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Operating Manual

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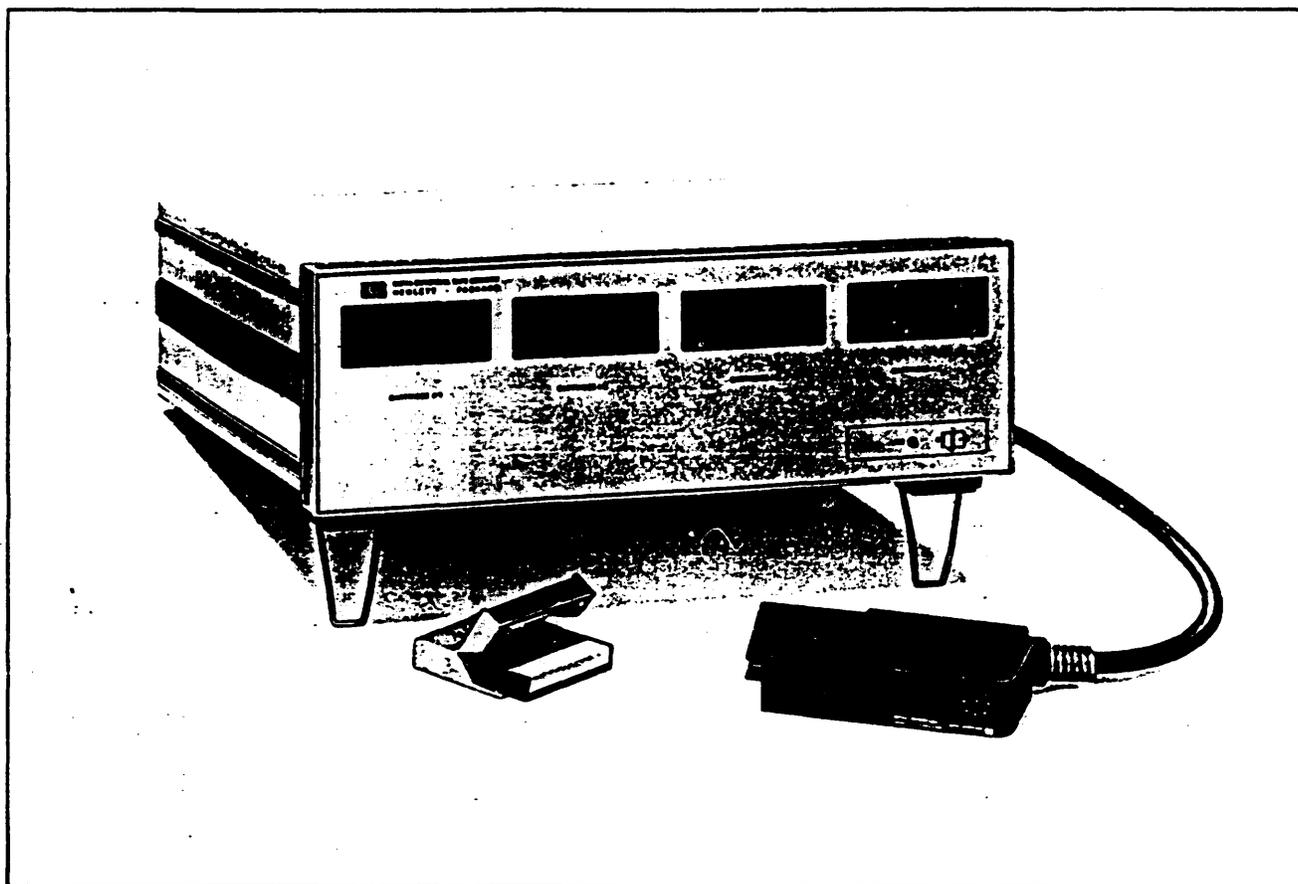
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Hewlett-Packard 9877A

External Tape Memory

Operating Manual

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**Hewlett-Packard 9877A
External Tape Memory**

