual use the Advanced Programming capability of for/next loops where needed.

Specifying a string longer than its dimensioned length results in error 53. For example, execute –

```
Z$[1, 20]
```

And the display shows –



Substrings

A substring is one or more contiguous characters within a string. Using the previous example, ABC is a substring of A$ starting at the second character and ending with the fourth. This substring is indicated by –

```
A$[2, 4]
```

With string arrays, an extra subscript is required to indicate which string in the array is specified. Expressions may be used as subscripts in strings or string arrays. So per, which is a substring of Keeper from the fourth character of Z$[1] to the sixth, can be specified by–

```
Z$[1,4,6]
```
or
```
Z$[1, A, A+2]
```
where the numeric variable A has the value 4.

Since there are no characters following per in Z$[1], this substring (from the fourth character to the end of the current length of the string) can also be specified by –

```
Z$[1, 4]
```

To specify the substring Fun in Z$[2], these subscripts are used –

```
Z$[2, 1, 3]
```

*Except when loading or recording arrays, when the string array name (such as Z$ from the previous example) may be used.

The u in Calculator can be specified by executing –

```
Z$[3,5,5]
```

Since a different number of subscripts are required to specify different things, it's a good idea to keep a record of the simple strings and string arrays you're using in a program. (The dim statement can be used in this way.)

Null String

The last string, Z$[4], in the string array is the null string, since it contains no characters. This null string can be specified by executing –

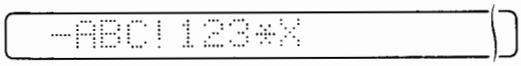
```
Z$[4]
```
or
```
Z$[4,4,3]
```
or
```
""
```

Two quotation marks with no intervening characters are considered a null string, but a string that is assigned spaces ("Δ"→A$[1, 80], where Δ represents a space) is not a null string.

The null string can be used when adding more characters to the current length of a string. Using A$ from the previous examples, execute –

```
"X"→A$[10,10]
A$
```

And the display shows –



The null string can also be used to clear a string. For example, to clear A$ (from the previous example) execute –

```
""→A$[1,10]
```

Chapter 3
String Variable Modification

A string or a substring can be modified by another string or substring. For example, a part of a string can be changed or characters can be added or deleted. The string containing the modification is called the **modifying** string; the string to be modified is called the **destination** string. For example, in the statement M$→D$, M$ is the modifying string and D$ is the destination string. The modifying string can be a string, a substring or text.* The destination string can be a string or substring; it cannot be text.

The length and content of the destination string after modification depend not only on the characteristics (length and content) of the modifying string, but also on the number of subscripts given for the destination string.

Each element or string of a string array can be used in exactly the same way as a simple string. Therefore, the following examples show simple string modification only; string array modifications are done in exactly the same way with an extra subscript (the first) to show which string in the array is being modified.

(If you've just executed the statements from the previous section, press ERASE A ENTER before executing the statements that follow.)

*Text is defined as characters within quotation marks.

Destination Strings without Subscripts

When the destination string has no subscript (or one subscript for string arrays) the entire destination string is replaced by the modifying string or substring, and its length and content after modification are the same as those of the modifying string or substring. To illustrate this, execute these statements –

```
dimA$[7],B$[7]
"Atwater"→A$
"Belcher"→B$
A$→B$
B$
```

```
Atwater
```

When the destination string is longer than the modifying string, the modifying string replaces the destination string. All characters of the destination string which are not replaced are truncated. For example –

```
dimC$[11]
"Bellweather"→C$
A$→C$
C$
```

```
Atwater
```

The current length of C$ is now 7 characters; the dimensioned length is 11 characters.

If the modifying string is longer than the dimension of the destination string, `error 89` occurs. For example –

```
"Bellweather"→C$
C$→A$
```

```
error 89
```

String arrays require one extra subscript to indicate which string in the array is to be modified.

Destination Strings with One Subscript

When the destination string has one subscript (or two subscripts for string arrays) the substring is replaced by the modifying string or substring.

(If you've just executed the statements from the previous section, press ERASE A ↵ before executing the statements that follow.)

