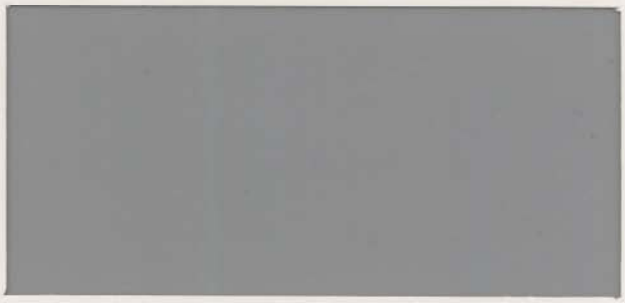
Brian Murphy
Do not remove



SERIES 9800

HEWLETT-PACKARD CALCULATOR

PART NO. 9320-

PROGRAMMING MANUAL

9882A CRT SUBSYSTEM
PROGRAMMING MANUAL
P/N 09882-90000
AUG. 1, 1975

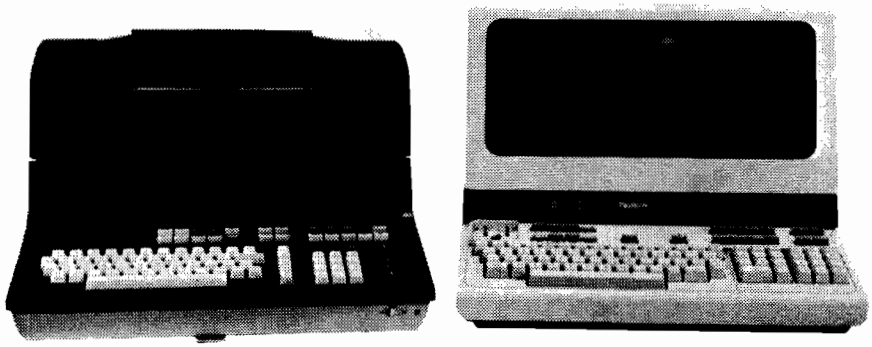


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TABLE OF CONTENTS

FIGURES

TABLES

Chapter 1

GENERAL INFORMATION

INTRODUCTION

The HP-9882A CRT Subsystem enhances the operational capability of the 9830A Calculator by providing an 'input-output' CRT display.

The intent of this manual is not that of an operating manual (for operational information refer to the 2640A Owner's Manual), but rather a programming manual, which describes how to program the 9882A CRT Subsystem and some of its applications.

Before attempting serious programming for the 9882A CRT Subsystem the programmer should:

1. Be familiar with 9830A Basic language programming, as described in the 9830A Calculator Operating and Programming Manual.
2. Have read the 2640A Owner's Manual.
3. Have read at least Chapter 4 (Data Comm. 1 ROM) of the Data Communications Operating and Programming Manual.

If any other ROMs (e.g., STRINGS) are to be used with the system, the programmer should also read the appropriate manuals.

With previous knowledge of the information described above and the information contained in this manual, the programmer should find programming for the 9882A CRT Subsystem as easy as that of any other peripheral.

OPTIONS AND ACCESSORIES

The basic 9882A CRT Subsystem consists of:

1. Firmware (ROM) for the 9830A Calculator
2. Interface card and Cables
3. HP-2640A Terminal (display and keyboard)

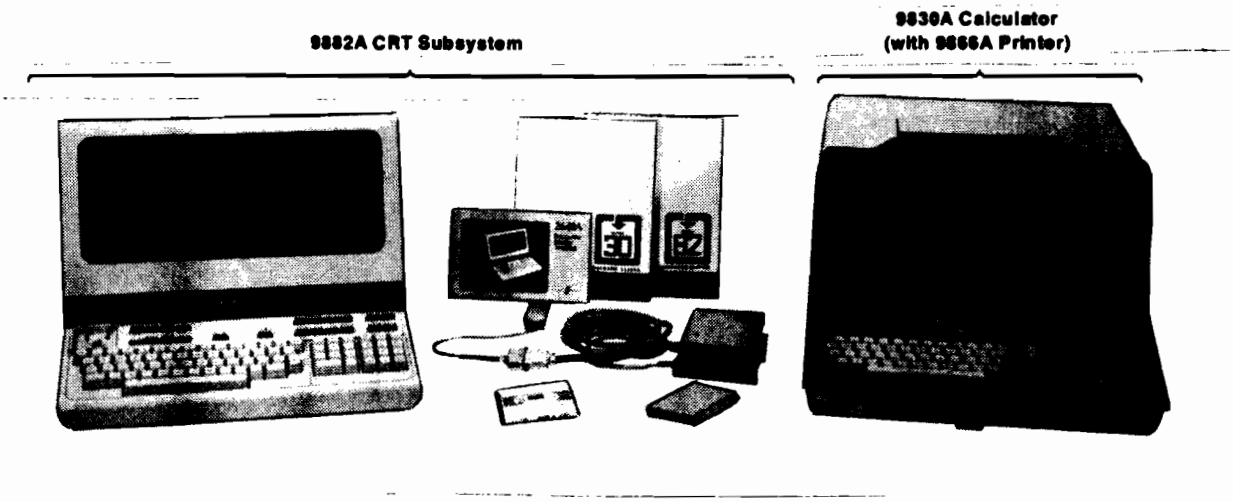


Figure 1-1. 9882A CRT Subsystem

Table 1-1. Options and Accessories

9882A CONFIGURATIONS	HP PART NO.
Standard 9882A CRT Subsystem	9882A
• 2640A Interactive Display Terminal Option	
001 - 128 Character Set	2640A Opt 001
• Terminal Memory Module (+2K)	13233A
• 2640A Owner's Manual	02640-90011
• Data Comm. Interface	11284A
• Data Comm. 1 ROM	11296B
• Operating and Programming Manual	11285-90000
• Quick Reference Card	11285-90010
• Test Packet, which includes:	11284-67903
ACU Test Connector (with switch)	11284-67902
Modem Test Connecter	11284-67901
11285 Test Cassette	11285-90001
• CRT Interface Cable	11284-61603
• CMERGE Binary Tape	11141-90008
• 9882A CRT Subsystem Programming Manual	09882-90000
9882A Option 001 (Extends Memory to 5K Total)	9882A Opt 001
• Standard 9882A	9882A
• Delete Terminal Memory Module (+2K)	13233A
• Add Terminal Memory Module (+4K)	13234A
9882A Option 002 (Deletes 11296B ROM)*	9882A Opt 002
• Standard 9882A	9882A
• Delete Data Comm. 1 ROM	11296B
*Assumes you already have the ROM	
9882A Option 015 (50 Hz, 220 Volt)	9882A Opt 015
• Standard 9882A	9882A
• Delete 2640A Option 001	2640A Opt 001
• Add 2640A Option 001/Option 015	2640A Opt 001/015
9882A Option 016 (50 Hz, 110 Volt)	9882A Opt 016
• Standard 9882A	9882A
• Delete 2640A Option 001	2640A Opt 001
• Add 2640A Option 001/Option 015*	2640A Opt 001/015
*Wired for 110 VAC	
9882A Option 900 (English Power Cord)	9882A Opt 900
• Standard 9882A	9882A
• Delete 2640A Option 001	2640A Opt 001
• Add 2640A Option 001/Option 900	2640A Opt 001/900
9882A Option 901 (Australian Power Cord)	9882A Opt 901
• Standard 9882A	9882A
• Delete 2640A Option 001	2640A Opt 001
• Add 2640A Option 001/901	2640A Opt 001/901
9882A Option 902 (European Power Cord)	9882A Opt 902
• Standard 9882A	9882A
• Delete 2640A Option 001	2640A Option 001
• Add 2640A Option 001/Option 902	2640A Opt 001/902

SPECIFICATIONS

Refer to the Specifications section in the HP 2640A Owner's Manual.

The exceptions to those specifications when the Terminal is part of the 9882A CRT Subsystem are:

- Data Rate: 110, 150, 300, 1200 Baud. 2400 Baud can be used if a software 'WAIT' statement is used between lines sent to the 9882A (Refer to 'Operating at High Speeds' in the 2640A Owner's Manual).
- Communication Interface: 11284A Data Comm. Interface and 11284-61603 CRT Interface Cable
- Transmission Mode: Half duplex, asynchronous
- Operating Mode: On line, Off line, Character or Block Mode
- Parity: None

SERVICE CONTRACTS

Service contracts are available for the Terminal. For further information contact your nearest HP Sales and Service Office; locations are listed at the back of this manual.

INSTALLATION

The following information tells you how to install the 9882A CRT Subsystem. Other items, such as the Calculator and printer, should be installed according to the instructions given in their own manuals.

Power Requirements

The Terminal requires either 110 or 220 Volts, +15% −20%, 60 Hz. The operation on 110 or 220 volts is hardwired at the factory and is indicated on the Identification Label found on the mainframe panel under the rear access cover.

CAUTION
DO NOT APPLY POWER TO THE TERMINAL UNLESS THE AVAILABLE LINE VOLTAGE CORRESPONDS TO THE REQUIRED VOLTAGE AS INDICATED ON THE IDENTIFICATION LABEL.

The power consumption of the Terminal is 75 to 125 watts maximum.

For 50 Hz operation, options 015 and 016 are available (see Options and Accessories in Table 1-1).

Grounding Requirements

For proper operation and safety, the Terminal's chassis must be gounded to earth ground via the AC power cord. The center pin of the 3-conductor power cord is ground. If a 3-conductor outlet is not available, use the appropriate adapter plug, and connect its third wire to a convenient grounding point.

WARNING
A SAFETY HAZARD EXISTS IF THE CHASSIS OF THE TERMINAL IS NOT GROUNDED TO EARTH GROUND.

Line Fuse

With the Terminal disconnected from the AC power source, check the rating of the fuse installed, this should agree with the following.

Table 1-2. Replacement Fuses

Voltage Requirement*	Fuse Description	HP Part No.
110 Vac	4 Ampere 250 Volt Slow Blow	2110-0365
220 Vac	2 Ampere 250 Volt Slow Blow	2110-0303

*as indicated on the Identification Label

Always be sure that the correct fuse is used, since failure to do so may result in needless damage to the Terminal should it malfunction or if an unusually high line voltage should occur.

Installation Procedure

This procedure should be followed when installing the Terminal in conjunction with the HP 9830A Calculator.

1. Verify that the HP 9830A Calculator has been installed as described in the 9830A Operating and Programming Manual and that the power switch is turned OFF.
2. Place the Terminal on any convenient surface, except plush or spongy surfaces that might restrict air flow through the bottom vents. Do not use a typewriter pad under the Terminal.
3. Raise the Terminal's hinged rear access cover (two rotating latches hold it in place) and connect the keyboard cable hood connector to the printed-circuit card connector that has been appropriately notched to match the cable connector.