TABLE OF CONTENTS

CHAPTER 1 GENERAL INFORMATION

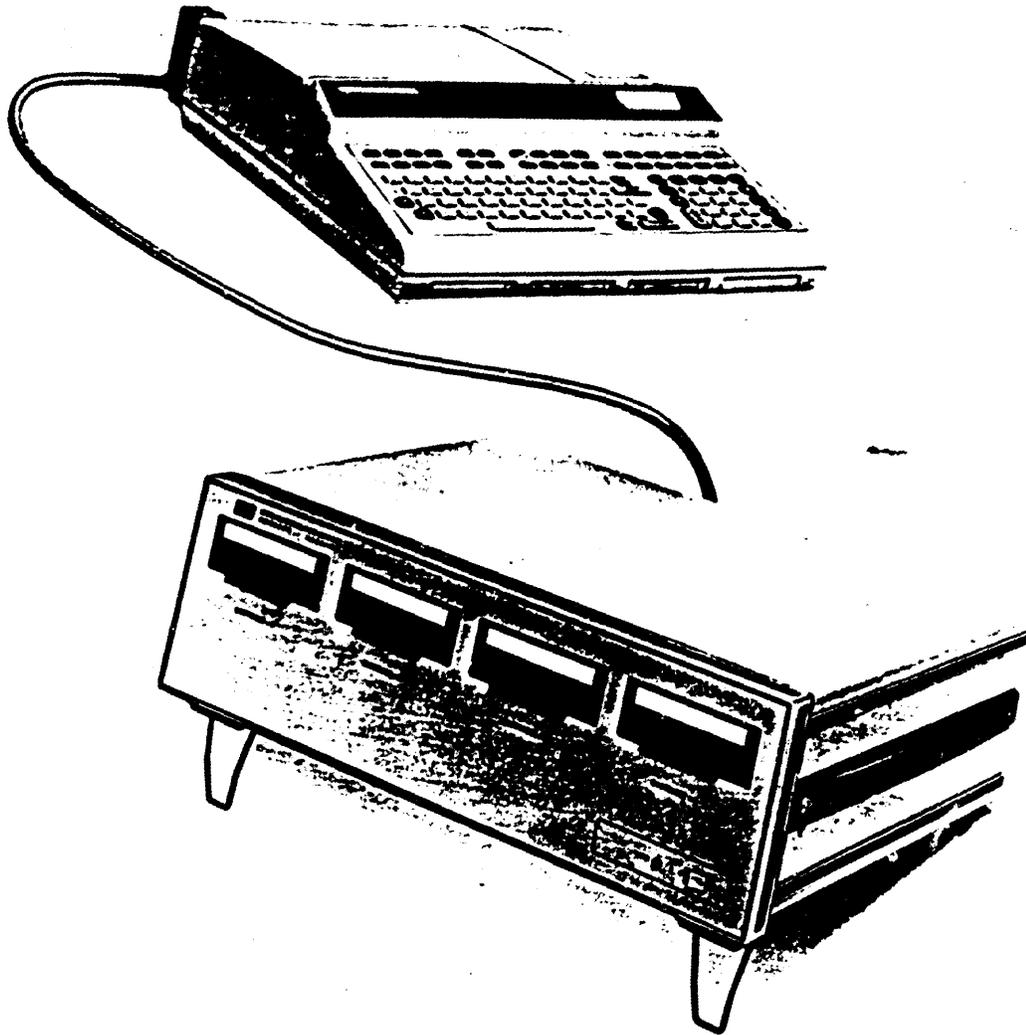
Introduction	1
Specifications	1

CHAPTER 2 INSTALLATION

Inspection Procedure	3
Power Cords	3
Power Requirements	4
Grounding Requirements	4
Fuses	5
External Tape Memory/Calculator Configuration	5
Initial Turn-on Instructions	6
Tape Cartridge Unit Test	6
Conditioning The Tape	7

CHAPTER 3 OPERATING INSTRUCTIONS

General	9
Setting The Select Code	9
Select Code Combinations	10
External Memory Mode	11
Tape Duplication Mode	11
General Notes On Duplication	14
Notes On Duplicator Binary Cartridge	16



HP 9877A External Tape Memory and the HP 9825A Calculator

CHAPTER 1

GENERAL INFORMATION

INTRODUCTION

The HP 9877A external tape memory provides the HP 9825A calculator with a simple to use external memory of up to 1 megabyte. The unit can also be used to obtain up to four tape copies at a time.

Before the external tape memory is used it is important that the select code is set up correctly. This procedure is described in Chapter 3 of this manual.

The tape cartridge units fitted in the external tape memory are identical in all respects to the tape cartridge unit in the HP 9825A calculator. Tape care, format and operations are also identical, therefore this manual only provides the additional operating information necessary to utilise the memory extension and tape duplication capabilities. For full information on tape care and operations refer to Chapter 9 of your HP 9825A Calculator Operating and Programming Manual.