If the destination substring is equal in length to the modifying string or substring, the modification will not affect the length of the destination string. When executed, these statements illustrate this –

```
dimA$[7]
"Atkins"→A$
"wood"→A$[3]
A$                                  Atwood
```

If the destination substring is longer than the modifying string, the modification causes the destination string to be shortened; the characters not replaced by the modifying string are truncated. These statements, when executed, illustrate this –

```
dimB$[7]
"Atwater"→B$
"kins"→B$[3]
B$                                  Atkins
```

If the destination substring is shorter than the modifying string (or substring), the modification causes the destination string to be lengthened (within the dimensioned length of the destination string). To illustrate this, execute these statements –

```
dimC$[8]
"Atwater"→C$
"kinson"→C$[3]
C$                                  Atkinson
```

Any attempt to lengthen a string beyond its dimensioned length causes error 59. For example –

```
"kinsons"→C$[3]
```

```
error 59
```

If the destination substring is a null string (the current length plus one), the modifying string is attached to the end of the destination string. For example –

```
"Atkin"→C$
"son"→C$[6]
C$
```

```
Atkinson
```

When characters of a modifying string (or substring) are added to a destination string (or substring), they must be contiguous, that is, they must immediately follow the destination string without any unassigned character spaces. If they are non-contiguous, error 53 occurs. For example –

```
dimD$[20]
"Andy"→D$
"Atkinson"→D$[8,
15]
```

```
error 53
```

By assigning blank characters to the string, error 53 is avoided. (Δ represents a space.) For example, execute these statements –

```
"ΔΔΔAtkinson"→D$
[5,15]
D$
```

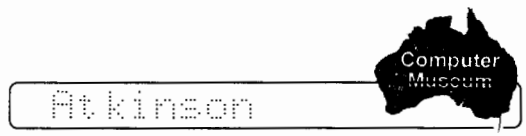
```
Andy    Atkinson
```

String arrays require an extra subscript to indicate which string in the array is to be modified.

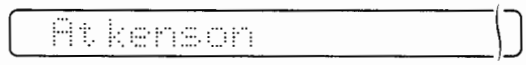
Destination Strings with Two Subscripts

When the destination string has two subscripts (or three subscripts for string arrays), the substring is replaced by the modifying string or substring. Since two subscripts define the beginning and ending characters of the substring to be replaced, truncation of the remaining (unreplaced) characters does not occur. Using an example from the previous section, execute –

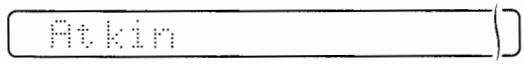
```
C$
```




```
"ken"→C$[3,5]
C$
```



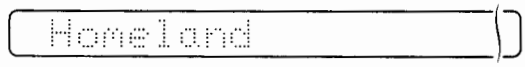

```
"kin"→C$[3]
C$
```



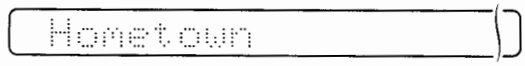
(Press ERASE A ↓ before executing the statements that follow.)

When the destination substring is equal in length to the modifying string or substring, the modification won't affect the length of the destination string; the destination substring characters are replaced. For example –

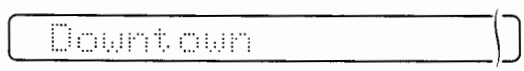
```
dimA$[8]
"Loveland"→A$
"Hom"→A$[1,3]
A$
```




```
"town"→A$[5,8]
A$
```




```
"Down"→A$[1,4]
A$
```



When the destination string has two subscripts, its length after modification will either be greater than before, or remain unchanged. When the value of the second subscript is greater than the current length of the destination string, the modification results in a lengthened string (within the dimensioned length of the string).

Here's an example that illustrates this. (Δ represents a space.) Execute these statements –

```
dimB$[32]

"AndrewΔ"→B$

"AtwaterΔ"→B$[8,
15]

"Atkinson"→B$[16
,32]

B$
```

```
Andrew Atwater Atkinson
```

When characters of a modifying string (or substring) are added to a destination string (or substring), they must be contiguous, that is, they must immediately follow the destination string without any unassigned character spaces. If they are non-contiguous error 53 occurs. For example –

```
"Andrew"→B$

"Atkinson"→B$[16
,23]
```

```
error 53
```

By assigning blank characters to the string, error 53 is avoided. (Δ represents a space.) For example, execute these statements –

```
"Δ"→B$[7,15]

"Atkinson"→B$[16
,23]

B$
```

```
Andrew          Atkinson
```

String arrays require an extra subscript to indicate which string in the array is to be modified.

