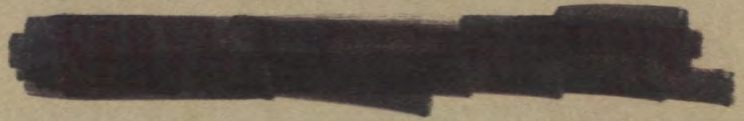


TUCKER ELECTRONICS
MASTER FILE
DO NOT SHIP

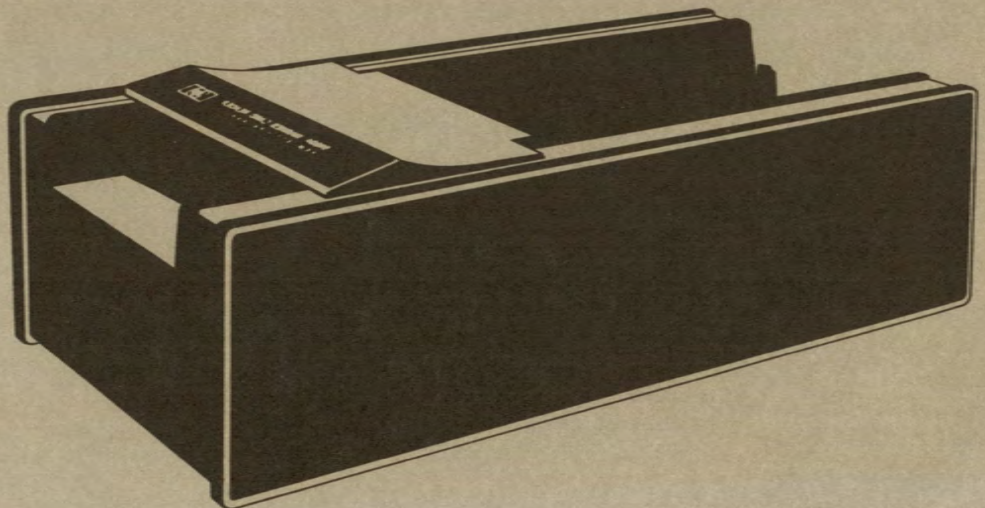
TUCKER ELECTRONICS
MASTER FILE
DO NOT SHIP



HEWLETT-PACKARD MARKED CARD READER

Model 9160A

Operating Manual



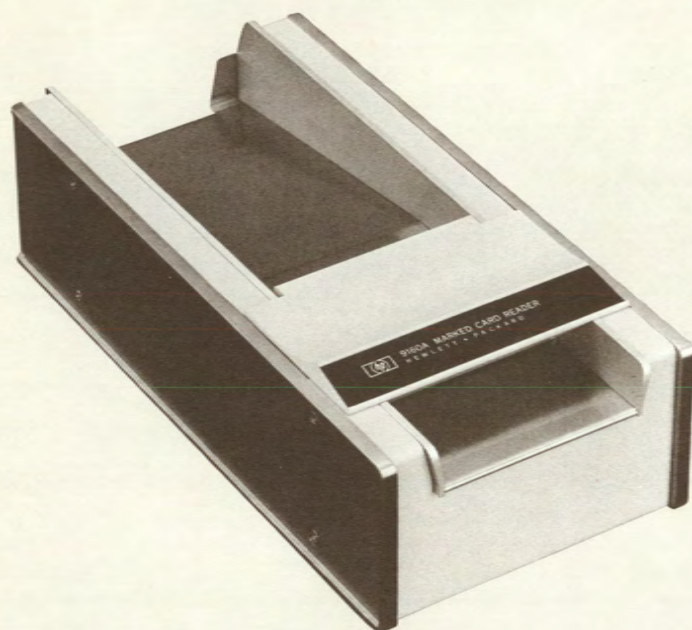


WARRANTY AND ASSISTANCE

The Hewlett-Packard 9160A Marked Card Reader is warranted against defects in materials and workmanship. This warranty applies for ninety (90) days from date of delivery. We will repair or replace components which prove to be defective during the warranty period. NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. WE ARE NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