SPECIFICATIONS

Each Tape Cartridge Unit

Capacity:	250,000 bytes
Average Access Time:	6 sec
Read/Write Speed:	55.9 cm/sec (22 in/sec)
Search Speed:	228.8 cm/sec (90 in/sec) (bidirectional)
Transfer Rate:	2,750 bytes/sec
Typical Access Rate:	14,300 bytes/sec
Typical Rewind Time:	19 sec (end to end)
Typical Erase Time:	40 sec (one entire track)
Tape Length:	42.87 m (140 ft)
Size:	63.5 mm x 82.5 mm x 12.7 mm (2.5 in x 3.25 in x 0.5 in)
Verification:	Automatic on recording

Tape Duplication Times (full cartridge, 2 tracks)

One tape	16 minutes approx.
Two tapes	26 minutes approx.
Four tapes	50 minutes approx.

Interface

The External Tape Memory interface comprises an interface card, and 1.50 m (5 ft) of cable terminated in a plug compatible with the HP 9877A. An externally accessible rotary switch on the interface card, allows any of the 14 user definable select codes to be chosen.

Environmental Range

Operating Temperature:	5°C to 40°C (ambient)
Storage Temperature:	-40°C to +65°C
Ambient Humidity:	20% to 80% (30°C max wet bulb temperature)

Size/Weight

Height:	13.97 cm (5 1/2 in)
Width:	43.18 cm (17 in)
Depth:	38.10 cm (15 in)
Net weight:	10.5 kg (stand. unit)
Shipping weight:	14.3 kg (stand. unit)
Cubes:	0.02m ³

} Add 0.75 kg for each extra cartridge unit.

Power Requirement

Source:
 100 V + 5%, -10%
 120 V + 5%, -10%
 220 V + 5%, -10%
 240 V + 5%, -10%

} Selected by rear panel switches

Line Frequency: 48 to 66 Hz

Power Consumption maximum:
 (hours/100.000)

	100/120 Volts	220/240 Volts
Standard	1.5A	700mA
Option 002	1.75A	800mA
Option 004	2.0A	920mA

Accessories Supplied

Quantity	Description	Part No.
1	Operating Manual	09877-90000
1	AC Power Cord	Depends on country
1	Tape Head Cleaner	8500-1251
1	Duplicator Tape	09877-1000) 2 12.06.74
•	Spare Fuse, 750mA	2110-0033 → 0360
•	Spare Fuse, 1.0AT	2110-0001 0007
•	Spare Fuse, 1.5AT	2110-0043 0304
•	Spare Fuse, 2.0AT	2110-0002 0303

Standard unit supplied with one 750mA and one 1.5AT fuse.
 Option 002 supplied with one 1.0AT and one 2.0AT fuse.
 Option 004 supplied with one 1.0AT and one 2.0AT fuse.

Ordering Information

Item	Order No.	Description
Standard	HP 9877A	1 Cartridge unit with power lead and interface card
Option 025		For interfacing with the 9825A Calculator
Option 002		2 Cartridge unit
Option 004		4 Cartridge unit
Field installable cartridge drive	HP 11242A	1 Tape drive assembly and associated electronic components

Accessories Available

Blank Data Cartridge	HP 9162-0061	98200A
Rack Mounting Kit (without front handles)	HP 5061-0077	
Rack Mounting Kit (with front handles)	HP 5061-0083	

CHAPTER 2

INSTALLATION

INSPECTION PROCEDURE

The individual parts of your external tape memory were thoroughly inspected before they were shipped to you. All equipment should be in good operating order. Carefully check the unit and other items for any physical damage sustained in transit. Notify HP and file a claim with the carrier if there is any such damage.

Please check to ensure that you have received all of the items which you ordered and that any options specified on your order have been installed in your unit. If you have any difficulties with your unit, if it is not operating properly, or if any items are missing, please contact your nearest HP sales and service office; addresses are supplied at the back of this manual.

POWER CORDS

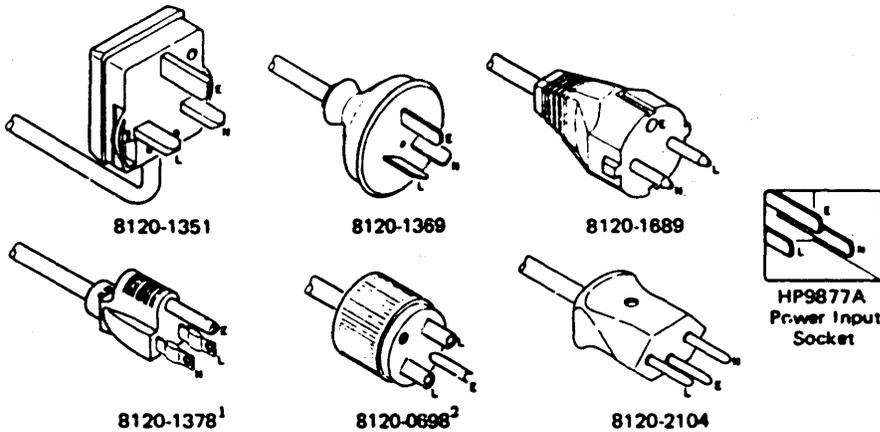
Power cords supplied by HP will have polarities matched to the power-input socket on the external tape memory, as shown below.