Chapter 4

String Variable Functions

A string function returns a numeric or string value to an expression. String functions enable you to determine the length and analyze the contents of a string. This is useful when strings with different characteristics (length and content) are processed at the same time, as in entering strings from the keyboard.

Length Function

The length (len) function returns the number of characters in a string or substring.

```
len (string variable or text )
```

The current length of the string (or substring) is returned, which is not necessarily equal to the length defined in the dim statement.

The following example uses a simple string to illustrate the length function. If you've run any of the examples from the previous chapter, press ERASE A ↵ before executing the following statements –

```
dim A$[32]

"length*width="→
A$

len("length*widt
h=")
```

```
 13.00
```

```
len(A$)
```

```
 13.00
```

In the following example, the last character of A$ is replaced –

```
"*height"→A$[len
(A$)]

A$
```

```
length*width*height
```

Here an addition to A$ is made –

```
"=volume"→A$[len
(A$)+1]

A$
```

```
length*width*height=volume
```

The length of a part of A$ can be found using the length function –

```
len(A$[21])
```

```
6.00
```

String arrays require an extra subscript to indicate which string in the array is being used in the function.

Position Function

The position (pos) function determines the position of a substring within a string.

pos (in string variable or text , of string variable or text)

If the second string is part of the first, the value of the function is the position of the beginning character of the second string within the first. If the second string is not a substring of the first string or if the second string is the null string, the value of the function is zero.

Simple strings are used in the following example to illustrate the position function. Execute these statements –

```
A$
```

```
length*width*height=volume
```

```
pos(A$,"width")
```

```
 8.00
```

```
dimC$[10]
"width"→C$
pos(A$,C$)
```

```
 8.00
```

```
"*width=area"→A$
[pos(A$,"*")]
A$
```

```
length*width=area
```

```
pos(A$,"area")
```

```
 14.00
```

String arrays require an extra subscript to indicate which string in the array is being used in the function.

Value Function

With the value (val) function, the numerical value of a string or a substring of digits can be used in calculations. (Normally the elements in a string are not recognized as numeric data and can't be used in calculations.)

val (string variable or text)

The first character to be converted in a string using the value function can be a digit, a plus or minus sign, a decimal point or a space. Leading plus signs are ignored; leading minus signs are counted. An odd number of minus signs is equal to a minus sign; an even number of minus signs is equal to a plus sign.

Numerical data entries can be combined logically with input text. All contiguous numerics are considered a part of the number until a non-numeric* is reached in the string. This means that a string can contain more than one number. The first character after leading spaces, plus signs or minus signs must be a digit or a decimal point. If the leading part of a string is not valid as a number according to the rules of the enter statement, an error occurs, unless flag 14 is set. If flag 14 is set, the default value (zero) is substituted for the number to be returned and flag 15 is automatically set (to 1) to indicate the substitution.

The value function requires a temporary storage area equivalent to the size of the portion of the string used. If there is not enough memory for this temporary storage area, error 40 will result.

Simple strings are used in the examples below to illustrate the value function. The simple string (E$) contains a name (Atkinson), a social security number (094-30-6441) and a balance due ($250).

```
dim E$[32]

"Atkinson+094306
441*+250"→E$

val(E$[21])
```

```
 250.00
```

*The * character is recognized as the "exponent of base 10", when it follows a numeric.

After a payment of $100, the balance due is $150, as shown below.

```
val(E$[21])-100
```

```
 150.00
```

Other operations can be performed, using the value function –

```
val(E$[20])*val(
E$[pos(E$,"*")+3
])
```

```
 12500.00
```

Alpha characters cannot be converted using the value function –

```
val(E$)
```

```
error 54
```

```
sfg14;val(E$)
```

```
 0.00
```

```
flg15
```

```
 1.00
```

String arrays require an extra subscript to indicate which string in the array is being used in the function.