INSTALLATION AND OPERATION

HEWLETT-PACKARD 9160A CARD READER



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INSTALLATION	3
GENERAL OPERATION	5
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OPERATION IN THE RUN MODE	11
SERVICE	13

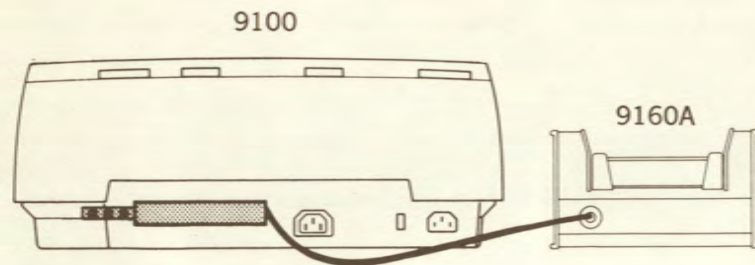
The Model 9160A is an optical mark sense card reader. It detects pencil marks in boxes on the standard card and transmits this coded information to the Model 9100 Calculator. It can be used to load programs into the calculator and also to load data into the calculator.

Basically, the card reader senses the difference between the unmarked card and locations with a lead pencil mark.

Inserting a card into the 9160A starts a motor which draws the card past the reader's optical assembly and deposits it in the card hopper. Cards are manually inserted one at a time.

Your Card Reader was carefully inspected both mechanically and electrically before shipment. It should be physically free of marks or scratches and in perfect electrical order. To confirm this, the reader should be inspected for physical damage in transit, then tested electrically with the calculator.

The 9160A takes its power directly from the Model 9100 Calculator. The only connection required is to insert the 9160A plug into the connector at the rear of the calculator. This connector is keyed so there is only one way to insert it. If it does not plug in easily, rotate the connector 180° and try again.



When using other peripherals, such as the 9125A Plotter, in conjunction with the Card Reader always plug the 9160A signal connector directly into the 9100A Calculator. Insert signal connector from second peripheral device into the back of the 9160A connector.

The three coaxial fittings which are located on the calculator end of the connecting cable are outputs for the Model 9150A Classroom Display. These outputs are not required for use with the 9160A Card Reader.

GENERAL DESCRIPTION

INITIAL INSPECTION

INSTALLATION

DIAGNOSTIC PROGRAM

NOTE

IT IS GOOD PRACTICE TO CHECK THAT THE 9100 POWER SWITCH IS **OFF** BEFORE INSTALLING THE 9160A PLUG.

Your 9160A Card Reader is shipped with a printed diagnostic card. This card allows you to check for correct electrical and mechanical operation of your card reader. Use the 9160A Diagnostic as follows:

- (1) Operate the 9100 Magnetic Card Diagnostic following the directions in the 9100 instruction manual.
- (2) Assuming satisfactory operation of the basic desktop computer, run the card reader diagnostic.

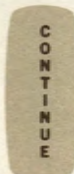
(3) Switch to  RUN

(4) PRESS:  

(5) Switch to PROGRAM 

(6) Insert the 9160A diagnostic card in the card reader

(7) Switch to  RUN

(8) PRESS:  

(9) A flashing display of

1.	Z
2.0000	Y
3.	X

indicates correct operation of your card reader. (Note that the card reader diagnostic will flash at a faster rate than the computer diagnostic).

Note that it is not necessary to completely fill in the box. Nor is it necessary to refrain from marking outside the box. A single straight line through the box is all that is required. You may mark outside the boxes; many times this is a fast and convenient way of marking two adjacent locations. Be careful, however, that no marks are left in any part of a box which you wish left blank.

It is important that you use a blunt pencil to mark the boxes on the mark sense card. A very sharp pencil may gouge the card, creating a groove in the soft paper. This may cause erratic operation of the optical sensing circuit used by the 9160A. A thin pencil mark in the bottom of a deep groove (such as might be made with a very sharp pencil) will not be detected as a mark.

Errors may be corrected by completely erasing the incorrect mark. A soft eraser will do the best job. Hard ink erasers will rough up the surface of the card. A very rough surface texture may be detected by the 9160A as if it were a pencil mark.