- L = Line or active conductor (also called "live" or "hot")
- N = Neutral or identified conductor
- E = Earth or safety ground

WARNING

IF IT IS NECESSARY TO REPLACE THE POWER CORD, THE REPLACEMENT CORD MUST HAVE THE SAME POLARITY AS THE ORIGINAL. OTHERWISE A SAFETY HAZARD FROM ELECTRICAL SHOCK TO PERSONNEL, WHICH COULD RESULT IN DEATH OR INJURY, MIGHT EXIST. IN ADDITION, THE EQUIPMENT COULD BE SEVERELY DAMAGED IF EVEN A RELATIVELY MINOR INTERNAL FAILURE OCCURED.

Power cords with different plugs are available for the external tape memory; the part number of each cord is shown below. Each plug has a ground connector. The cord packaged with each unit depends upon where it is to be delivered. If your unit has the wrong power cord for your area, please contact your local HP sales and service office.



¹ UL and CSA approved for use in the United States of America and Canada when set for either 100 or 120 Vac operation.

² UL and CSA approved for use in the United States of America and Canada when set for either 220 or 240 Vac operation.

POWER REQUIREMENTS

The HP 9877A has the following power requirements:

- Line Voltage:

100 Vac +5%, -10%	}	Switch Selectable
120 Vac +5%, -10%		
220 Vac +5%, -10%		
240 Vac +5%, -10%		
- Line Frequency: 48 to 66 Hertz
- Power Consumption:

	110/120V	220/240V
Standard	1.5A	700mA
Option 002	1.75A	800mA
Option 004	2.0A	920mA

GROUNDING REQUIREMENTS

To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that the unit be properly grounded. The 9877A is equipped with a three-conductor power cable which, when connected to an appropriate power receptacle, grounds the unit. To preserve this protection feature, do not operate the unit from an ac power outlet which has no ground connection.

FUSES

The fuse installed in the external tape memory depends upon the unit type and the power supply voltage. Check that the fuse installed in your unit conforms to the table below.

	100V/120V	220/240V
Standard	1.5AT	750mAT
Option 002	2.0 1.75AT	1.0AT
Option 004	2.0AT	1.0AT

WARNING

TO AVOID THE POSSIBILITY OF SERIOUS INJURY, DISCONNECT THE AC POWER CORD BEFORE REMOVING OR INSTALLING A FUSE.

The fuse is located on the rear panel of the external tape memory to the left of the power socket. To change the fuse, disconnect the power cord to the unit. Remove the fuse cap by pressing inward while twisting it counterclockwise. Remove the fuse from the cap and insert the correct replacement fuse (either end) into the cap. Put the fuse and cap back into the fuse holder. Press on the cap and twist it clockwise until it locks in place.

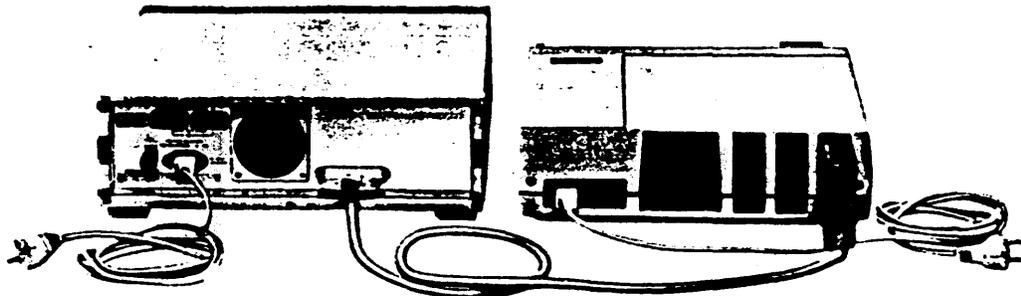
EXTERNAL TAPE MEMORY/CALCULATOR CONFIGURATION

Place the external tape memory and calculator on a flat surface where they are to be used. Raise the two front tilt stands located underneath the front of the HP 9877A.