The string function, covered next, is the opposite of the value function.

String Function

The string (str) function converts a numeric value into an equivalent ASCII* string using the current fixed or float setting. If the numeric value is positive, the resulting string has a leading blank. The string function is the opposite of the value function.

```
str(expression)
```

The string function is illustrated using the simple string from the value function examples on the previous pages. The examples use E$ which contains a name (Atkinson), a social security number (094-30-6441) and an amount due ($250). Using the value function, the amount due is located in E$. Then a payment of $100 results in a balance due of $150. To return the $250 to E$, the string function is used. Execute these statements –

```
str(250)→E$[21]
E$
```

```
Atkinson+094306441++ 250.00
```

or

```
250→X
str(X)→E$[21]
E$
```

```
Atkinson+094306441++ 250.00
```

*American Standard Code for Information Interchange

Character Function

The character (char) function converts a numeric value (modulo 256) to an ASCII character. Any of the 94 alphanumeric characters and symbols from the 9825A keyboard, and 34 other characters which are not on the keyboard can be output by executing the character function. (See the complete character set in the Appendix.)

char (expression)

All of the 128 characters can be displayed using the following program.

```
0: fxd 0
1: for I=0 to
 127
2: dsp char(I)
3: wait 500
4: next I
5: end
```

The character function can also be used when the 9825A is interfaced to output devices like a tape reader, 9871A printer or a digital volt meter.

The character function is the opposite of the numeric function, which is covered next.

Numeric Function

The numeric (num) function returns the ASCII decimal value of a single character. The numeric function is the opposite of the character function.

num (single character of a string variable or text)

For example, execute these statements –

```
num("A")
```

```
 65.00
```

```
num("B")
```

```
 66.00
```

```
num("C")
```

```
 67.00
```

All 94 alphanumeric characters and symbols from the 9825A keyboard, and 34 others not on the keyboard, have a decimal value (or code) for their binary equivalent. These decimal values and the equivalent character or symbol are printed using the character function in the following program.

```
0: fxd 0
1: for I=0 to
 127
2: prt char(I),I
3: next I
4: end
```

Here's the printout of the internal character set (128 characters) and equivalent decimal codes –

◀	0	0	48	a	97
¿	1	1	49	b	98
☒	2	2	50	c	99
₦	3	3	51	d	100
α	4	4	52	e	101
ß	5	5	53	f	102
Γ	6	6	54	g	103
π	7	7	55	h	104
Δ	8	8	56	i	105
σ	9	9	57	j	106
↓	10	:	58	k	107
∧	11	;	59	l	108
µ	12	<	60	m	109
←	13	=	61	n	110
↵	14	>	62	o	111
▼	15	?	63	p	112
Θ	16	@	64	q	113
Ω	17	A	65	r	114
δ	18	B	66	s	115
Ä	19	C	67	t	116
ä	20	D	68	u	117
Ä	21	E	69	v	118
ä	22	F	70	w	119
Ö	23	G	71	x	120
ö	24	H	72	y	121
Ü	25	I	73	z	122
Ü	26	J	74	₥	123
Æ	27	K	75	|	124
æ	28	L	76	→	125
²	29	M	77	Σ	126
£	30	N	78	⊢	127
▒	31	O	79		
	32	P	80		
!	33	Q	81		
"	34	R	82		
#	35	S	83		
$	36	T	84		
%	37	U	85		
&	38	V	86		
'	39	W	87		
(	40	X	88		
)	41	Y	89		
*	42	Z	90		
+	43	[	91		
,	44	⌐	92		
-	45	]	93		
.	46	↑	94		
/	47	_	95		
		'	96		

The character and numeric functions can be used to store and retrieve numbers in the range 0 to 255 using only 1 byte of memory per number. Each number is represented in memory by one of the 256 characters of the internal printer character set. For example, in the following program the five test scores on the right are stored in T$ –

```
0: dim T$[5]
1: for I=1 to 5
2: ent X
3: char(X)→T$[I,
 I]
4: next I
5: end
```

Student	Score
1. Andy Atkins	88
2. Tom Atwater	78
3. Jim Belcher	65
4. Jerry Hafford	100
5. Rob Rood	99

To recover a test score, the numeric function is used. For example, the last score can be displayed by executing –

```
num(T$[5,5])
```

```
99.00
```

The length of the string used to store the values is limited by memory size only. However, only values between 0 and 255 can be stored in this way.