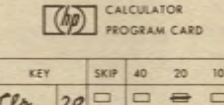
Operation with the Calculator in the PROGRAM MODE loads programs from the program cards into the Calculator. The two columns marked "step" are for recording the Calculator memory location in which you intend to load each program step. You must supply the first digit which will remain unchanged for each group of fourteen instructions. They will be loaded into a single Calculator register. Ordinarily, of course, your programs will start at location 0 - 0.

MARKS

ERASURE

OPERATION IN THE PROGRAM MODE

The six right hand columns are for marking the key codes in a way that the Card Reader can recognize. Program steps are coded in the octal key code by adding the column weights to total the digits of the key code. The example below shows how the value of each marked box is added to form the key code.



CARD NO. 1



CALCULATOR
PROGRAM CARD

STEP	KEY	SKIP	40	20	10	4	2	1
0	CLR 20	☐	☐	☒	☐	☐	☐	☐
1	1 01	☐	☐	☐	☐	☐	☐	☐
2	+ 33	☐	☐	☒	☐	☐	☒	☐
3	PSE 57	☐	☐	☐	☒	☐	☒	☐
4	PSE 57	☐	☐	☐	☒	☐	☒	☐
5	GT 44	☐	☒	☐	☐	☒	☐	☐
6	0 00	☐	☐	☐	☐	☐	☐	☐
7	Z 02	☐	☐	☐	☐	☐	☒	☐
8	END 46	☐	☐	☐	☐	☒	☐	☐
9		☐	☐	☐	☐	☐	☐	☐
a		☐	☐	☐	☐	☐	☐	☐
b		☐	☐	☐	☐	☐	☐	☐
c		☐	☐	☐	☐	☐	☐	☐
d		☐	☐	☐	☐	☐	☐	☐
0		☐	☐	☐	☐	☐	☐	☐
1		☐	☐	☐	☐	☐	☐	☐
2		☐	☐	☐	☐	☐	☐	☐
3		☐	☐	☐	☐	☐	☐	☐
4		☐	☐	☐	☐	☐	☐	☐
5		☐	☐	☐	☐	☐	☐	☐
6		☐	☐	☐	☐	☐	☐	☐
7		☐	☐	☐	☐	☐	☐	☐
8		☐	☐	☐	☐	☐	☐	☐
9		☐	☐	☐	☐	☐	☐	☐
a		☐	☐	☐	☐	☐	☐	☐
b		☐	☐	☐	☐	☐	☐	☐
c		☐	☐	☐	☐	☐	☐	☐
d		☐	☐	☐	☐	☐	☐	☐

TITLE Count NAME _____

1. USE SOFT PENCIL
 2. ERASE COMPLETELY
 3. INSERT THIS SIDE UP
 4. MARKING SKIP COLUMN CAUSES THAT ROW TO BE SKIPPED

Part No. 9320-1182

The exact sequence of operations for loading a program into the Calculator from the Card Reader is:

- (1) Switch to  RUN
- (2) Press:  , Starting Address.
- (3) Switch to PROGRAM. 
- (4) Enter program cards face up into the 9160A sequentially starting with the card containing the first steps of your program.
- (5) Switch to  RUN.
- (6) Press:  , Starting Address.
- (7) Follow operating instructions for your program.

Errors may also be eliminated by using the skip channel. Marks in this column of boxes cause the card reader to ignore that line of coding. Using the skip channel will cause addresses of the following instructions to be off by one place. For example, if step 0 - 4 on the card is skipped, the instruction labeled 0 - 5 on your card will be loaded into location 0 - 4 in the Calculator. Many times it is convenient to relabel the step column after using the skip feature.

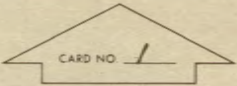
SKIP

A set of dotted boxes is provided at the end of the card for adding an extra instruction. This will allow you to get a full 28 instructions on one card even when you have eliminated one row with the skip column. Be sure to fill in the dark black mark on the right hand edge of the card when using this extra location. Failure to mark here will cause the Card Reader to ignore your extra step.

OPERATION IN THE PROGRAM MODE

LOOP ADDRESSES

Having your steps correctly labeled is important when writing programs with loops. You must have the correct address for the branching instruction. Using the extra 29th step all of the instructions on following cards will be accurately labeled. In the following example the instructions beginning on the second card are correctly labeled 2-0. Note, however, the incorrect destination for the branch at 1-3.