CAUTION

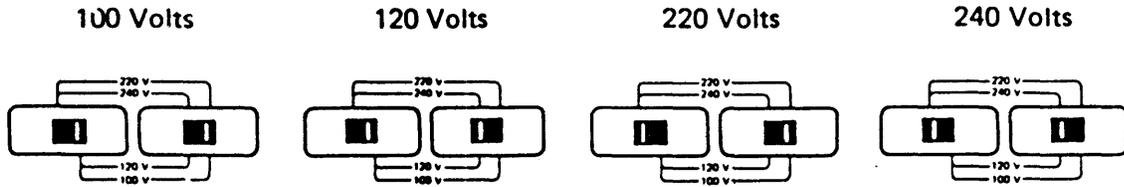
The interface connector must not be inserted or removed from the external tape memory or calculator with the power on either unit. To do so will cause damage to the equipment.

Insert the interface card into any of the three slots located at the rear of the calculator. Connect the other end of the interface into the socket on the rear of the external memory. Do not connect the power leads at this stage.



INITIAL TURN-ON INSTRUCTIONS

1. Set the external tape memory voltage selector switches to the setting applicable to your ac mains supply. The voltage selector switches are located on the rear of the unit. Switch settings for the nominal line voltages are shown below.



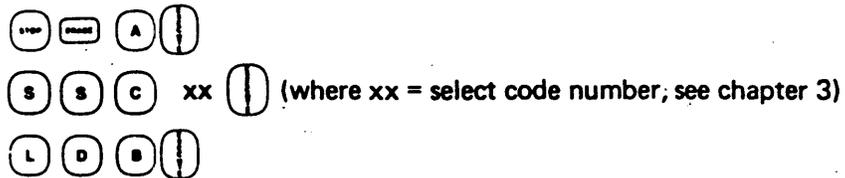
2. Check that the calculator voltage selector is set to the correct position (see your 9825A Calculator Operating and Programming Manual).
3. Connect both the external tape memory and calculator power leads into ac mains sockets.
4. Using the switch on the front panel of the external tape memory, and on the right hand side of the calculator, switch on the power.

TAPE CARTRIDGE UNIT TEST

Before using the external tape memory (or when faulty operation is suspected), the unit should be tested with the System Test Cartridge supplied with the calculator.

Procedure:

1. Turn on the calculator and external tape memory.
2. Insert the System Test Cartridge into the tape cartridge unit to be tested.
3. Press:



4. The calculator display will show:

WHICH TEST(S)?

5. Press:



6. The following display and printout should be seen:

```
PRELIMINARY TEST RESULTS  
CARTRIDGE TEST
```

7. Remove the System Test Cartridge and insert a scratch cartridge*, then press  .
8. After about 45 seconds the following display and printout should be seen.

```
REPLACE TEST CARTRIDGE  
CARTRIDGE TEST  
COMPLETE
```

9. Remove the scratch cartridge.

*The scratch cartridge must be a good, unprotected tape cartridge which does not contain wanted information.

For full information on calculator tests refer to the HP 9825A System Test Booklet, Part No. 09825-90031.

CONDITIONING THE TAPE

On any individual tape drive, repeated operations over a short length of tape (usually less than 4000 bytes or 1.5 m (5 ft.)) can cause slack (extreme changes in temperature can also cause this). The outer layer of tape can slip and rub on the cartridge, causing damage to the tape. If operation continues, the tape may jam and be ruined.

NOTE

This problem is most likely to occur if exclusive use is made of one file or two adjacent files near the beginning or end of tape.

If a particular application requires such operation, this slack can be prevented by conditioning the tape periodically. For example, for a tape with 80 files where only files 0 and 1 are used, execute the following program segment after every 200 operations on file 0 or 1:

```
18: fdf 80  
19: rew
```

CHAPTER 3

OPERATING INSTRUCTIONS

GENERAL

As stated in Chapter 1, the external tape memory cartridge units are identical to the unit fitted in the calculator. Also, tape care, format and commands are identical. Therefore, before using the external tape memory the user should read Chapter 9 (tape cartridge operations) in the calculator operating and programming manual. The following chapter only provides the additional information required to use the HP 9877A.

SETTING THE SELECT CODE

The select code is a number by which the calculator identifies a peripheral device. When a select code is addressed in a program or through the calculator keyboard, a communication link is set up between the calculator and peripheral. Although the external tape memory is essentially one peripheral, each tape cartridge unit is considered by the calculator to be an individual peripheral. The reason for this is that the calculator can service only one tape cartridge unit at a time.

To provide the communication link between the 9825A calculator and a specific tape cartridge unit in the 9877A, there are two stages in setting up the select code. This is accomplished by setting a switch on the interface card and by a calculator keyboard entry or by specification in a peripheral control program.