String arrays require an extra subscript to indicate which string in the array is being used in the function.

Capital Function

The capital (cap) function converts lower case alphabetic characters to upper case without modifying the original string. This enables you to compare strings for sorting or alphabetizing without regard to upper or lower case characters.

cap (string variable or text)

Strings or substrings of string variables can be converted using the capital function. For example –

```
dim X$[3],Y$[3]
"yes"→X$
cap(X$)
```

YES

```
cap("yes")
```

YES

String arrays require an extra subscript to indicate which string in the array is being used in the function.

A temporary storage area is required by the cap function equivalent in size to the portion of the string used. If there is not enough memory for this temporary storage area, error 40 will result.

Chapter 5

String Variable Operations

Relational Operators

The `if` statement allows comparison of strings or substrings. All of the relational operators allowed in numerical comparisons can be used for string comparisons.

=	equal to
>	greater than
<	less than
>= or =>	greater than or equal to
<= or =<	less than or equal to
# or <> or ><	not equal to

Here's an example that uses a relational operator to illustrate conversational programming –

```
0: dim A$[10]
1: ent "Do you
 wish to continu
 e?",A$
2: if cap(A$)="Y
 ES";sto 4
3: stp
4: dsp "Continue
 ..."
```

When the enter statement prompt is displayed, the answer is keyed in.

Within the calculator's memory, each character contained in a string is represented by a standard ASCII* decimal equivalent code, as shown in the table on page 38. When two string characters are compared, the smaller of the two characters is the one whose decimal code is smaller. For example, `2` (decimal code 50) is smaller than `R` (decimal code 82).

*American Standard Code for Information Interchange

In some cases, such as alphabetic sequencing problems, strings must be compared for conditions other than "equal to" or "not equal to". For example, to arrange a number of strings in alphabetical order, the following type of string comparison is used –

```
0: dim A$[20],
 B$[20],Z$[20]
1: ent A$,B$;if
 A$<B$;gto 3
2: B$→Z$;A$→B$;
 Z$→A$
3: prt A$,"is
 less than",B$
```

Strings are compared, character by character, from left to right until a difference is found. If one string ends before a difference is found, the shorter string is considered smaller. For example, execute these statements –

```
"Atkinson">"Atki
ns"
```

```
 1.00
```

Concatenation (Linking) Operator

The concatenation operator (&) links strings or substrings in order from left to right.

string variable or text & string variable or text [&...]

The resulting string is the total number of characters in all of the strings. Strings or substrings can be linked. Press [ERASE] [A] [EXECUTE] before executing the following statements –

```
dimA$[15],B$[15]
,C$[15],D$[45]

"Andrew"→A$

"ΔAtwater"→B$

"ΔAtkinson"→C$

A$&B$&C$→D$

D$
```

```
 Andrew Atwater Atkinson
```

The concatenation operator requires a temporary storage area equivalent to the size of the portion of the string used. If insufficient memory is available for this temporary storage area, error 40 will result.

Chapter 6

Input and Output of String Variables

Enter Statement

The enter (ent) statement allows string variables to be input from the calculator keyboard during program execution. Up to 80 characters may be entered into a string at one time. To enter a string longer than 80 characters, several substrings of up to 80 characters each may be entered. For example –

```
0: dim A$[160]
1: ent A$[1,80]
2: ent A$[81,
 160]
```

After the first 80 characters are entered, a second data request - A$[81, 160]? - is displayed so the second 80 characters may be entered. With the Advanced Programming ROM, a for/next loop can be used to enter very long strings.

String arrays require an extra subscript to indicate the appropriate string in the array.

Strings and numeric variables can be used together in an enter statement –

```
0: dim C$[10],
 D$[10]
1: ent C$,D$,C,D
```

In conversational programming, the enter statement assigns text to string variables from the keyboard while a program is running. The destination string follows the same rules as the destination string in string assignment and modification. For example –

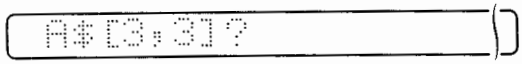
```
0: dim A$[160]
1: ent "NAME?",
 A$
```

When line 0 is executed, the prompt Name? is displayed. When the user types in a name and presses CONTINUE, that name is assigned to A$.