CARD NO. 1



CALCULATOR
PROGRAM CARD

STEP	KEY	SKIP	40	20	10	4	2	1
0	CLR 20	☐	☐	☒	☐	☐	☐	☐
1	STP 41	☐	☒	☐	☐	☐	☐	☒
2	R↑ 22	☐	☐	☒	☐	☐	☐	☒
3	÷ 35	☐	☐	☒	☐	☐	☐	☒
4	R↑ 22	☐	☐	☒	☐	☐	☐	☒
5	XEQ 30	☐	☐	☒	☐	☐	☐	☐
6	÷ 35	☐	☐	☒	☐	☐	☐	☒
7	2 02	☐	☐	☐	☐	☐	☐	☒
8	CHS 32	☐	☐	☒	☐	☐	☐	☒
9	÷ 35	☐	☐	☒	☐	☐	☐	☒
a	↓ 25	☐	☐	☒	☐	☐	☐	☒
b	↑ 27	☐	☐	☐	☐	☐	☒	☒
c	X 36	☐	☐	☒	☐	☐	☐	☒
d	R↑ 31	☐	☐	☒	☐	☐	☐	☒
1	XEQ 30	☐	☐	☒	☐	☐	☐	☐
1	- 34	☐	☐	☒	☐	☐	☐	☐
2	CLX 37	☐	☐	☒	☐	☐	☐	☒
3	X=Y 50	☐	☒	☐	☐	☐	☐	☐
4	3 03	☐	☐	☐	☐	☐	☐	☒
5	S 05	☐	☐	☐	☐	☐	☐	☒
6		☒	☐	☐	☐	☐	☐	☐
7	X↑Y 53	☐	☒	☐	☐	☐	☐	☒
8	2 02	☐	☐	☐	☐	☐	☐	☒
9	9 11	☐	☐	☐	☐	☐	☐	☒
a	↓ 25	☐	☐	☒	☐	☐	☐	☒
b	√x 76	☐	☒	☐	☐	☐	☐	☒
c	↑ 27	☐	☐	☐	☐	☐	☒	☒
d	CHS 32	☐	☐	☒	☐	☐	☐	☒
	R↑ 22	☐	☐	☒	☐	☐	☐	☒

1. USE SOFT PENCIL
 2. ERASE COMPLETELY
 3. INSERT THIS SIDE UP
 4. MARKING SKIP COLUMN CAUSES THAT ROW TO BE SKIPPED

TITLE QUADRATIC ROOTS

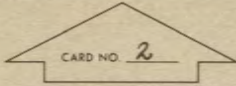
NAME _____

Part No. 9320-1182

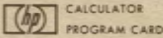
OPERATION IN THE PROGRAM MODE

9

The $\downarrow$ instruction at location 3-5 on card #2 is loaded into location 3-4 in the Calculator because one line was skipped. The program will not operate properly because the address for the branching instruction on card #1 is incorrect.



CARD NO. 2



CALCULATOR PROGRAM CARD

STEP	KEY	SKIP	40	20	10	4	2	1
2 0	+	33	☐	☐	☒	☐	☐	☐
1	R↑	22	☐	☐	☐	☐	☐	☐
2	+	33	☐	☒	☐	☐	☐	☐
3	CLX	37	☐	☐	☐	☐	☐	☐
4	R↓	31	☐	☐	☒	☐	☐	☐
5	STP	41	☐	☒	☐	☐	☐	☐
6	GT	44	☐	☐	☐	☒	☐	☐
7	0	00	☐	☐	☐	☐	☐	☐
8	0	00	☐	☐	☐	☐	☐	☐
9	↓	25	☐	☐	☐	☒	☐	☐
a	CHS	32	☐	☐	☒	☐	☐	☐
b	CHS	32	☐	☐	☒	☐	☐	☐
c	√x	76	☐	☐	☐	☐	☐	☐
d	↑	27	☐	☐	☐	☐	☐	☐
3 0	CHS	32	☐	☐	☒	☐	☐	☐
1	R↑	22	☐	☐	☐	☐	☐	☐
2	GT	44	☐	☐	☐	☒	☐	☐
3	Z	02	☐	☐	☐	☐	☐	☐
4	S	05	☐	☐	☐	☐	☐	☐
5	↓	25	☐	☐	☐	☒	☐	☐
6	CLX	37	☐	☐	☐	☐	☐	☐
7	R↓	31	☐	☐	☒	☐	☐	☐
8	GT	44	☐	☐	☐	☐	☐	☐
9	Z	02	☐	☐	☐	☐	☐	☐
a	S	05	☐	☐	☐	☐	☐	☐
b	END	46	☐	☐	☐	☐	☐	☐
c			☐	☐	☐	☐	☐	☐
d			☐	☐	☐	☐	☐	☐