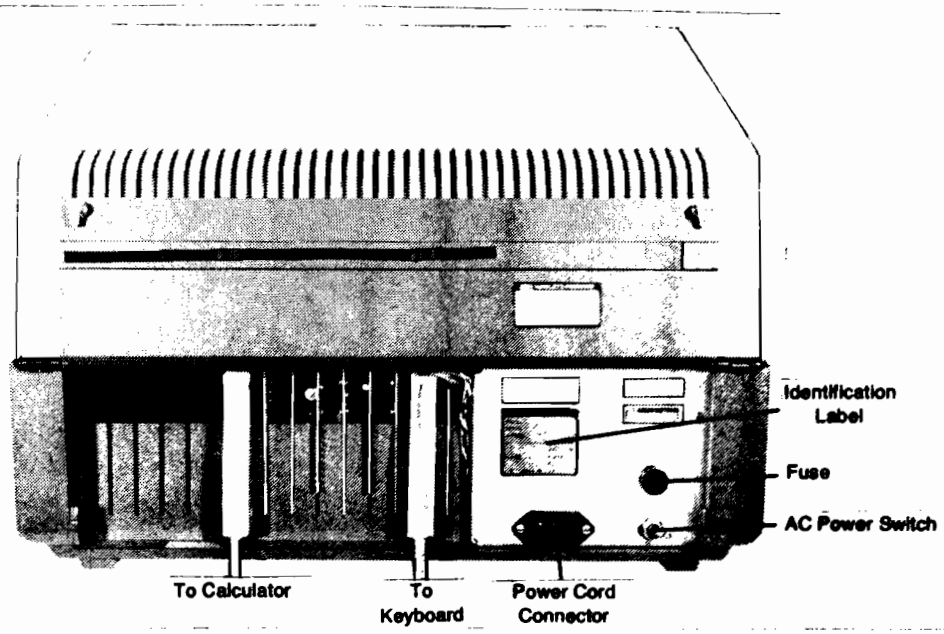


Figure 1-2. Terminal's Rear Access Cover Raised

4. Connect the 'two piece' interface cable (P/N 11284A - Opt 040) together as shown below. The 'two piece' interface cable consists of the Data Comm. cable (11284A) and the CRT Interface cable (11284-61603).

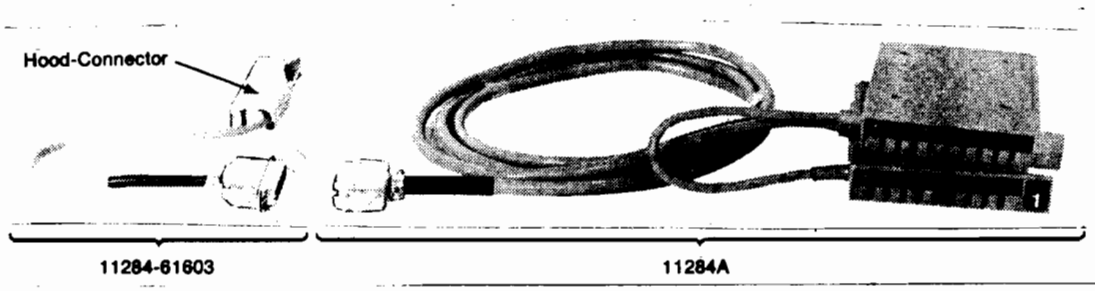


Figure 1-3. 11284A - Opt 040

Check the select-code setting of the Data Comm. interface cards if there is reason to believe that they have been changed (refer to the Data Comm. Operating and Service Manual). The select-code is set at the factory to 1.

> **NOTE**
> The hood-connectors have been keyed to prevent erroneous connection. Minimal pressure is required to make the connection.

5. Connect the interface cable (P/N 11284A - Opt 040) hood-connector to the printed-circuit card connector that has been appropriately notched to match the interface hood-connector. Connect the other end of the interface cable to the HP 9830A Calculator by installing the two I/O cards in any two of the Calculator I/O slots.

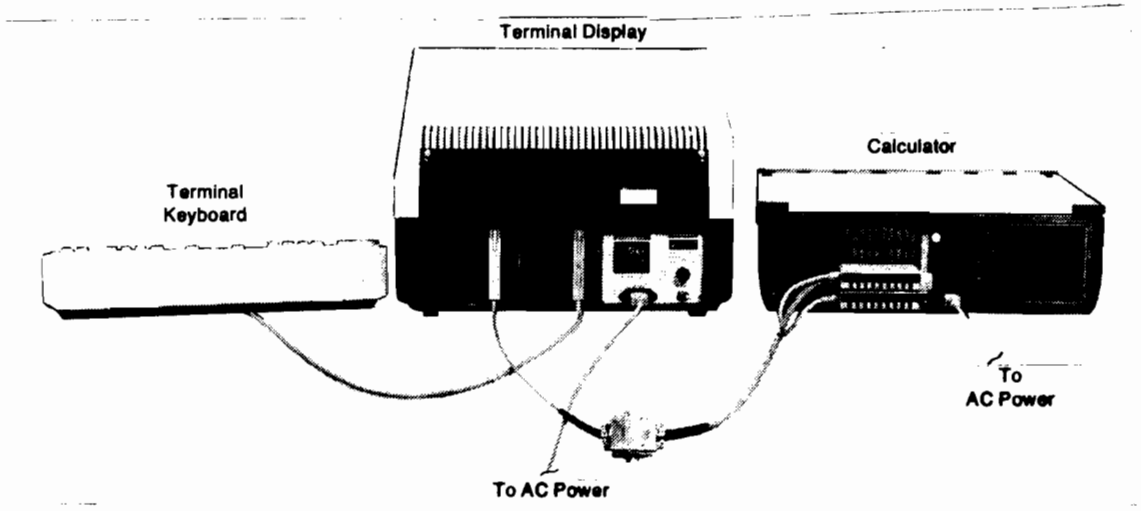


Figure 1-4. Connections to be made on the Back of the System

6. Install the Data Communication ROM 1 in any ROM slot of the HP 9830A Calculator as described in the Operating and Programming Manual. Also ensure that all other ROM's that are going to be used with the system are installed (e.g., Strings, Extended I/O).

7. Switch the AC power switch of the CRT to the OFF position (located on the mainframe rear panel). Connect the power cord to the AC power cord connector on the Terminal.
8. After ensuring that your available AC power voltage corresponds to the Terminal's voltage requirements (either 110V or 220V, see Power Requirements) plug the 3-prong power connector into your AC power source outlet.

> **NOTE**
> For safety reasons a 3-prong grounded power outlet must be used.

TURN-ON

After the HP 9830A Calculator and Terminal have been properly installed:

1. Ensure that the REMOTE latching key is not depressed (i.e., the Terminal is set for off-line operation).
2. Switch the AC power switches on the Calculator and the Terminal to the ON position. The AC power switch for the Terminal is located on the rear panel.

If a cassette is installed in the calculator tape transport, and the tape transport door is closed when the power is switched on the 9830A Calculator automatically executes: LOAD Ø, 1Ø, 1Ø — this feature is an automatic power failure recovery feature of the Data Comm. 1 ROM (refer to chapter 4 of the Data Communications Operating and Programming Manual). To inhibit this, make sure the tape transport is empty or press the STOP key.

PERFORMANCE VERIFICATION

Terminal Verification

To verify the operation of the Terminal press the TEST key on the Terminal. If the Terminal gives an audible beep and displays a test pattern then the Terminal is working properly. This is a self-test for the Terminal and, if necessary, can be done without the Terminal being connected to the Calculator. For more details refer to the Self-Test section in the 2640A Owner's Manual.

If the cursor does not appear or the Test function does not work properly, set the AC power switch to OFF and do not attempt to operate the CRT until the malfunction has been corrected by a qualified service representative. Refer to the back of this manual for your nearest service office.

Calculator and Data Comm. Verification

To verify the operation of the Calculator and the Data Comm. hardware refer to the Data Communications Operating and Service Manual, Chapter 7.

STRAPPING OPTIONS

The five 'Straps' are plug-in jumper-wires that, when installed or removed, alter the normal operating characteristics of the Terminal. Refer to the 2640A Owner's Manual for the definition of the straps.

The standard strapping configuration is to have all straps installed. If there is a question as to what straps are present, press the Test key. The six digit code, at the end of the test pattern, can be decoded to reveal the strapping configuration. The decoding information can be found in the Terminal Status section of the Owner's Manual.

NOTE

The six digit code is the same status code that a calculator would receive upon requesting the status information (ESC^) from the Terminal.

Chapter 2

9882A/9830A SYSTEM PROGRAMMING

INTRODUCTION

This chapter describes the programming necessary for system operation, by giving step-by-step procedures and example programs.

This chapter is divided into two sections:

1. Terminal 'off line' operations
2. Terminal 'on line' operations

The 'off line' (REMOTE key in the up position) section is intended to show the programmer or operator how forms, to be used for 'formatted data input', can be generated. The forms will be generated with the aid of the ENHANCE DISPLAY, UNPROTECTED FIELD and FORMAT MODE keys. The FORMAT MODE allows you to perform I/O operations on only those fields that have been previously unprotected.

The 'on line' (REMOTE key in the down position) section of this chapter will combine 'off line' operation with example programs that you can load into the Calculator, to build an operating system.

TERMINAL 'OFF LINE' OPERATIONS

Introduction

'Off line' operations are defined as 'operations that are performed on the Terminal with the REMOTE key in the up position.' This type of operation is generally used when generating forms or doing extensive editing. The Terminal does not have to be connected to the system when operating 'off line'.

In general, the function of the keys on the Terminal are described in the 2640A Owner's Manual. The following section of this chapter will further explain and give examples to demonstrate the function of the keys.

Key Groups

The keys of the Terminal are grouped into identifiable sections. These sections are shown in Figure 2-1. Each key, other than the ones listed below, can be simulated by a sequence of other keys of the CHARACTER SET GROUP. For example, pressing ESC E simulates the RESET TERMINAL key. These sequences enable remote devices to control the Terminal, as shown in the 'on line' section of this chapter. Refer to the back cover of the 2640A Owner's Manual for the control code sequences. The keys that cannot be simulated are:

1. BREAK
2. BLOCK MODE
3. REMOTE
4. CAPS LOCK
5. AUTO LF
6. ENTER

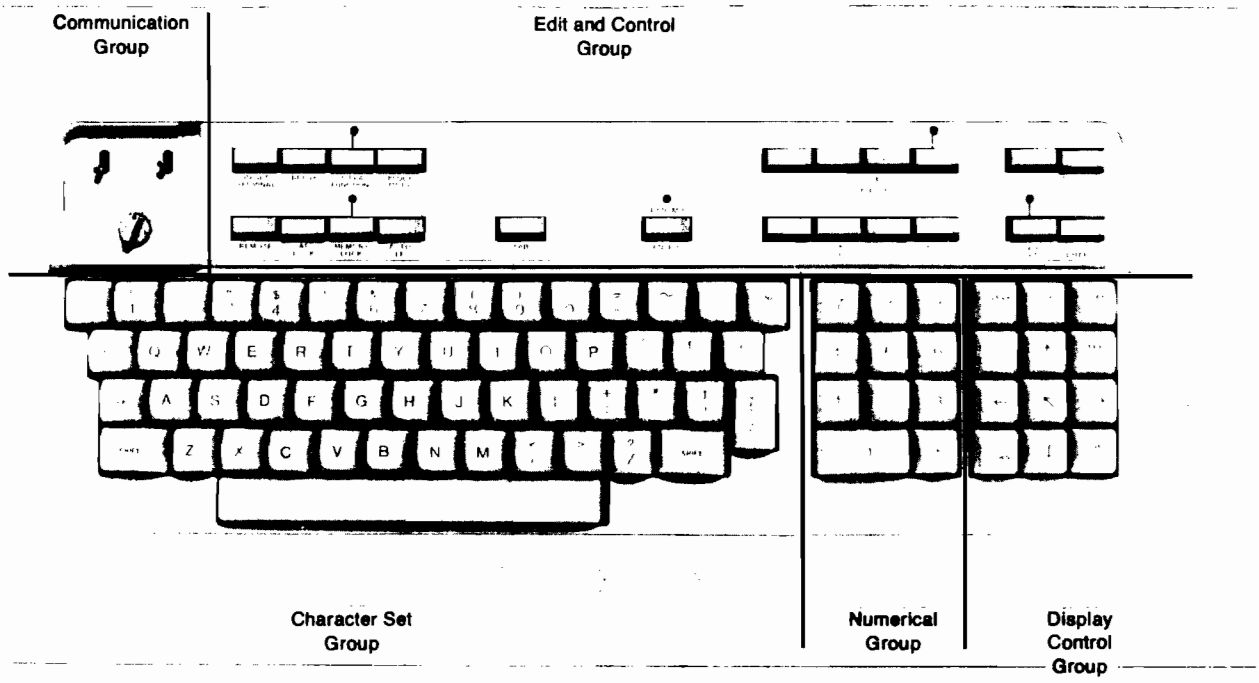


Figure 2-1. Terminal Key Groups

Communication Group

The Duplex, Parity and Baud switches make up the communication group. Once these switches are set to the proper position, they will not normally require changing. For most applications, the switches should be in the following positions:

Duplex - Half
Parity - None
Baud Rate - 1200

The DUPLEX switch should be left in the 'HALF' position.

The PARITY switch should always be left in the 'NONE' position, since the calculator does not check parity on input and this switch only refers to parity on output characters from the Terminal.

The BAUD RATE switch should be set to '1200', and the SYSTEM statement baud rate parameter should always agree with the setting of this switch. The slower baud rates can be used as a 'de-bugging' aid. The lower rates will slow down I/O operations, allowing you to watch (on the display) the I/O operations. The faster (2400) Baud Rate can be used, but with caution. The results of high speed operation are sometimes unpredictable, especially when non-displayed characters (e.g., ESC, ENHANCE) are transferred to the Terminal. Refer to the 'Operating at High Speed' section of the 2640A Owner's Manual.

Edit and Control Group

The Edit and Control Group of keys control the Terminal's Display and the I/O operations with the Calculator. Refer to the 2640A Owner's Manual for the definition of each key.

Display Control Group

This group of keys controls the display and the cursor position in the display. Refer to 2640A Owner's Manual.

Character Set and Numerical Groups

The Character Set and Numerical Groups are similar to the keys on a standard typewriter and adding machine. Refer to the 2640A Owner's Manual for explanation of the exceptions.

Data Input, Form Generation

A displayed form that can be filled in by an operator is a very effective means of simplifying data entry. The form will normally be generated by a programmer. The completed form may be simple or complex, but the procedure for generating the form will be the same.

The advantages of using a form for data input are:

1. Fields are provided with a given length and location, that prompt the operator for the correct input data.
2. In FORMAT MODE only the fields that have been unprotected can be changed or used for data input.

Example Form

For this example we will say that there is a need for a form that will allow an operator to input data to address envelopes. The data fields that will be needed are:

NAME:

STREET:

CITY: STATE: ZIP:

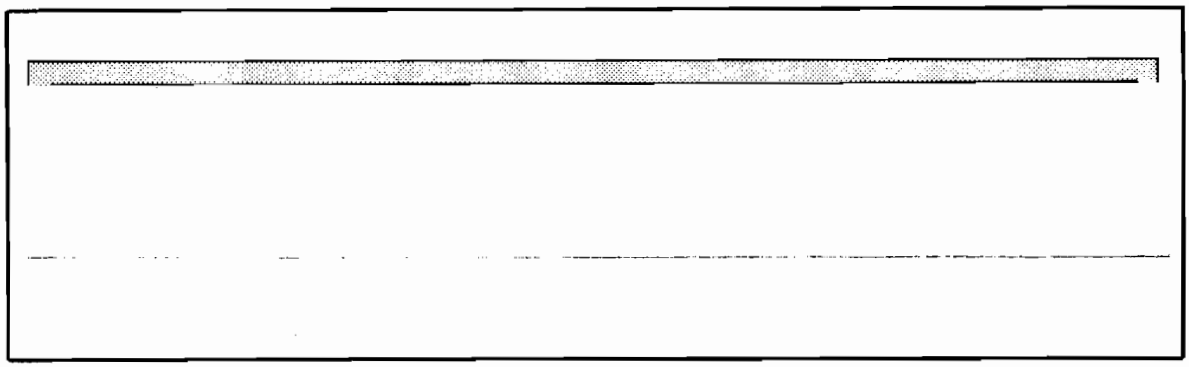
To generate this form the Terminal should be in the following configuration:

Key or Mode	Required Key Position
CHARACTER MODE	Block Mode Key up
OFF LINE	Remote key up
CAPS LOCK	Key down
AUTO LF	Key down
RESET TERMINAL	Pressed once

To generate the example form, press the following keys in the order shown. If a mistake is made press DELETE LINE and start the line over again. (NOTE: an INSERT LINE will also be required if you are correcting a line other than the last line of the display.)

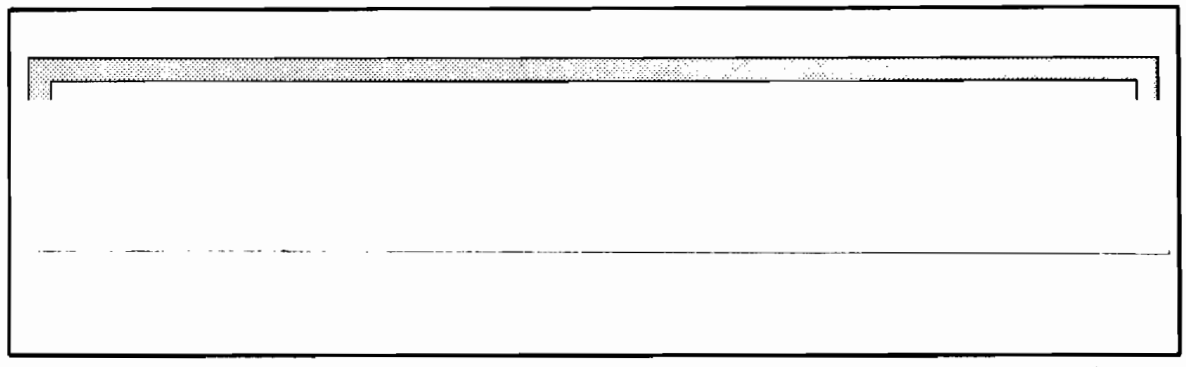
LINE NUMBER 1

1. ENHANCE DISPLAY
2. B (capital B, CAPS LOCK is in effect so shift is not required — ENHANCE DISPLAY B= Inverse video)
3. Space (80 spaces, to move cursor to right of display)



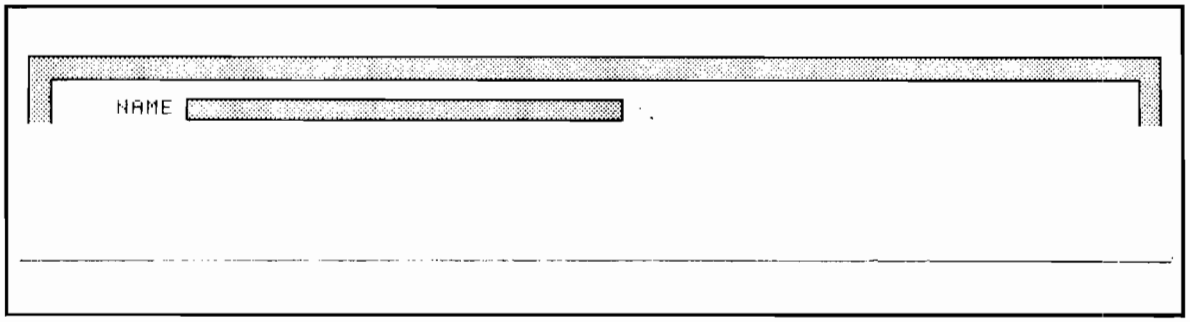
LINE NUMBER 2

1. ENHANCE DISPLAY
2. B
3. space (1)
4. ENHANCE DISPLAY
5. @ (ENHANCE DISPLAY @ = normal video)
6. space (78)
7. ENHANCE DISPLAY
8. B
9. space (1)



LINE NUMBER 3

1. ENHANCE DISPLAY
2. B
3. space (1)
4. ENHANCE DISPLAY
5. @
6. space (5)
7. type NAME
8. space (1)
9. ENHANCE DISPLAY
10. B
11. START (unprotect key)
12. space (30 times)
13. END (unprotect key)
14. ENHANCE DISPLAY
15. @
16. space (to last position on this line)
17. ENHANCE DISPLAY
18. B
19. space (1)

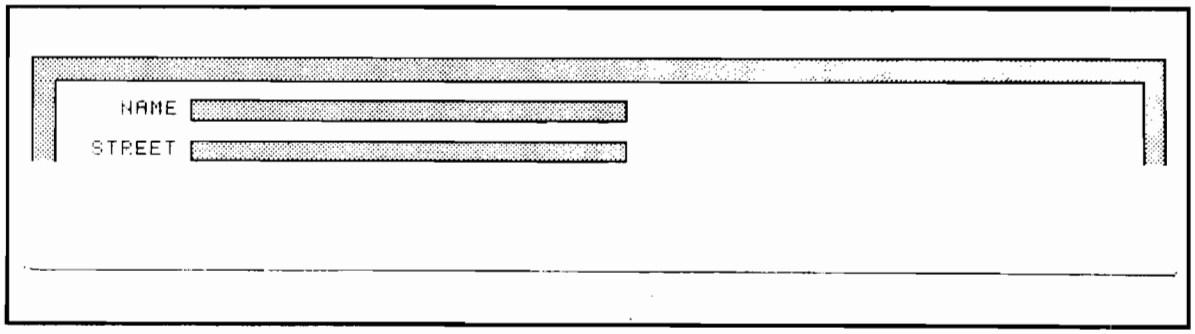


LINE NUMBER 4

Repeat Line Number 2.