If a literal prompt is not given, the destination string variable is displayed as a prompt. For example –

```
1: ent A$[3,3]
```

When the line above is executed, the display shows –



When the user types in the appropriate data and presses the CONTINUE key, the data is assigned to A$[3, 3].

Print Statement

The print (prt) statement can be used to print string characters. With the print statement, and automatic carriage return-line feed (cr/lf) occurs when a new string is output. The string characters are left justified when output.

Here's a program that prints out the internal printer character set using the print statement.

```
0: fxd 0
1: dim Z$[128]
2: for I=0 to
 127
3: char(I)→Z$[I+
 1,I+1]
4: next I
5: prt Z$
6: end
```

When executed, this is printed –

```
◀¿ΣÑαßΓπΔσ↓λμ÷τ‡
ΘΩδÁàÄäÖöÜüÆæ²£▒
 !"#$%&'()*+,-./
0123456789:;<=>?
@ABCDEFGHIJKLMNO
PQRSTUVWXYZ[Γ]↑_
'abcdefghijklmno
pqrstuvwxyzπ|→Σ⊢
```

Strings, string arrays, numeric variables and constants may be included together in a print statement, as shown in lines 6 and 7 of the following temperature conversion program. (A represents the month, B represents the day and F represents the Fahrenheit temperature.)

```
0: fxd 0
1: dim C$[20],
 F$[20]
2: ent A,B,F
3: "Celsius"→C$
4: "Fahrenheit"→
 F$
5: 5(F-32)/9→C
6: prt "Today
 is:",A,B,1976;
 spc
7: prt "Temperat
 ure is:",F$,F,
 C$,C
8: end
```

```
Today is:        3
                12
              1976

Temperature is:
Fahrenheit      41
Celsius          5
```

Display Statement

The display (dsp) statement can be used to display a maximum of 80 characters. Only 32 of these characters can be viewed at one time. The display control keys (◄ and ►) are used to shift the display to the left and right to view all 80 characters.

Write Statement

The write (wrt) statement is a General I/O ROM statement which allows strings to be output to external devices, as well as to the internal printer.

The write statement works like the print statement, without automatic carriage return-line feeds. The write statement outputs the entire string (as does prt). Using the example from the prt statement description, the write statement replaces print in line 5. The number following wrt is the select code of the output device being used (16 is the internal printer select code and 0 is the display select code). Compare the outputs –

```
0: fxd 0
1: dim Z$[128]
2: for I=0 to
 127
3: char(I)→Z$[I+
 1,I+1]
4: next I
5: wrt 16,Z$
6: end
```

```
◀¿x̄N̄αβΓπ̄Δσ
λμτΦθΩδÅåÄäÖöÜüÆ
```

Characters 10 (line feed) and 13 (carriage return) cause a carriage return and line feed. When the internal printer reaches the tenth character, a line feed occurs. Then the next 16 characters are output (except the thirteenth, which is a carriage return). Since line feeds are not automatic, the characters following the carriage return are not printed.

The write statement can be used with free-field format or with format specifications. The following example uses the write statement without format specs. Execute these statements –

```
dimA$[10]
"ABCDEFGHI"→A$
wrt16,A$[5]
```

EFGHIJ

```
wrt0,A$[6,6]
```

F

```
wrt0,A$
```

ABCDEFGHIJ

When format specifications are used, the spec that sets the width of a character field is c followed by the width of the field in number of characters. (A value can precede c to indicate the number of strings to be output.) The strings are right justified when output. Execute these statements –

```
fmtc15;wrt16,A$
```

ABCDEFGHIJ

```
fmtc10;wrt16,A$
```

ABCDEFGHIJ

```
fmtc10;wrt16,A$[
1,5]
```

ABCDE

```
fmtc15;wrt16,A$[
1,5]
```

ABCDE

```
fmtc5;wrt16,A$[1
,5]
```

ABCDE

When the string is longer than the specified field, an overflow condition exists and dollar signs are output.

```
fmtc5;wrt16,A$
```

$$$$$

Complete information about the write and format statements can be found in the General I/O ROM Programming Manual.