1. USE SOFT PENCIL
 2. ERASE COMPLETELY
 3. INSERT THIS SIDE UP
 4. MARKING SKIP COLUMN CAUSES THAT ROW TO BE SKIPPED

TITLE **QUADRATIC ROOTS**

NAME _____

Part No. 9320-1182

OPERATION IN THE PROGRAM MODE

END

Unlike the magnetic card reader, the 9160A does not recognize the END statement as anything special. It is a good idea to finish your programs with END since they can then be recorded with no trouble on magnetic cards when desired.

There is a simple way to test for correct loading of your program. The program location counter displayed after each card has been read by the 9160A will be higher by the exact number of steps on the card. If your program starts in location 0-0 and you have twenty-eight instructions on the card with no skips, the display will read 1-d at the completion of reading that card. Inserting another full card will cause the program counter to advance to 3-d. Cards which have rows skipped will advance the counter by less than twenty-eight locations. Note that blanks on the card at the end of your program will be loaded into the 9100 as zeros; they will be read into the Calculator even though the last instruction on the card is END.

Switch:  RUN

Press:  CLEAR

Press:  END

Switch: PROGRAM 

Display

0.	00	Z
0.	00	Y
0.	00	X

Insert 9160A card

Display

0.	00	Z
0.	00	Y
1.d - - -	xx	X

Insert second 9160A card (one row skipped)

Display

0.	00	Z
0.	00	Y
3.c - - -	xx	X

It takes 0.02 seconds (20 milliseconds) for the 9160A to read a key code from the card. If the Calculator is in the RUN mode, it will perform the coded operation before reading the next line on the 9160A card—provided the operation takes less than 20 milliseconds. Since all of the data entry keys have operation times of less than 20 milliseconds, this is a useful method of data entry. The storage commands, the GO TO, and the CONTINUE also take less than 20 milliseconds and it is possible to enter data into the X register, store it in any other register, direct the Calculator to any program address, and commence automatic program operation.

Keys requiring over 20 milliseconds may be used by marking enough skip blocks following the instruction to take up the time (20 milliseconds per skip) required for the Calculator to complete its cycle. See Figure 2 for the operation time associated with each key.

It is necessary to place a decimal point in your data, even if it is an integer. Failure to specifically place the decimal point will cause all the blank portions of the card to be added as significant places after the last digit coded on the card.

For example:

Before Display

0.	Z
0.	Y
0.	X


 CALCULATOR
PROGRAM CARD

STEP	KEY	SKIP	40	20	10	4	2	1
0	3	☐	☐	☐	☐	☐	☒	☒
1	4	☐	☐	☐	☐	☒	☐	☐
2		☐	☐	☐	☐	☐	☐	☐

After Display

0.	Z
0.	Y
3.4	27 X

OPERATION IN THE RUN MODE

Before Display

0.	Z
0.	Y
0.	X

CARD NO. _____

 CALCULATOR
PROGRAM CARD

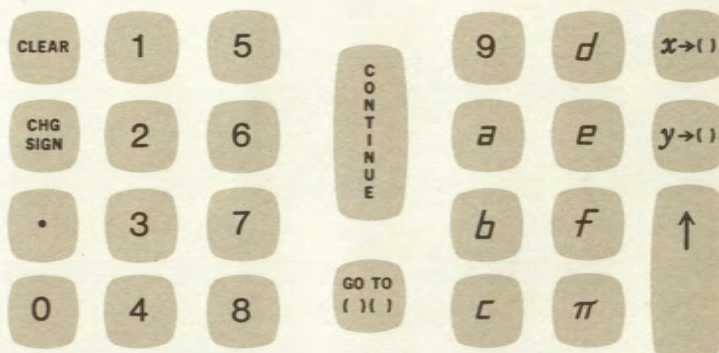
STEP	KEY	SKIP	40	20	10	4	2	1
0	3	03						
1	4	04						
2	2	21						
3								
4								