The select code number set on the interface card identifies the HP 9877A as a whole. If you also have other peripherals or instruments connected to the calculator each of these must be allocated their own code number. You must therefore choose a select code whose combination does not include a number already allocated to another device (see select code combinations). This number, once set, does not normally need to be altered again.



Interface Card Select Code Switch

The select code number entered through the calculator keyboard, or specified in a peripheral control program, identifies the individual tape cartridge units. When the 9877A is being used as an external memory, the user must identify the specific cartridge each time he wishes to use it by addressing it in the control program or through the keyboard with the appropriate select code. This includes the calculator built-in unit which is always identified by select code number 1 (ssc 1). See 'External Memory Mode' in this chapter for a more detailed description.

When the unit is being used to duplicate a master tape, the DUPLICATOR tape cartridge supplied with the HP 9877A is used. The program contained on this cartridge includes the cartridge select codes. Therefore the user only needs to set the interface card selector. See "Tape Duplication Mode" in this chapter for a more detailed description.

SELECT CODE COMBINATIONS

The select code numbers you choose to set on the 9877A interface card and through the calculator keyboard (or control program) are governed by various restrictions. It is important that you observe these restrictions in order that the 9825A/9877A configuration functions correctly.

Described below are the combinations of select codes applicable to each of the three versions of HP 9877A. For all versions select codes 0 and 1 must never be used as these are allocated to functions within the 9825A calculator (0 selects keyboard and display and 1 selects the built-in cartridge). In addition, select codes 2 and 3 must not be used with option 004. If either 2 or 3 is used a meaningless response will result. The select code combinations for each version is as follows:

Standard (1 cartridge unit)

Select codes 2 to 15 inclusive are available. The select code set on the interface card must also be addressed through the keyboard (or control program). Whichever number you select cannot be used to identify any other peripheral. Also you cannot use any number already allocated to another peripheral.

Option 002 (2 cartridge unit)

Select Code	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Tape Cartridge	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2

Select codes 2 to 15 inclusive are available. The code numbers are divided into pairs. To identify the 9877A as a whole either number of a pair may be set on the interface card (e.g. 2 or 3; 4 or 5; 6 or 7 etc.). However, if either number of a pair is being used to identify another peripheral then neither number is available for use with the 9877A. Also, whichever number you choose to set on the 9877A interface means that its partner number cannot be used to identify other peripherals.

To identify the individual tape cartridge units, select codes must also be addressed through the calculator keyboard (or by control program). The select codes used here must relate directly to the number set on the interface card. For example, if 6 is set on the interface only 6 or 7 may be used to identify the individual cartridge units. For each number pair the lower number always identifies tape cartridge # 1 and the higher number tape cartridge # 2.

Option 004 (4 cartridge unit)

Select Code	4	5	6	7	8	9	10	11	12	13	14	15
Tape Cartridge	#1	#2	#3	#4	#1	#2	#3	#4	#1	#2	#3	#4

Only select codes 4 to 15 inclusive are available and these are divided into groups of four as shown above. To identify the 9877A as a whole, any number of a group may be set on the interface card providing that this number, or any other number in it's group, is not being used to identify other peripherals. Similarly the number you choose to set on the interface, along with the other three numbers from its group cannot be used to identify other peripherals.

To identify the individual tape cartridge units, select codes must also be addressed through the calculator keyboard (or by control program). As with option 002 these codes must relate directly to the code number set on the interface card. For example, if 9 is set on the interface card, numbers 8, 9, 10 and 11 may be used. With each group the lower number always identifies tape cartridge #1 and the higher number tape cartridge # 4.

EXTERNAL MEMORY MODE

Keyboard Operation

1. Check the select code number set on the interface card.
2. Insert the data cartridge(s) into the HP 9877A tape cartridge unit(s).
3. Press: **(s)** **(s)** **(c)** xx **(|)** (where xx = select code number)
4. Use the selected tape cartridge unit in exactly the same manner as the calculator's built-in unit (employ the commands as described in Chapter 9 of the 9825A Operating and Programming Manual).
5. Each time the tape cartridge unit is no longer required, it must be disabled by RESET or by executing another ssc instruction to identify another tape cartridge unit.

By Program

Repeat steps 1 and 2 as detailed in Keyboard Operation above. The select code (ssc xx) statement must be executed in the program flow. This directs any cartridge operation to the specified tape cartridge unit. An ssc xx statement remains operational until another is specified.