LINE NUMBER 5

1. ENHANCE DISPLAY
2. B
3. space (1)
4. ENHANCE DISPLAY
5. @
6. space (3)
7. type STREET
8. space (1)
9. ENHANCE DISPLAY
10. B
11. START (unprotect key)
12. space (30)
13. END (unprotect key)
14. ENHANCE DISPLAY
15. @
16. space (to last position on this line)
17. ENHANCE DISPLAY
18. B
19. space (1)

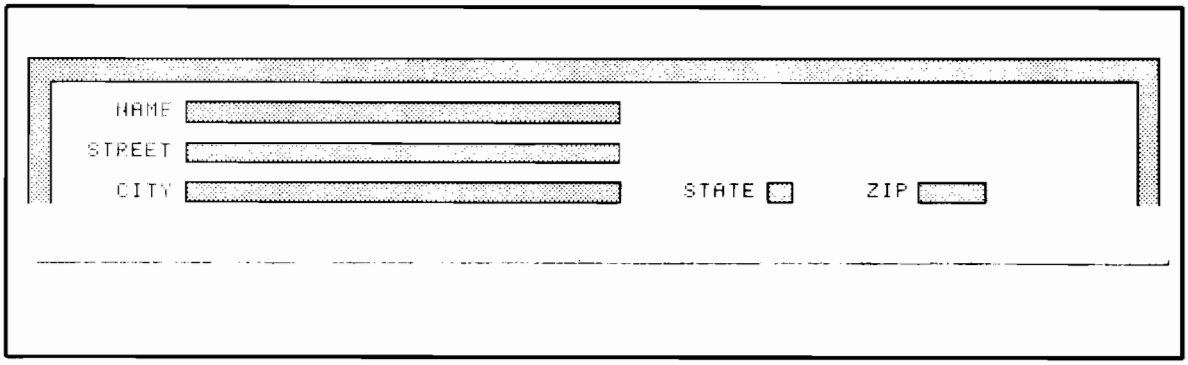


LINE NUMBER 6

Repeat Line Number 2.

LINE NUMBER 7

1. ENHANCE DISPLAY
2. B
3. space (1)
4. ENHANCE DISPLAY
5. @
6. space (5)
7. type CITY
8. space (1)
9. ENHANCE DISPLAY
10. B
11. START
12. space (30)
13. END
14. ENHANCE DISPLAY
15. @
16. space (5)
17. type STATE
18. space (1)
19. ENHANCE DISPLAY
20. B
21. START
22. space (2)
23. END
24. ENHANCE DISPLAY
25. @
26. space (5)
27. type ZIP
28. space (1)
29. ENHANCE DISPLAY
30. B
31. START
32. space (5)
33. END
34. ENHANCE DISPLAY
35. @
36. space (to last position of this line)
37. ENHANCE DISPLAY
38. B
29. space (1)



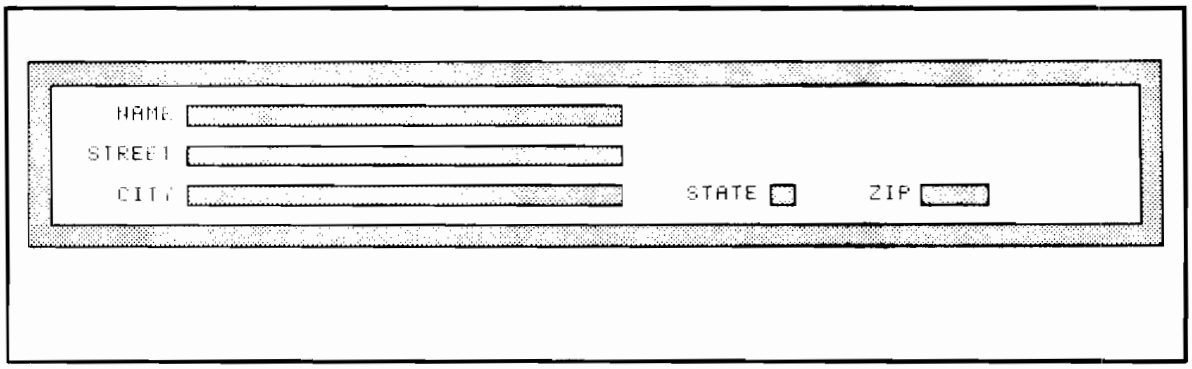
LINE NUMBER 8

Repeat Line Number 2

LINE NUMBER 9

Repeat Line Number 1

FINAL RESULT



In this example, all of the unprotected fields are shown in inverse video (ENHANCE DISPLAY B); this need not always be the case. Any portion of the Display can be unprotected.

Test the Resultant Form

1. Press FORMAT MODE, the indicator light should come on and the cursor should move to the first position in the NAME field.
2. Hold down the 'X' key, the cursor will fill the unprotected fields with X's.
3. If the cursor put X's in other than anticipated positions (unprotected fields), an error was made in generating the form. Refer to 'Correcting Mistakes made in the Form'.
4. If the cursor does not place X's in the anticipated positions an error was made in generating the form. Refer to 'Correcting Mistakes made in the Form.'
5. With the unprotected field filled with X's press the [↖] (home key) then press CLEAR DISPLAY (making sure the format indicator light is on), all fields should be cleared with the complete form remaining. If not, a mistake was made in generating the form. Refer to 'Correcting Mistakes made in the Form'.
6. With the FORMAT MODE 'ON' you should not be able to type characters in the display except in the unprotected fields.

If no mistakes were made in generating the form, it can now be used with the appropriate software to input data to the calculator (refer to 'Data Input, using the Form' in this chapter).

Correcting Mistakes made in the Form

If you have to correct a mistake, where the mistake involves control characters (i.e., non-displayed characters such as ESC, ENHANCE DISPLAY and START) the result may be unpredictable. This is because the order in which the non-displayed characters are stored in the display memory is critical. The order of the characters is easily upset when the INSERT and DELETE CHARACTER keys are used. To avoid this problem insert a new line (INSERT LINE key) immediately under the line containing the mistake, retype the line correctly, using the old line as a reference, and then delete the old line with the DELETE LINE key.

Storing the Form

If you wish, the example form can be stored on a cassette for later use. To do this:

1. Ensure that the Terminal is connected to the calculator as described in the Installation Procedure.
2. Press the REMOTE key to the down position.
3. Ensure that the format indicator light is off, if not press the FORMAT MODE key.
4. Load one of the example 'Transfer Display To or From a Data Array' programs (example 2 is recommended), from Chapter 3, into the calculator.
5. Follow the instructions given with the program.

Data Input, Using the Form

If you wish to see how the example form may be used to input data to the calculator:

1. Ensure that the REMOTE key is in the down position and the Terminal is connected to the calculator as described in the Installation Procedure.
2. Load one of the two example 'Transfer Display to Printer' programs (example 2 is recommended), from Chapter 3, into the calculator.
3. Ensure that the format indicator light is on, if not press the FORMAT MODE key.
4. Fill the unprotected fields on the example form with your own information.
5. Press: RUN, EXECUTE on the calculator.

The calculator will cause the 9866A Printer to print just the information in the unprotected fields.

TERMINAL 'ON LINE' OPERATION

Introduction

'On Line' System Operations are defined as 'Operations that are performed with the Terminal and 9830A Calculator operating as a system.' To operate the system ensure that the Terminal and 9830A Calculator are connected as described in the Installation Procedure, Chapter1.

> **NOTE**
> If the system does not include a 9866A Printer or an output peripheral set to select-code 15, a PRINT statment, TRACE, or PRINT ALL will halt the system operation.

The remainder of this section describes the statements used for communication between the Terminal and the 9830A Calculator. These statements are discussed in this manual only to the extent that they pertain to this system's operation. For more detailed information refer to the 9830A Operating and Programming Manual and to Chapter 4 of the Data Communications Manual.

While reading this material you will find it useful to define some of the calculator special function keys as typing aids or programs. You will probably be experimenting, so having statements, such as the SYSTEM statement, on a key will save you a great deal of time.

System Configuration

For most applications the following system configuration is recommended:

1. Data Comm. Interface select-code set to 1 (as set at the factory).
2. Strapping (all straps "in" as shipped from the factory).
   - Line strapped
   - Cursor End-of-line Wrap Around
   - Space Overwrite
   - Non-Function Key Transmission
   - Non-Alter Control Action Key
3. Character Mode Set (BLOCK MODE key up)
4. Auto Line Feed (key in down position)
5. Remote (key in down position)

Mode Control Statements

The Mode control statements are:

1. SYSTEM
2. EOT
3. RKEY
4. LKEY

These statements define and control the I/O operations of the Terminal/Calculator system.

The SYSTEM Statement

The SYSTEM statement sets up the communication link between the Terminal and the Calculator. This statement, with the proper parameters, must be executed before any transfer of information can take place. The SYSTEM statement can be a program line or a stand-alone statement, in either case it is not reset or changed unless you execute a new SYSTEM statement or switch the calculator and/or Terminal off, and then back on.

SYNTAX:

[line number] SYSTEM select-code, data transmission rate, bits per character, parity, transmission method, mode

EXAMPLE:

```
10 SYSTEM 1,1200,8,NONE,ASYL,FD
```

NOTE

The SYSTEM statement must be executed before ANY information can be transferred to the Terminal.

The EOT Statement

The EOT statement permits the 'end-of-transmission' character to be programmed to have any octal integer value between 0 and 377. If undefined, the EOT character defaults to octal 4.

For most applications, depending on the Terminal's mode (i.e., line or page mode) an EOT of 15 (CR) or 36 (RS) should be used.

SYNTAX:

[line number] EOT expression

Example:

```
30 EOT 15
```

RKEY and LKEY Statements

The RKEY and LKEY statements set the mode of the 9830A keyboard to be either 'locally and remotely' accessible (RKEY) or only 'locally' accessible (LKEY). For most applications, when operating the 9830A with the Terminal, the mode should be set to LKEY.

Syntax:

[line number] RKEY select-code

or

[line number] LKEY select-code

RKEY Example:

```
20 RKEY !
```

LKEY Example:

```
20 LKEY !
```

Calculator Input Operations

The two statements used to input information to the Calculator from the Terminal are:

1. TREAD
2. CMERGE

TREAD, allows you to input, to the calculator, ASCII characters in the form of data array elements or strings.

CMERGE is a command on the Binary Tape (see Table 1-1) which allows you input lines of programs, from the Terminal to the calculator.

The TREAD Statement

The TREAD statement allows the 9830A to receive data into a String or numeric array from the Terminal. Before this transfer of data can take place the calculator has to inform the Terminal, that a data transfer is going to take place. This is done with a TWRITE statement (see Calculator Output Operations) with the proper octal codes which depend on the 'line or page' strapping.

Syntax:

[line number] TREAD (select code, code type) variable

Example 1:

```
60 TREAD( 1,ASC)A$
```

Example 2:

```
60 TREAD( 1,ASC)D(20:125)
```

The following example program will TREAD and print on the 9866A Printer, one line from the Terminal Display.

Terminal configuration:

1. REMOTE
2. Line strapped
3. CHARACTER or BLOCK MODE

Additional ROMs and equipment required:

1. Strings ROM
2. 9866A Printer

```
10 SYSTEM 1,1200,3,NONE,ASY1,FD
20 DIM B$[255]
30 EOT 15
40 FORMAT B
50 TWRITE 1,ASC(33,144,21)
60 TREAD 1,ASC(LF)
70 FOR I=1 TO 241 STEP 80
80 IF LEN(B$)<I THEN 110
90 WRITE (15,40:B$[I,I+79])
100 NEXT I
110 IF LEN(B$)#0 THEN 130
120 PRINT
130 END
```

Line 50 - see Appendix A, ASCII Character Code Table, Octal Codes.

Lines 70 through 100 - a line of 80 displayed characters on the Terminal can have more than 80 characters in it (control characters), thus the need for the string length decoder.