After Display

0.	Z
0.	Y
34.	X

Each digit in your data will require a separate line on the 9160A card. Digits are recorded from most significant to least significant; i.e., the left most digit is coded first on the card, followed by the next digit to the right, etc., until you reach the decimal point. Fractional parts are recorded after coding octal 21 for the decimal.

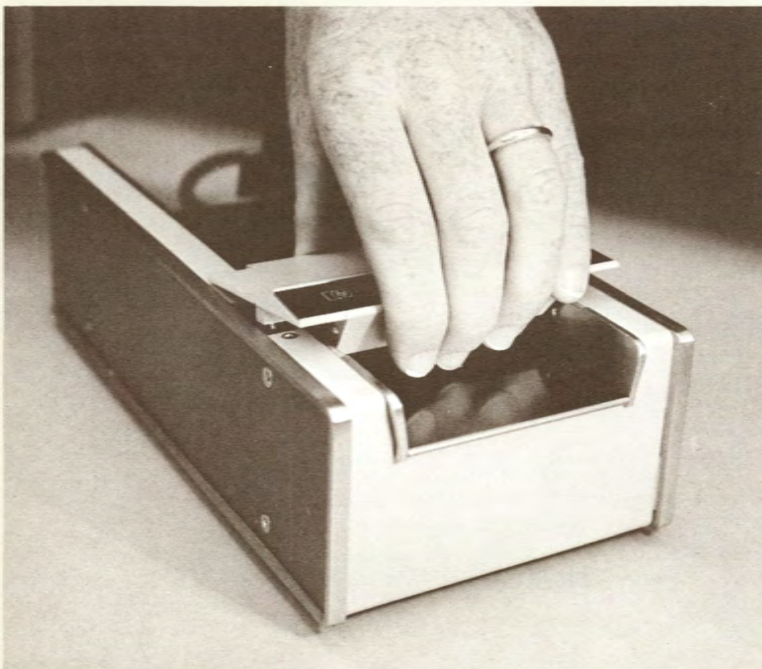
COMMANDS COMMONLY USED IN RUN MODE



Occasionally the lamp which lights the program card will require replacing. A defective lamp will prevent the motor, which draws the card through the Card Reader, from operating. Always check first for a burned out lamp when program cards fail to feed properly. Light from a correctly functioning lamp can be seen when looking into the card slot with the 9100 turned on.

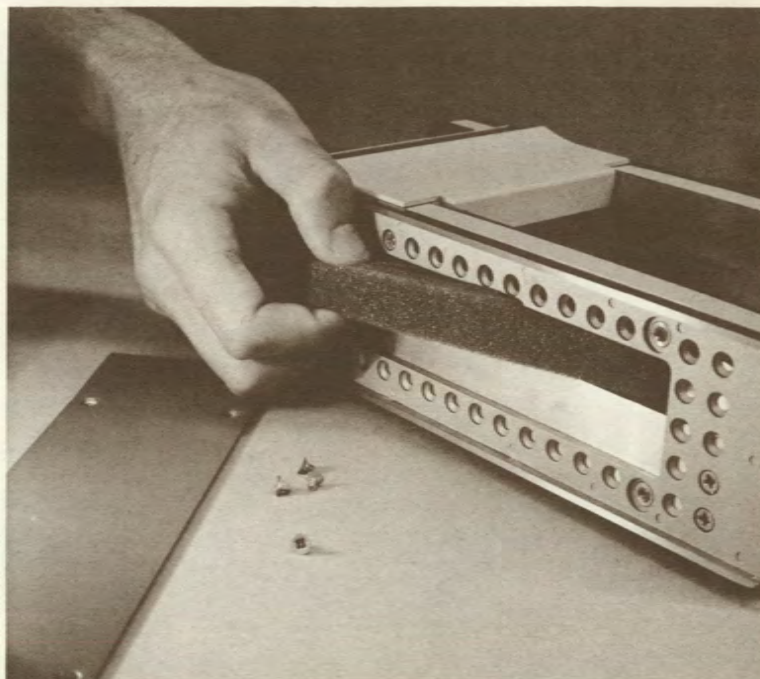
If the card fails to feed and the lamp glow is not visible in the card slot, replace the lamp by following these instructions.