TAPE DUPLICATION MODE

Syntax: `dupc master sc, slave sc [, slave sc [, slave sc [, slave sc]]]`

Parameters for master and slave tapes can be constants or expressions. All select code parameters must be in the range 1-15 inclusive (select code 1 always addresses the 9825A calculator built-in cartridge unit). At least one slave select code must be specified. The DUPLICATOR program occupies 736 bytes of R/W memory and must be loaded into the calculator before executing the dupc command. Executing dupc does not destroy programs, special function key allocations or variables resident in the calculator memory.

Keyboard Operation

1. Check the select code number set on the interface card.
2. Insert the DUPLICATOR program cartridge into the 9825A tape cartridge unit. Read "Notes on DUPLICATOR binary cartridge" at the end of this chapter.
3. Load the DUPLICATOR program into the calculator by pressing:

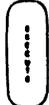
(L) (D) (B) n (where n = file number from 1 to 10)

4. Press:



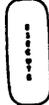
5. Remove DUPLICATOR cartridge.
6. Insert master data cartridge into calculator or any slot in the 9877A.
7. Insert slave tape(s) into 9877A or calculator.

8. Press:

(T) (R) (K) x 

where x = tape track number 0 or 1. If trk is not entered, track 0 is automatically duplicated. If, prior to duplication, track 1 on the master tape was being used and you wish to copy track 0, the RESET button (on calculator) can be pressed instead of executing trk 0.

9. Press:

(D) (U) (P) (C) x, y [, y [, y [, y]]] 

where x = master tape select code number. If tape is in calculator, this number is 1.
y = slave tape(s) select code numbers.

10. Once the dupc command has been executed the calculator screen displays:

trk x file x

The track number set through the keyboard is displayed through the entire duplication routine. As the duplication progresses, the file number currently being copied is displayed.

Executing dupc also initiates duplication of the entire specified track of the master tape. If you wish to terminate duplication, this can be done at any time by pressing STOP or RESET on the calculator. At the end of the complete duplication process, all tapes are automatically rewound and the calculator screen displays .

By Program

dupc is a programmable statement and can therefore be used in a program. Generating "back up" data cartridges for important data automatically at the end of a program course is easily achieved by dupc. To utilise this feature proceed as follows:

1. Repeat steps 1 to 5 described in "Keyboard Operation" above.
2. Insert your program data cartridge into any cartridge unit, for example into the calculator unit.
3. Insert your "working" and "back up" data cartridges into the remaining cartridge units according to the select codes used in your program.
4. At the end of your program enter into the DUPLICATOR routine by the following statements for a copy of track 0:

```
trk0; dupc x, y [,y [,y [, y]]]
```

If a copy of track 1 is also required, trk 1 must be set before dupc is executed again.

Example:

A program takes inputs of data, processes it and then stores it on the external tape cartridge units with select codes 4 and 5 (or whichever select codes are applicable). At the end of the job the user requires copies of his important results. To achieve this the following routine can be appended to the end of the program to provide automatic "back up" copies on the external tape cartridges (for this example select codes 6 and 7 are used).

```
68: "REMARK":  
69: trk 0; dupc  
4,6; dupc 5,7  
70: trk 1; dupc  
4,6; dupc 5,7  
71: dsp "back-  
up copies done"  
72: end
```

Using dupc in "Live Keyboard" Mode

The dupc routine can also be used in "Live Keyboard" mode on the 9825A Calculator. After execution of dupc the calculator does not know the tape position. Before continuing further, the tape position must be re-established by executing rewind (rew) or find file (fdf), (see also 'track and select code' in General Notes On Duplication).

Example: a keyboard entry of dupc 0; Y; rew will establish the tape position.

Normally a problem will arise only when "live keyboard duplication" interferes with a mark process. To avoid this, ensure that the statement (mrk) is on the same line as find file (fdf) or rewind (rew) instruction in your program.

Example:

```
53: rew
54: mrk 10,40
```

This format will cause a problem

```
53:
54: rew;mrk 10,
40
55:
```

Correct format, no problem.

GENERAL NOTES ON DUPLICATION

Duplicated file size: The dupc statement uses only "free memory space", which means that programs and variable allocations currently established in the calculator are preserved and will not be changed.

Example:

Assuming that a 9825A Calculator, option 001 with 16K bytes of memory is used. The DUPLICATOR program and a user program requiring 4.3K bytes is loaded into the calculator memory. The user program assigns variables requiring 5K of memory. The following figures show how large (in this example) a cartridge file can be at maximum for successful duplication.