The CMERGE Command

CMERGE is a command on a Binary Tape (see Table 1-1) which allows you to input to the calculator, lines of programming from the Terminal. CMERGE will 'MERGE' lines input from the Terminal with lines already in the calculator. This allows appending subroutines written on the Terminal to programs in Calculator memory. To replace programs in Calculator memory, execute SCRATCH before doing CMERGE. Do not execute SCRATCH A, this will scratch the CMERGE Binary Program.

If no errors are encountered as the program is input from the Terminal it will be ready to RUN when CMERGE is complete. Error messages on lines that are input will be logged on the printer, or other device on select-code 15, as they occur.

If no device is connected to select-code 15 or if the printer is out of paper, CMERGE will stop and hang up waiting to output the error message. Therefore, a logging device or select-code 15 is required to use CMERGE.

A SYSTEM statement must be executed before executing CMERGE.

Syntax:	Function:
CMERGE select-code	merge all lines on the Terminal display into the calculator
CMERGE select-code,expression	merge, starting at top of display, a given number of lines.
CMERGE select-code;	merge, starting at the present cursor line position to end of display.
CMERGE select-code;expression	merge, starting at the present cursor line position, a given number of lines.

NOTE
Blank lines are considered as lines when counting the number of lines for the CMERGE 'number of lines' expression.

Calculator Output Operations

The calculator output operations to the Terminal are very similar to the output operations to a Printer. Since the Data Comm. hardware can only be set to select-codes 1 through 9 (set at the factory to one) operations that require select-code 15, PRINT, PRINT ALL and TRACE, cannot be displayed by the Terminal.

NOTE
PRINT, PRINT ALL and TRACE will halt the operation of the Calculator if a select-code 15 peripheral is not connected to, and operating with, the calculator.

LIST, by itself, also specifies select-code 15, but this can be changed as indicated in the Operating and Programming Manual by adding "# select-code" to the syntax.

The Calculator output statements that can be used with the Terminal are:

1. LIST #
2. WRITE
3. TWRITE

The LIST# Statement

The LIST# statement allows you to list programs on the Terminal. These can be 'main line' or 'key' programs. The only things that cannot be listed in this way, are keys defined as "typing aids" or "immediate execute keys".

NOTE
A SYSTEM statement must be executed before using the LIST# command.

Syntax:
LIST# select code [, start line number [,stop line number]]

Example:

`LIST#1`	lists all program lines on Terminal
`LIST#1,30`	lists all program lines 30 and above on the Terminal
`LIST#1,30,100`	lists program lines 30 through 100 (inclusive)

To list a calculator special function key program on the Terminal:

1. Ensure that a SYSTEM statement has been executed.
2. Fetch the key.
3. Execute one of the three LIST# statements.

The display control keys (the 9 lower right keys on the Terminal keyboard) can now be used to view any part of the Terminal's display memory.

Applies not on HP262/A

If you want to list a program which is too long for the Terminal memory and you do not want to lose the first part of the display (to "write-over" when the display memory is filled) press the following keys, on the Terminal keyboard:

1. REST TERMINAL
2. MEMORY LOCK

Now you can list the program on the Terminal, as described above. When the Terminal display memory is exceeded, the Terminal beeps and the Memory Lock lamp blinks on and off. For more details about the Terminal Memory Lock refer to the 2640A Owner's Manual.

The WRITE Statement

The WRITE statement is used as described in the 9830A Operating and Programming Manual.

The WRITE statement allows you to output simple variables to the Terminal (the TWRITE statement will not do this).

The following is an example program using a WRITE statement with FORMAT to output simple variables to the Terminal Display.

```
10 SYSTEM 1,1200,8,NONE,ASY1,FD
20 LKEY 1
30 X=12
40 FORMAT "  X=",F6.1,10X,"X SQUARED =",F6.1
50 WRITE (1,40)X,X↑2
60 END
```

The Terminal displays:

```
X=   12.0          X SQUARED =  144.0
```

The following example program uses a WRITE statement to output a string variable to the Terminal Display:

```
10 SYSTEM 1,1200,8,NONE,ASY1,FD
20 DIM A$[80]
30 LKEY 1
40 A$="THIS IS AN EXAMPLE OF THE 'WRITE' STATEMENT"
50 WRITE (1,*)A$
60 END
```

The resultant Terminal Display is:

```
THIS IS AN EXAMPLE OF THE 'WRITE' STATEMENT
```

The following is an example of a Formated Binary WRITE statement. Note that the WRITE statement uses decimal codes (see Appendix A), whereas the TWRITE statement uses the octal equivalents.

```
10 SYSTEM 1,1200,8,NONE,ASY1,FD
20 LKEY 1
30 FORMAT 20B
40 WRITE (1,30)27,69,66,73,70,65,82,89,32,
50 WRITE (1,30)87,82,73,84,69,32,69,88,80,46
60 END
```

Terminal Display:

```
BINARY WRITE EXP.
```

The TWRITE Statement

The TWRITE statement allows information to be transferred to the Terminal from the Calculator. Unlike the WRITE statement the TWRITE **cannot** be used to output simple variables to the Terminal.

The TWRITE statement uses octal code in the syntax.

Syntax:
[LINE NUMBER] TWRITE (select-code, code type) list

Example:

```
60 TWRITE( 1,ASC)33,"H",A$,B$,
```

Refer to the Data Comm. manual for a definition of "list" in the syntax.

This program uses TWRITE to transfer a string, typed on the Calculator, to the Terminal.

```
10 SYSTEM 1,1200,8,NONE,ASY1,FD
20 DIM A$[80]
30 DISP "INPUT A$";
40 INPUT A$
50 TWRITE( 1,ASC)A$,15,
60 IF LEN(A$)>79 THEN 80
70 TWRITE( 1,ASC)12,
80 GOTO 30
90 END
```

Line 50 - Displays A$ on Terminal, give CR (oct 15)

Lines 60 and 70 - Check length of A$ and if it is >79 suppress line feed (oct 12), the Terminal will give CR/LF.

Terminal Display:

```
THIS WAS TYPED ON THE CALCULATOR AND DISPLAYED ON THE TERMINAL
```

The following is an example of a TWRITE statement being used to transfer octal codes, literals, and strings to the Terminal.

```
10 SYSTEM 1,1200,8,NONE,ASY1,FD
20 DIM A$[4]
30 A$="BOOK"
40 TWRITE( 1,ASC)33,"E","TEXT",A$,15,12,"HAND",A$,
50 END
```

Terminal Display:

```
TEXTBOOK
HANDBOOK
```

The code, 33, "E", in the TWRITE statement is the escape code-sequence (ESC,E) used to reset the Terminal. The 15 and 12 are octal codes that give the Terminal carriage-return/line-feed (CR/LF).

Transferring Array Data using TWRITE:

```
10 SYSTEM 1,1200,8,NONE,ASY1,FD
20 DIM A%[18]
30 A[1]=18766
40 A[2]=21573
50 A[3]=18245
60 A[4]=21024
70 A[5]=16722
80 A[6]=21057
90 A[7]=22816
100 A[8]=21586
110 A[9]=16718
120 A[10]=21318
130 A[11]=17746
140 A[12]=8277
150 A[13]=21321
160 A[14]=20039
170 A[15]=8276
180 A[16]=22354
190 A[17]=18772
200 A[18]=17677
210 TWRITE( 1,ASC)A[18],
220 END
```

Terminal Display:

```
INTEGER ARRAY TRANSFER USING TWRITE
```

Each of the elements of the integer array is made up of two octal codes representing two characters to be displayed on the Terminal.

A[1] = $18766_{10} = 44516_8 = 0100100101001110_2 =$

I			N		
1	1	1_8	1	1	6_8
01	001	001	01	001	110_2

therefore A[1] contains the first two letters of the word, "INTEGER". You can verify this by changing line 210 to:

```
210 TWRITE( 1,ASC)A[1],
```

End-of Line Wrap Around Strapping

The "End-of-Line Wrap Around" strapping of the Terminal will affect the operation of the WRITE or TWRITE statement that has 80 or more characters in it. The normal strapping is to have the "End-of-Line Wrap Around" in effect (i.e., the strap installed). What happens is the WRITE or TWRITE statement will give a CR/LF and so will the Terminal, thus resulting in a skipped line on the Terminal Display. Software can be used to prevent this problem (see lines 60 and 70 of the following example).

Example:

```
10 SYSTEM 1,1200,8,NONE,ASY1,FD
20 DIM A$[80]
30 FORMAT B
40 DISP "INPUT A$";
50 INPUT A$
60 WRITE (1,30)A$,13;
70 IF LEN(A$)>79 THEN 90
80 WRITE (1,30)10;
90 GOTO 40
100 END
```

Chapter 3

EXAMPLE PROGRAMS

In this chapter there are several example programs, which demonstrate some applications for the 9882A CRT Subsystem. The example programs are not intended to be a software package but they are usable and will be helpful in developing software for your system operations.

KEYBOARD AND STRAPPING CONFIGURATION

The normal Terminal keyboard strapping configuration used with the example programs in this section is:

Strapping:

1. Non-Function key Transmission (strap installed)
2. Space Overwrite (strap installed)
3. END-OF-LINE WRAP AROUND (strap installed)
4. LINE (strap installed)
5. Normal Control action (strap installed)

All straps are installed when shipped from the factory. Refer to STRAPPING OPTIONS in this manual and the 2640A Owner's Manual.

Terminal Keyboard:

1. DUPLEX - HALF
2. PARITY - NONE
3. BAUD RATE - 1200
4. DISPLAY FUNCTION - indicator light off
5. BLOCK MODE - up position
6. REMOTE - down position
7. CAPS LOCK - up position
8. MEMORY LOCK - indicator light off
9. AUTO LF - down position
10. INSERT CHARACTER - indicator light off

SYSTEM STATEMENT PROGRAM

This program is very simple, but it is very convenient to have a special function key on the 9830A Calculator defined with this program. When executed, this program will set-up the system's interface, with all the necessary communication parameters, and then RESET the Terminal.

```
10 SYSTEM 1,1200,8,NONE,ASY1,FD
20 LKEY 1
30 EOT 15
40 TWRITE( 1,ASC)33,"E",
50 END
```

TRANSFER ONE LINE TO B$

This program transfers one line, starting at the current cursor position, to B$. A maximum of 255 characters (displayed or control) can be transferred to B$. B$ is printed on the 9866A printer.

This program together with the next one (DISPLAY B$) can be used to duplicate lines on the Terminal Display, if more than one line of the same kind is needed.

```
10 SYSTEM 1,1200,8,NONE,ASY1,FD
20 DIM B$[255]
30 EOT 15
40 FORMAT B
50 TWRITE( 1,ASC)33,144,21,
60 TREAD( 1,ASC)B$
70 FOR I=1 TO 241 STEP 80
80 IF LEN(B$)<1 THEN 110
90 WRITE (15,40)B$[I,I+79]
100 NEXT I
110 IF LEN(B$)#0 THEN 130
120 PRINT
130 END
```

When B$ is printed by the 9866A Printer, some of the Terminal control characters can not be printed (e.g., ESC). The code for ENHANCE DISPLAY is "ESC & d", therefore only "& D" will be printed on the 9866A. If the length of B$, LEN (B$), is checked you will find that even though some control characters are not printed on the 9866A, they are contained in B$.