Access to the lamp in the card reading assembly is obtained by grasping the top of the card slot with your hand and pulling upward. The top of the Card Reader is hinged and will pivot up to reveal the lamp.

**CAUTION**

THE LAMP IS VERY FRAGILE.

CHANGING THE LAMP



A replacement lamp is located inside the Card Reader behind the right side panel. Remove the sponge plastic cushion which protects the spare lamp.

CAUTION

THE LAMP IS VERY FRAGILE. ONE SIDE OF THE CUSHION HAS A SLIT CONTAINING THE LAMP.

Notice that there is a small spring inside the glass bulb on the left hand side.

Remove the lamp from the card reading assembly. To prevent breakage do not grab this lamp by the glass cylinder; rather follow these directions for safe removal. Insert the point of a screwdriver, or other similar tool, under the lamp and pry upward. Insert the replacement, spring toward the left, by pushing down with your thumbs on the metal ferrils at each end of the glass tube. Do not press against the glass itself as this may break the new lamp!

Return the top cover to its original position by pushing down. Replace the cushion, the side cover and the four retaining

screws. You will probably want to order a new lamp at this time from your local Hewlett-Packard office. Then you will always have a spare on hand. The lamp is part number 2140-0031.

After replacing the lamp run the Card Reader diagnostic to verify proper operation.

In some areas of the world the AC line voltage commonly fluctuates outside the nominal limits of 115 volts $\pm 10\%$ which have been established for the Calculator. Adding the Card Reader may cause erratic operation of your 9100 under these conditions. Your local Hewlett-Packard Sales and Service Office can install a modification which will allow normal operation under low line voltage conditions.

Service contracts providing preventative maintenance and on site service and repair of any problems are available. For further information contact your local Hewlett-Packard Sales and Service Office.

LINE VOLTAGE

SERVICE CONTRACTS



FIGURE 1

KEY CODES AND MAXIMUM EXECUTION TIMES

Key	Octal Code	Max Time MS
.	21	.03
+	33	2
-	34	2
÷	35	27
x	36	22
0	00	.03
1	01	.03
2	02	.03
3	03	.03
4	04	.03
5	05	.03
6	06	.03
7	07	.03
8	10	.03
9	11	.03
a	13	.25
ABS	55	.03
ACC+	60	5
ACC-	63	5
ARC	72	.03
b	14	.25
c	16	.25
CHS	32	.03
CLR	20	1
CLX	37	.12
CNT	47	.05
COS	73	200
d	17	.25
DN	25	.3
e	12	.25
EEX	26	.03
END	46	.2

Key	Octal Code	Max Time MS
EXP	74	130
f	15	.25
FMT	42	.02
GTO	44	.03
HYP	67	.03
IFL	43	3
INT	64	.06
LN	65	70
LOG	75	90
PI	56	.1
PNT	45	.03
POL	62	400
PSE	57	150
RCL	61	.5
RCT	66	400
RDN	31	.45
RUP	22	.45
SFL	54	.03
SIN	70	200
SQT	76	30
STEP	51	.
STP	41	.03
TAN	71	200
UP	27	.3
X=Y	50	3
X<Y	52	3
X>Y	53	3
KEY	30	.25
XTO	23	.03
YE	24	.03
YTO	40	.03

FIGURE 2

Each operation requires 0.2 ms more when executed in a program.



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TWX: 910-367-2092

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TWX: 810-863-0366

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Atlanta 30328
Tel: (404) 436-6181
TWX: 810-766-4890

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Tel: (312) 677-0400
TWX: 910-223-3613

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TWX: 810-341-3263

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