Total available R/W memory — 15028 bytes

Duplicator program — 736 bytes

User program — 4300 bytes

Assigned variables — 5000 bytes

10036 bytes

subtract from total available R/W memory enables a maximum file size of 4992 bytes to be duplicated.

The DUPLICATOR will mark the files on the slave tape(s) with exactly the same size as they are on the master tape regardless of file type. When the available free memory space is too small (memory overflow), the particular file will not be copied. This file can be copied at any time under manual control.

A memory overflow error: This will be printed with track and file # on 9825A printer.

Auto-verify: Duplicated files will be automatically verified if auto-verify has been enabled, otherwise verification is skipped for fast duplication.

Auto erase: Slave cartridges will be erased after the last file.

Track and select code: The dupc statement does not affect the current track and cartridge drive select code (ssc) settings. Tape position will be unknown after finishing this statement. Use fdf (find file) or rew (rewind) statement to establish tape position if necessary.

Binary files: Cannot be duplicated with the dupc statement. If binary files are detected on the master cartridge, error 57 will be printed and the file will only be marked.

Failures on master cartridges: Will terminate the duplication. With an Extended I/O ROM plugged into the 9825A they can be isolated (see cartridge error codes in 9825 Operating and Programming Manual and error statements in the Extended I/O ROM manual).

Failures on slave cartridges: Will not terminate the duplication, unless all slaves fail. In this case an 'error B1' will terminate the operation. All slave failures will be printed on the 9825A printer to indicate the error type:

```
eg.      error 42 in 1    ← error type
         on sc 5         ← slave select code
         trk 1 file 6    ← file location
```

The DUPLICATOR will leave the tape where the failure occurred, disable the drive on this select code operation and continue with duplication on remaining slave cartridges.

The slave cartridge errors are trapped automatically by the DUPLICATOR and cannot be indicated by Extended I/O ROM.

Beginning and end: DUPLICATOR always starts with file 0 on the current track and duplicates the whole track. At the normal end of duplication, the master tape and all good slave tapes are rewound. The cartridge select code, before calling DUPLICATOR, will be set and the tape position set to lost.

Error codes: All cartridge errors are valid during duplication (see 'Error Messages' in the 9825A Operating and Programming Manual). In addition, the DUPLICATOR generates the following errors:

- B0 — duplication terminated by () .
- B1 — all slaves bad; cannot continue.
- B2 — # of parameters incorrect, select code specified twice.

NOTES ON DUPLICATOR BINARY CARTRIDGE

The DUPLICATOR cartridge contains the tape duplication program in binary format on track 0 and is recorded ten times on files 1 to 10. Therefore when the program is to be loaded into the calculator any file number (between 1 and 10) may be specified after the ldb statement. File 0 contains the initialization routine for "auto-start" when the Extended I/O ROM is installed.

CAUTION

As with all tape cartridges, strong magnetic fields can erase the programs on the DUPLICATOR cartridge.

General Considerations For Binary Programs

A binary program can be loaded over another binary program of equal or greater length at any time.

Any binary program can be loaded at any time (from the keyboard or a running program) provided there is room in the memory for it and no simple, array, or string variables have been allocated.

Once simple, array, or string variables are allocated, a binary program cannot be loaded unless space has been allocated for it by a previous load binary operation.

It is suggested that before any variables are referenced, load the largest binary program file that will be needed. Then variables can be allocated and other binary programs can be loaded without concern for reserved space. When the Extended I/O ROM is installed, the "auto-start" feature ensures that the DUPLICATOR binary program is automatically loaded when the calculator is switched on.

Record Memory and Load Memory with a binary program

Binary programs will not be recorded when a record memory (rcm) is executed. Further, an rcm statement erases the binary program currently in memory.

Therefore use the following procedure to record memory:

1. On another cartridge, mark a file for 32566 bytes (or as applicable to the actual memory size of the 9825A) to hold the recorded memory.
2. Execute rcm Y; where Y = file number to hold the recorded memory.

To load memory (ldm) at a later time use this sequence:

1. Insert the binary cartridge in the 9825A tape transport.
2. Execute ldb n (where n = the file number of the binary program that was in memory when the memory was recorded).
3. Remove the binary cartridge and insert the cartridge containing the recorded memory.
4. Execute ldm Y (where Y = the file number of the recorded memory).
5. Repeat steps 1 and 2 above to reload the required binary program.

General Cartridge Errors

A full list of tape cartridge errors will be found in the following manuals:

- Your HP 9825A Calculator Operating and Programming Manual.
- String ROM Manual 09825–90020.
- Advanced Programming ROM Manual 09825–90021.
- Extended I/O ROM Manual 09825–90025.

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