DISPLAY B$

This program transfers B$ to the Terminal's display. B$ has to be previously dimensioned and defined by another program.

```
10 SYSTEM 1,1200,8,NONE,ASY1,FD
20 TWRITE( 1,ASC)B$,
30 END
```

After you have used this program to copy B$ back onto the display, try using it as a 'de-bugging' aid where control codes (e.g., ESC) are used in the string.

1. use the previous program to get B$
2. press: 'DISPLAY FUNCTION' on the Terminal
3. execute the above program
4. press: 'DISPLAY FUNCTION' on the Terminal, again, to terminate this mode.

The result is that the Terminal displays all of the characters in B$, both normal and control characters.

TRANSFER DISPLAY TO PRINTER

Example 1

The Extended I/O ROM is not required for this program.

This program transfers all displayed lines (on the Terminal) to the 9866A Printer (printing all printable characters).

The Terminal's AUTO LF key must be in the down position.

```
10 SYSTEM 1,1200,8,NONE,ASY1,FD
20 DIM B$[255]
30 FORMAT 30B
40 EOT 15
50 TWRITE( 1,ASC)33,"H",
60 X=0
70 IF X>16 THEN 200
80 TWRITE( 1,ASC)33,144,21,
90 TREAD( 1,ASC)B$
100 IF LEN(B$)>0 THEN 120
110 PRINT
120 IF B$>" " THEN 150
130 X=X+1
140 GOTO 70
150 FOR I=1 TO 241 STEP 80
160 IF LEN(B$)<I THEN 60
170 WRITE (15,30)B$[I,I+79]
180 NEXT I
190 GOTO 60
200 DISP "END"
210 END
```

The advantage of this program over example 2 is:

- **the Extended I/O ROM is not required.**

The disadvantage is:

- **because of the programming technique used in line 120, the program will skip all displayed lines that have in the first position a control key (e.g., ESC) with an octal code of less than 40 (40 is the octal code for a space - refer to Appendix A).**

Example 2

The Extended I/O ROM is required for this program.

This program transfers all displayed lines (on the Terminal) to the 9866A Printer (printing all printable characters). The Extended I/O ROM is required for the OUTPUT statement in line 30.

The Terminal's AUTO LF key must be in the down position.

```
10 SYSTEM 1,1200,8,NONE,ASY1,FD
20 DIM B$[255],Z$[2]
30 OUTPUT (Z$,40)30;
40 FORMAT B
50 EOT 15
60 TWRITE( 1,ASC)33,"H",
70 TWRITE( 1,ASC)33,144,21,
80 TREAD( 1,ASC)B$
90 IF LEN(B$)>0 THEN 110
100 PRINT
110 IF B$=Z$ THEN 170
120 FOR I=1 TO 241 STEP 80
130 IF LEN(B$)<I THEN 70
140 WRITE (15,40)B$[I,79+I]
150 NEXT I
160 GOTO 70
170 DISP "END"
180 END
```

This is a better version of the 'Transfer Display to Printer' programs, because it does not have the limitation described about the previous program.

TRANSFER DISPLAY TO OR FROM A DATA ARRAY

Example 1

The Advanced Programming, Strings and Extended I/O ROMs are not required for this program.

This program will transfer a form or display to an integer data array without the need of the Advanced Programming, Strings and Extended I/O ROMs. The data array can be stored on a tape cassette and then re-displayed at a later time. The prerequisites for this type of programming are:

1. The Terminal must be 'page' strapped and in BLOCK MODE.
2. The integer array must be dimensioned large enough to store all the characters in the display (normal and control characters).
3. All lines in the display must be defined with at least one character; even the blank lines must contain at least one space character.
4. The length of the displayed lines must not be greater than 79 characters. The reason for this is that when the line is transferred to the Terminal, the Terminal will give a 'carriage return/line feed' (CR/LF) upon displaying the 80th character in addition to the CR/LF that is stored in the data array. This will cause a line to be skipped in the display.

```
10 SYSTEM 1,1200,8,NONE,ASY1,FD
20 DIM D[20,75]
30 LKEY 1
40 EOT 15
50 DISP "ENT. 0=STORE DATA , 1=DISP DATA ";
60 INPUT X
70 GOSUB X+1 OF 100,210
80 GOTO 50
90 REM-----------------DISP TO DATA ARRAY
100 EOT 36
110 TWRITE( 1,ASC)33,"H",
120 TWRITE( 1,ASC)33,144,21,
130 TREAD( 1,ASC)D[20,75]
140 EOT 15
150 DISP "ENT. STORAGE FILE NO. ";
160 INPUT X
170 IF X<1 THEN 190
180 STORE  DATA 4,D
190 RETURN
200 REM-----------------DATA ARRAY TO DISP
210 DISP "ENT, FILE NO. TO READ ";
220 INPUT X
230 IF X=-1 THEN 260
240 IF X<1 THEN 300
250 LOAD  DATA X,D
260 EOT 36
270 TWRITE( 1,ASC)D[20,75]
280 EOT 15
290 TWRITE( 1,ASC)33,"H",
300 RETURN
310 END
```

To operate this program:

1. **Load the program.**
2. **Press RUN EXECUTE**
   The calculator display will be:

   ```
   ENT. 0=STORE DATA , 1=DISP DATA
   ```

3. **Enter a 'Ø' in the calculator.**
   The Terminal will transfer the display to the data array.
4. **The calculator display will be:**

   ```
   ENT. STORAGE FILE NO.
   ```

5. **Enter the cassette file number (the file size must be 1500 words or greater) you wish to store the display data in. If you enter 'Ø' the operation will be canceled, but the data array will still contain the display data.**
6. **When the above operation is complete the calculator will display:**

   ```
   ENT. 0=STORE DATA , 1=DISP DATA
   ```

7. **Move the Terminal's cursor to the first position on a blank line below the previous display or press: RESET TERMINAL.**
8. **Enter '1' into the calculator.**

9. The calculator display will be:

```
ENT, FILE NO. TO READ
```

   If you stored the display on the cassette, enter the appropriate file number.

   If the display was not stored on a cassette, but is still in the calculator's memory, enter '−1'.

   If you wish to cancel the operation, enter 'Ø'.

10. If you entered '−1' or the appropriate cassette file number, the calculator will reproduce the previously stored form or information on the Terminal's display.

If lines are skipped when the display is reproduced, check the length of the line above the skipped line, its length must be 79 characters or less. A typed blank space, even at the end of a line counts as a character. The next example program will allow you to use all 80 positions on a line for characters.

In this example an integer array of 20 x 75 is used, enough to store a 3000 character display.

Because of the 'page' strapping and the uncertainty of the size of the necessary data array for a given display, this type of programming is not recommended. If the Advance Programming, Strings and Extended I/O ROMs are available, the recommended procedure then is to store Strings with the TRANSFER function into data arrays, as shown in the next example.

Example 2

The Advanced Programming, Strings and Extended I/O ROMs are required for this program.

This program will transfer a form or display (24 lines) to an integer data array. The data array can be stored on a tape cassette and then re-displayed at a later time. This program does not have the limitations of the previous program. You can have 80 displayed characters on a line and blank lines do not have to contain a blank space character.

The prerequisites for this program are:

1. The Terminal must be 'line' strapped.
2. The AUTO LF key must be in the down position.
3. BLOCK MODE is recommended.

```
10 SYSTEM 1,1200,8,NONE,ASY1,FD
20 DIM D$[255],Z$[2],DI[25,76]
30 OUTPUT (Z$[1,1],50)30;
40 OUTPUT (Z$[2,2],50)31;
50 FORMAT B
60 LKEY 1
70 EOT 15
80 DISP "ENT. Ø=STORE DATA , 1=DISP DATA ";
90 INPUT X
100 GOSUB X+1 OF 130,430
110 GOTO 80
```

```
120 REM--------------------DISP TO DATA ARRAY
130 D=0
140 TWRITE( 1,ASC)33,"H",
150 TWRITE( 1,ASC)33,144,21,
160 TREAD( 1,ASC)D$
170 IF D$=Z$[1,1] THEN 360
180 L=LEN(D$)
190 IF L<151 THEN 240
200 PRINT
210 PRINT "LINE "%D+1%"CONTAINS MORE THAN 150 CHARACTERS'
220 PRINT
230 GOTO 410
240 IF L>0 THEN 270
250 D$=" "
260 L=L+1
270 D$[L+1,L+1]=Z$[2,2]
280 D=D+1
290 TRANSFER D$ TO D[D,1]
300 IF D<24 THEN 150
310 BEEP
320 WAIT 200
330 BEEP
340 DISP "END OF MEMORY"
350 WAIT 1000
360 D[25,1]=D
370 DISP "ENT. STORAGE FILE NO. "%
380 INPUT X
390 IF X<1 THEN 410
400 STORE  DATA 4,D
410 RETURN
420 REM--------------------DATA ARRAY TO DISP
430 DISP "ENT, FILE NO. TO READ "%
440 INPUT X
450 IF X=-1 THEN 480
460 IF X<1 THEN 590
470 LOAD  DATA X,D
480 D=D[25,1]
490 IF D<1 THEN 590
500 FOR I=1 TO D
510 TRANSFER D[I,1] TO D$
520 L=POS(D$,Z$[2,2])
530 D$=D$[1,L-1]
540 TWRITE( 1,ASC)D$,15,
550 IF L>80 THEN 570
560 TWRITE( 1,ASC)12,
570 NEXT I
580 TWRITE( 1,ASC)33,"H",
590 RETURN
600 END
```

To operate this program:

1. Load the program.
2. Press: RUN, EXECUTE
   The calculator display will be:

```
ENT. 0=STORE DATA , 1=DISP DATA
```

3. Enter a 'Ø' in the calculator.
   The Terminal will transfer the display to the data array.
4. The calculator display will be:

```
ENT. STORAGE FILE NO.
```

5. Enter the cassette file number you wish to store the display data in. If you enter 'Ø' the operation will be canceled, but the data array will contain the display data.
6. When the above operation is complete the calculator will display:

```
ENT. 0=STORE DATA , 1=DISP DATA
```

7. Move the Terminal's cursor to the first position on a blank line below the previous display or press: RESET TERMINAL
8. Enter '1' into the calculator.
9. The calculator display will be:

```
ENT, FILE NO. TO READ
```

   If you stored the display on the cassette, enter the appropriate file number.

   If the display was not stored on a cassette, but is still in the calculator's memory, enter '−1'.

   If you wish to cancel the operation, enter 'Ø'.

10. If you entered '−1' or the appropriate cassette file number, the calculator will reproduce the previously stored form or information on the Terminal's display.

EXECUTIVE PROGRAM

Example 1

The following Executive Program can be used to build a complex program, enabling subroutine access from the Terminal's special function keys. If you wish, you can insert your own subroutines at the appropriate lines (the DISP statement with the subroutine number that you wish to use) in the Executive program. A REN statement (e.g., REN 50, 50) will open up the program to allow you to insert a greater number of subroutine lines.