Read Statement

The read (red) statement is a General I/O ROM statement used to input data. The read statement can be used with free-field format or with format specifications.

Here's an example using free-field format that reads A$ using an input device that responds to select code 3 (the number following red), such as a tape reader. Assume this string is on tape –

ABCDEFGHIJ (LF)

```
dim B$[10]

red 3,B$

dsp B$
```

```
ABCDEFGHIJ
```

When format specs are used, as with the write statement, parts of a string can be read. Using the previous example, the first three characters only can be read by executing these statements –

```
fmt c3

red 3,B$

dsp B$
```

```
ABC
```

Strings, string arrays, numeric variables and constants may be used together in a read statement. Complete information about the read and format statements can be found in the General I/O ROM Programming Manual.

Chapter 7
Loading and Recording Strings

Each character of a string requires 1 byte of memory for storage. Extra bytes of memory , called overhead, are required to store strings and string arrays on tape. For example, to store an array dimensioned A$[X, Y], it takes 6+2X bytes of overhead plus the data requirements of XY bytes (plus 1 byte if XY is odd) to store X strings.

Recording Data

To store string variables on tape, first mark the number and size of the file or files required and then use the record file (`rcf`) statement.

`rcf` file number , string variable [, string variable...]

When the record file statement is executed, the strings found in the list of data items are recorded into the file number specified, on the current track. Strings in the list must be entire simple strings or entire string arrays. For example –

```
0: dim A$[5],
 B$[10,20],C
    •
    •
    •
3: rcf 3,A$,B$
```

When recording a list of items, such as A$, B$, X, the items must appear in the same order as allocated in a previously encountered `dim` statement. For example –

```
0: dim A$[5],X,
 B$[10,20],Y,Z
    •
    •
    •
3: rcf 5,A$,X,
 B$,Y,Z
```

Loading Data

To load string variables into the calculator's memory from tape, the load file (ldf) statement is used.

ldf file number , string variable [, string variable...]

When the load file statement is executed, the data in the file specified from the current track is loaded into the calculator's memory. A dim statement must be executed before the load file statement. The list of variables in the load file statement must be in the same order as previously allocated in the dim statement.

String variables can't be combined in the load file statement. For example, if A$ and B$ are dimensioned and then linked later in a program (A$ & B$ → C$), they must be recorded and loaded as dimensioned –

```
0: dim A$[5],
 B$[10],C$[15]
    •
    •
    •
4: A$&B$→C$
5: rcf 1,A$,B$
    •
    •
    •
9: ldf 1,A$,B$
```

Appendix

String Variable Syntax

The following conventions apply to the syntax for the functions and operations shown below.

`dot matrix` - All items in dot matrix are required, exactly as shown.

[ ] - All items in square brackets are optional, unless the brackets are in dot matrix.

Length - returns length of string or substring in number of characters

`len` (string variable or text)

Position - returns position or location (in number of characters) of string or substring

`pos` (in string variable or text, of string variable or text)

Value - returns numeric value of digits in a string for use in calculations

`val` (string variable or text)

String - converts numeric value of a variable to a string using the equivalent ASCII string based on the current fixed or float setting

`str` (expression)

Character - converts a value to a single character based on the value modulo 256

`char` (expression)

Numeric - returns decimal value of a single character

`num` (single character of string variable or text)

Capital - converts lower case alpha characters to upper case without modifying original string

`cap` (string variable or text)

Concatenation - links strings to each other

string variable or text & string variable or text [&...]

ASCII Character Codes

ASCII Char.	EQUIVALENT FORMS Binary	Octal	Dec
NULL	00000000	000	0
SOH	00000001	001	1
STX	00000010	002	2
ETX	00000011	003	3
EOT	00000100	004	4
ENQ	00000101	005	5
ACK	00000110	006	6
BELL	00000111	007	7
BS	00001000	010	8
HT	00001001	011	9
LF	00001010	012	10
V_{TAB}	00001011	013	11
FF	00001100	014	12
CR	00001101	015	13
SO	00001110	016	14
SI	00001111	017	15
DLE	00010000	020	16
DC_1	00010001	021	17
DC_2	00010010	022	18
DC_3	00010011	023	19
DC_4	00010100	024	20
NAK	00010101	025	21
SYNC	00010110	026	22
ETB	00010111	027	23
CAN	00011000	030	24
EM	00011001	031	25
SUB	00011010	032	26
ESC	00011011	033	27
FS	00011100	034	28
GS	00011101	035	29
RS	00011110	036	30
US	00011111	037	31

ASCII Char.	EQUIVALENT FORMS Binary	Octal	Dec
space	00100000	040	32
!	00100001	041	33
"	00100010	042	34
#	00100011	043	35
$	00100100	044	36
%	00100101	045	37
&	00100110	046	38
'	00100111	047	39
(	00101000	050	40
)	00101001	051	41
*	00101010	052	42
+	00101011	053	43
,	00101100	054	44
–	00101101	055	45
.	00101110	056	46
/	00101111	057	47
0	00110000	060	48
1	00110001	061	49
2	00110010	062	50
3	00110011	063	51
4	00110100	064	52
5	00110101	065	53
6	00110110	066	54
7	00110111	067	55
8	00111000	070	56
9	00111001	071	57
:	00111010	072	58
;	00111011	073	59
<	00111100	074	60
=	00111101	075	61
>	00111110	076	62
?	00111111	077	63

ASCII Char.	EQUIVALENT FORMS Binary	Octal	Dec
@	01000000	100	64
A	01000001	101	65
B	01000010	102	66
C	01000011	103	67
D	01000100	104	68
E	01000101	105	69
F	01000110	106	70
G	01000111	107	71
H	01001000	110	72
I	01001001	111	73
J	01001010	112	74
K	01001011	113	75
L	01001100	114	76
M	01001101	115	77
N	01001110	116	78
O	01001111	117	79
P	01010000	120	80
Q	01010001	121	81
R	01010010	122	82
S	01010011	123	83
T	01010100	124	84
U	01010101	125	85
V	01010110	126	86
W	01010111	127	87
X	01011000	130	88
Y	01011001	131	89
Z	01011010	132	90
[	01011011	133	91
\	01011100	134	92
]	01011101	135	93
^	01011110	136	94
_	01011111	137	95

ASCII Char.	EQUIVALENT FORMS Binary	Octal	Dec
`	01100000	140	96
a	01100001	141	97
b	01100010	142	98
c	01100011	143	99
d	01100100	144	100
e	01100101	145	101
f	01100110	146	102
g	01100111	147	103
h	01101000	150	104
i	01101001	151	105
j	01101010	152	106
k	01101011	153	107
l	01101100	154	108
m	01101101	155	109
n	01101110	156	110
o	01101111	157	111
p	01110000	160	112
q	01110001	161	113
r	01110010	162	114
s	01110011	163	115
t	01110100	164	116
u	01110101	165	117
v	01110110	166	118
w	01110111	167	119
x	01111000	170	120
y	01111001	171	121
z	01111010	172	122
{	01111011	173	123
|	01111100	174	124
}	01111101	175	125
~	01111110	176	126
DEL	01111111	177	127

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Notes

Error Messages

error S0 Invalid set of strings in data list of `ldf` statement.

error S1 Improper argument for string function or string variable.

error S2 More parameters than necessary for string function or string variable.

error S3 Attempt to access or assign to a non-contiguous string. Attempt to execute the `num` function with the null string as a parameter.

error S4 Attempt to find the `val` of a non-numeric string or the null string. Exponent in the `val` function too large or has improper exponent format.

error S5 Invalid destination type for string assignment (e.g., cannot assign text to a string array).

error S6 Invalid sequence of parameters for string variable. Parameter is zero, negative or exceeds dimensioned size.

error S7 String not yet allocated.

error S8 String previously allocated.

error S9 Maximum string length exceeded.

HP 9825A String Variable Programming

HEWLETT hp PACKARD

PART NO. 09825-90020
MICROFICHE NO. 09825-99020

PRINTED IN U.S.A.
JUL 2, 1976