After loading the program and pressing RUN, EXECUTE, the subroutines can be accessed by holding down the 'CNTL' key, and pressing the appropriate Terminal's special function key (f1 through f8). The subroutine will cause the calculator to display the subroutine number (e.g., SUBROUTINE NUMBER 2), assuming that you have not replaced the subroutines that are given in the example with subroutines of your own.

To use this program, the Terminal should be: 'line strapped' and in Character or Block Mode; or 'page strapped' and in Character Mode. Line Strapped and Block Mode are recommended for most applications.

The characters in Y$, line 70, are the 'escape' characters for the Terminal's special function keys. They must be keyed into the calculator in lower case. However the 9866A Printer will show them only in upper case.

```
10 REM          LINE STRAPPED - CHARACTER OR BLOCK MODE
20 REM                        OR
30 REM          PAGE STRAPPED - CHARACTER MODE
40 REM
50 SYSTEM 1,1200,8,NONE,ASY1,FD
60 DIM A$[255],Y$[10]
70 Y$="PQRSTUVW"
80 A$=""
90 LKEY 1
100 EOT 15
110 TWRITE( 1,ASC)7,
120 TWRITE( 1,ASC)33,142,21,
130 TREAD( 1,ASC)A$
140 TWRITE( 1,ASC)33,40,33,143,
150 IF LEN(A$)#1 THEN 170
160 IF A$<" " THEN 120
170 X=POS(Y$,A$[2,2])+1
180 GOSUB X OF 200,240,270,300,330,360,390,420,450
190 GOTO 80
200 DISP "SUBROUTINE FOR THE 'ENTER' KEY"
210 DISP A$
220 WAIT 1000
230 RETURN
240 DISP "SUBROUTINE NO.1'
250 WAIT 1000
260 RETURN
270 DISP "SUBROUTINE NO.2"
280 WAIT 1000
290 RETURN
300 DISP "SUBROUTINE NO.3"
310 WAIT 1000
320 RETURN
330 DISP "SUBROUTINE NO.4"
340 WAIT 1000
350 RETURN
360 DISP "SUBROUTINE NO.5"
370 WAIT 1000
380 RETURN
390 DISP "SUBROUTINE NO.6"
400 WAIT 1000
410 RETURN
420 DISP "SUBROUTINE NO.7"
430 WAIT 1000
440 RETURN
450 DISP "SUBROUTINE NO.8"
460 WAIT 1000
470 RETURN
480 END
```

NOTE: The letters in Y$ are shown as upper-case but are programmed in lower-case.

Example 2

The following Executive Program can be used like the previous one, except the Terminal must be 'page strapped' and in Block Mode.

```
10 REM---------- PAGE STRAPPED - BLOCK MODE
20 REM
30 SYSTEM 1,1200,8,NONE,ASY1,FD
40 DIM A$[255],Y$[8]
50 Y$="PQRSTUVW"
60 A$=""
70 LKEY 1
80 EOT 22
90 TWRITE( 1,ASC)7,33,142,21,
100 TREAD( 1,ASC)A$
110 TWRITE( 1,ASC)33,40,33,143,
120 EOT 36
130 TWRITE( 1,ASC)21,
140 TREAD( 1,ASC)A$
150 X=POS(Y$,A$[2,2])+1
160 GOSUB X OF 180,220,250,280,310,340,370,400,430
170 GOTO 60
180 DISP "SUBROUTINE FOR THE 'ENTER' KEY"
190 DISP A$
200 WAIT 1000
210 RETURN
220 DISP "SUBROUTINE NO.1".
230 WAIT 1000
240 RETURN
250 DISP "SUBROUTINE NO.2"
260 WAIT 1000
270 RETURN
280 DISP "SUBROUTINE NO.3"
290 WAIT 1000
300 RETURN
310 DISP "SUBROUTINE NO.4"
320 WAIT 1000
330 RETURN
340 DISP "SUBROUTINE NO.5"
350 WAIT 1000
360 RETURN
370 DISP "SUBROUTINE NO.6"
380 WAIT 1000
390 RETURN
400 DISP "SUBROUTINE NO.7"
410 WAIT 1000
420 RETURN
430 DISP "SUBROUTINE NO.8"
440 WAIT 1000
450 RETURN
460 END
```

NOTE: The letters in Y$ are shown in upper-case but are programmed in lower-case.

WORD PROCESSOR EXAMPLE PROGRAM

The following program demonstrates how the Executive Program can be used in conjunction with the system to develop a realistic application – in this case, a fairly simple Word-Processing System. To do this you substitute useful subroutines for the trivial subroutines in the original version of the Executive Program. A calculator with Opt. 276 (8k memory) is required to run this program.

The Extended I/O, Strings, and Advanced Programming ROMs are required for this example program.

The Terminal's configuration should be 'line strapped' and in BLOCK MODE when using this program.

As before, to access one of the subroutines, you hold the 'CNTL' key down while pressing the appropriate special function key on the Terminal.

Subroutine Number 1, Transfers all lines in the display to the 9866A Printer.

Subroutine Number 2, Transfers one line of the display to B$ in the Calculator, starting at the current cursor location. B$ is printed on the 9866A Printer.

Subroutine Number 3, Displays B$ on the Terminal starting at the current cursor location, ending with a CR/LF.

Subroutine Number 4, Displays B$ on the Terminal starting at the current cursor location, ending without a CR/LF

Subroutine Number 5, Stores a 100 line display in an integer data array and then asks for the cassette file number you wish to store the data in. If you enter 'ø' the STORE operation will be canceled. The cassette has to be previously marked with the appropriate length of files. This example requires a 4500 word file for data storage.

Subroutine Number 6, Will re-display, from a cassette data file, a previouly stored display. The Calculator will ask for the cassette file number of the stored data. If you enter 'ø' the operation will be canceled.

Subroutine Number 7, Not used

Subroutine Number 8, Transfers all lines in the display to an output printer, in this case, a printer set to select-code 9.

```
10 REM     LINE STRAPPED - CHARACTER OR BLOCK MODE
20 REM               OR
30 REM     PAGE STRAPPED - CHARACTER MODE
40 REM
50 SYSTEM 1,1200,8,NONE,ASY1,FD
60 DIM DI[101,41]
70 DIM A$[255],B$[255],D$[81],Y$[10],Z$[2]
80 OUTPUT (Z$[1,1],110)30;
90 OUTPUT (Z$[2,2],110)31;
100 D[101,1]=0
110 FORMAT B
120 Y$="PQRSTUVW"
130 A$=""
```

NOTE: The letters in Y$ are shown in upper-case but are programmed in lower-case.

```
140 LKEY 1
150 EOT 15
160 TWRITE( 1,ASC)7,
170 TWRITE( 1,ASC)33,142,21,
180 TREAD( 1,ASC)A$
190 TWRITE( 1,ASC)33,4A,33,143,
200 IF LEN(A$)#1 THEN 220
210 IF A$(" " THEN 170
220 X=POS(Y$,A$[2,2])+1
230 GOSUB X OF 260,300,440,550,580,610,910,1080,1120
240 GOTO 130
250 REM-------------SUBROUTINE FOR THE 'ENTER' KEY"
260 DISP A$
270 WAIT 1000
280 RETURN
290 REM----------F1--TRANSFER DISP TO 9866A
300 TWRITE( 1,ASC)33,"H",
310 TWRITE( 1,ASC)33,144,21,
320 TREAD( 1,ASC)B$
330 IF B$=Z$[1,1] THEN 410
340 IF LEN(B$)#0 THEN 360
350 PRINT
360 FOR I=1 TO 241 STEP 80
370 IF LEN(B$)<I THEN 410
380 WRITE (15,110)B$[I,79+I]
390 NEXT I
400 GOTO 410
410 PRINT
420 RETURN
430 REM----------F2--TRANSFER ONE LINE TO B$
440 FORMAT B
450 TWRITE( 1,ASC)33,144,21,
460 TREAD( 1,ASC)B$
470 FOR I=1 TO 241 STEP 80
480 IF LEN(B$)<I THEN 510
490 WRITE (15,440)B$[I,79+I]
500 NEXT I
510 IF LEN(B$)#0 THEN 530
520 PRINT
530 RETURN
540 REM----------F3--DISP B$ WITH CR/LF
550 TWRITE( 1,ASC)B$,15,12,
560 RETURN
570 REM----------F4--DISP B$ WITHOUT CR/LF
580 TWRITE( 1,ASC)B$,
590 RETURN
600 REM----------F5--TRANSFER DISP TO DATA ARRAY
610 D=0
620 TWRITE( 1,ASC)33,"H",
630 TWRITE( 1,ASC)33,144,21,
640 TREAD( 1,ASC)D$
650 IF D$=Z$[1,1] THEN 840
660 L=LEN(D$)
670 IF L<81 THEN 720
680 PRINT
690 PRINT "LINE ";D+1;"CONTAINS MORE THEN 80 CHARACTERS"
```

```
700 PRINT
710 GOTO 890
720 IF L>0 THEN 750
730 D$=" "
740 L=L+1
750 D$[L+1,L+1]=Z$[2,2]
760 D=D+1
770 TRANSFER D$ TO D[D,1]
780 IF D<100 THEN 630
790 BEEP
800 WAIT 200
810 BEEP
820 DISP " END OF MEMORY"
830 WAIT 1000
840 D[101,1]=D
850 DISP "ENT. STORAGE FILE NO. ";
860 INPUT X
870 IF X<1 THEN 890
880 STORE  DATA X,D
890 RETURN
900 REM---------F6--TRANSFER DATA ARRAY TO DISP
910 DISP "ENT. FILE NO. TO READ ";
920 INPUT X
930 IF X=-1 THEN 960
940 IF X<1 THEN 1060
950 LOAD  DATA X,D
960 D=D[101,1]
970 IF D<1 THEN 1060
980 FOR I=1 TO D
990 TRANSFER D[I,1] TO D$
1000 L=POS(D$,Z$[2,2])
1010 D$=D$[1,L-1]
1020 TWRITE( 1,ASC)D$,15,
1030 IF L-1>79 THEN 1050
1040 TWRITE( 1,ASC)12,
1050 NEXT I
1060 RETURN
1070 REM---------F7--NOT USED
1080 DISP "SUBROUTINE NO.7"
1090 WAIT 1000
1100 RETURN
1110 REM---------F8--TRANSFER DISP TO OUTPUT PRINTER
1120 TWRITE( 1,ASC)33,"H",
1130 TWRITE( 1,ASC)33,144,21,
1140 TREAD( 1,ASC)B$
1150 IF B$=Z$[1,1] THEN 1230
1160 IF LEN(B$)#0 THEN 1180
1170 WRITE (9,*)
1180 FOR I=1 TO 241 STEP 80
1190 IF LEN(B$)<I THEN 1130
1200 WRITE (9,110)B$[I,79+I]
1210 NEXT I
1220 GOTO 1130
1230 RETURN
1240 END
```

PLOT (SIN X)/X

The following program demonstrates how the Terminal can be used to display a plot. This example will plot (sin x)/x with the 'X - Y' axis, on the diplay.

Line 300 contains the function to be plotted; to change the plot, change the function.

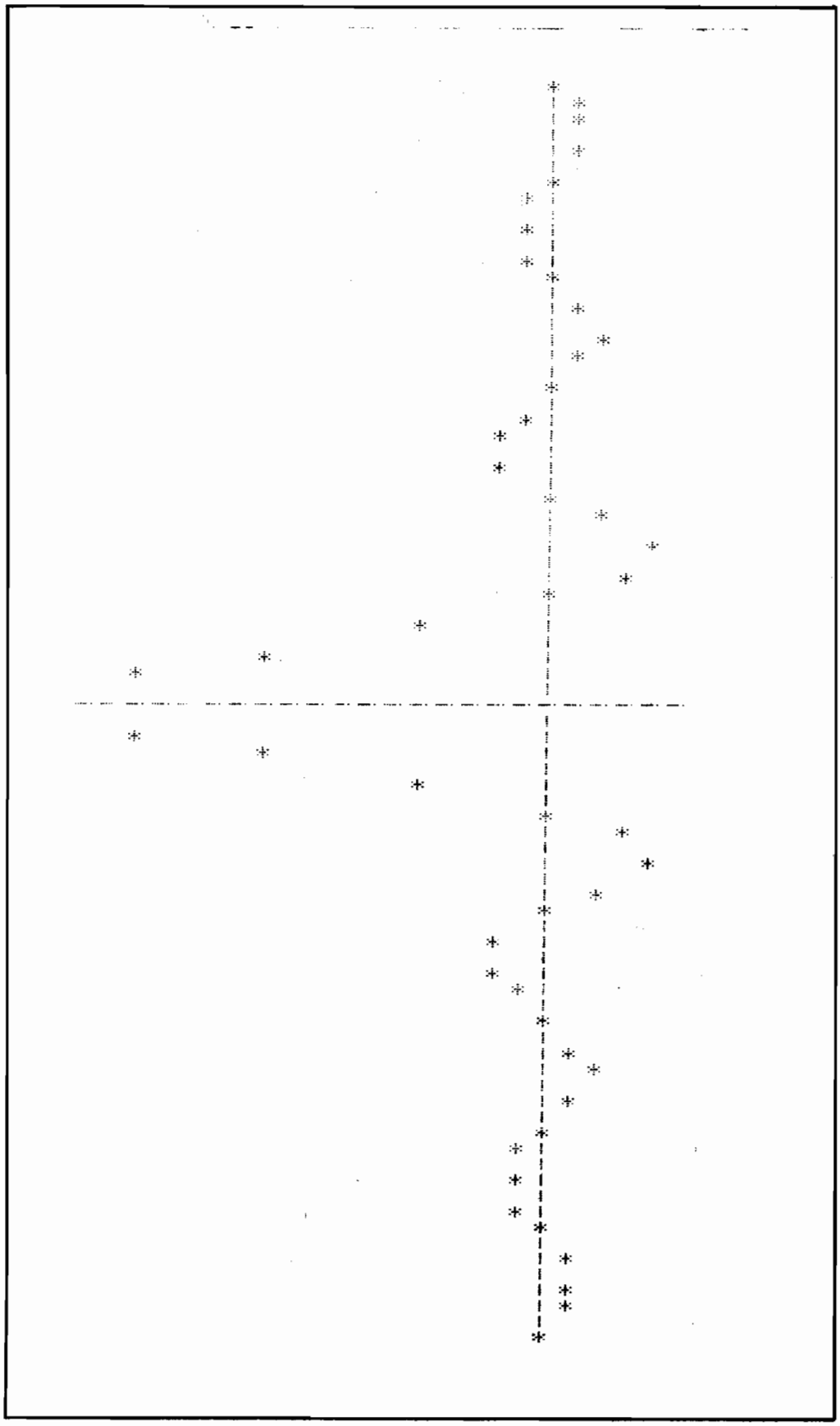
The parameters used in this example are:

X-MIN	−1080	Y-MIN	−.006	FROM	−1080
X-MAX	1080	Y-MAX	.018	TO	1080
Y-OFFSET	0	X-OFFSET	0	STEP	45

To run the program:

1. Load the program
2. Press RUN, EXECUTE
3. Enter the parameters as they are called for, three at a time (e.g., −1080, 1080, 0)

```
10 SYSTEM 1,1200,8,NONE,ASY1,FD
20 FORMAT 5B,F3.0,B
30 FORMAT 3B,F3.0,3B
40 FORMAT 3B,F3.0,B,F3.0,3B
50 DEG
60 REM-----------------------------------ENT PARAMETERS
70 DISP "ENT. X-MIN,X-MAX , Y-OFFSET";
80 INPUT X1,X2,X3
90 DISP "ENT. Y-MIN , Y-MAX , X-OFFSET ";
100 INPUT Y1,Y2,Y3
110 DISP "PLOT FROM, TO, STEP";
120 INPUT Z1,Z2,Z3
130 REM-----------------------------------DRAW AXIS
140 TWRITE( 1,ASC)33,"E",
150 X=Y3
160 Y=X3
170 GOSUB 370
180 WRITE (1,20)27,38,97,0,99,M,82;
190 FOR I=1 TO 80
200 TWRITE( 1,ASC)55,
210 NEXT I
220 WRITE (1,30)27,38,97,L,99,0,82;
230 FOR I=1 TO 23
240 TWRITE( 1,ASC)41,10,12,
250 NEXT I
260 TWRITE( 1,ASC)41,33,"H",
270 REM-----------------------------------PLOT
280 FOR X=Z1 TO Z2 STEP Z3
290 IF X=0 THEN 330
300 Y=(SINX)/X
310 GOSUB 370
320 WRITE (1,40)27,38,97,L,99,M,82,42,8;
330 NEXT X
340 TWRITE( 1,ASC)33,"H",
350 GOTO 60
360 REM-----------------------------------GET L,M
370 L=INT((X-X1)*80/(X2-X1)+0.5)
380 M=INT((Y-Y2)*24/(Y1-Y2)+0.5)
390 RETURN
400 END
```



Terminal's Display, Plot (Sin x)/x

STRIPCHART PLOT

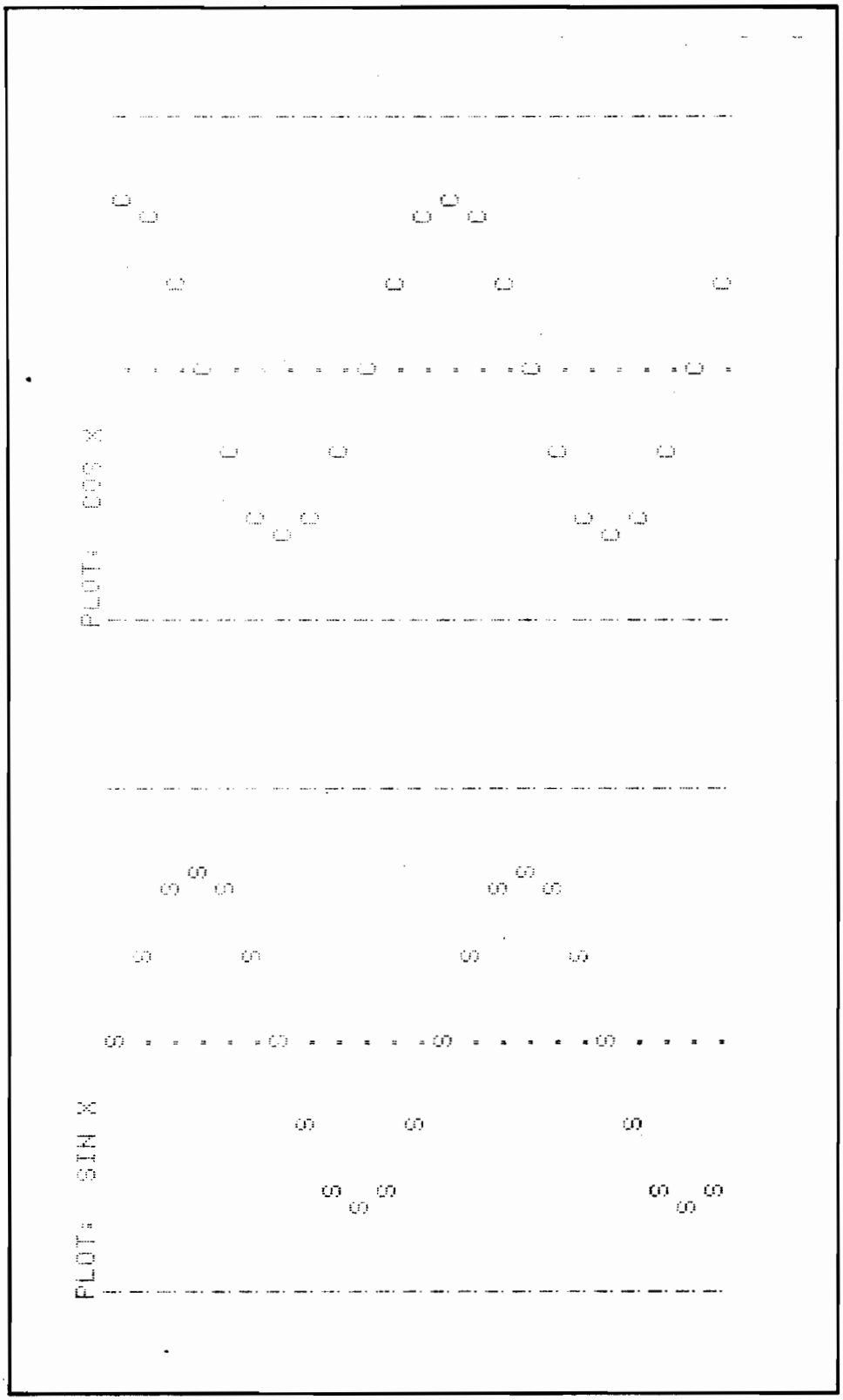
The following example program produces a 'stripchart' type plot, of 'sin x' and 'cos x'. To change the plot change lines 120 and 130 as necessary.

To run the program:

1. **Load the program**
2. **Press RUN, EXECUTE**

```
10 SYSTEM 1,1200,8,NONE,ASY1,FD
20 DIM A$[80]
30 DEG
40 REM-----------------------------------------LABEL
50 TWRITE[ 1,ASC]33,"E","PLOT:  SIN X",
60 TWRITE[ 1,ASC]33,46,141,60,64,60,143,60,60,60,122,
70 TWRITE[ 1,ASC]"PLOT:  COS X",15,12,33,154,
80 REM-----------------------------------CALCULATE
90 I=0
100 GOTO !20
110 I=I+30
120 X=SIN I
130 Y=COS I
140 REM-----------------------------------X,Y
150 X=(X+1.5)*10+1
160 Y=(Y+1.5)*10+41
170 A$=""
180 A$[1,40]="!ΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔ.ΔΔΔΔΔΔΔΔΔΔΔΔΔΔ!"
190 A$[41,80]="!ΔΔΔΔΔΔΔΔΔΔΔΔΔΔΔ.ΔΔΔΔΔΔΔΔΔΔΔΔΔΔ!"
200 A$[X,X]="S"
210 A$[Y,Y]="C"
220 REM-----------------------------------PLOT
230 TWRITE[ 1,ASC]A$
240 GOTO 110
250 END
```

Δ= one blank space



Terminal's Display, Stripchart Plot

APPENDIX A

ASCII CHARACTER CODE TABLE

The following table gives the ASCII characters and their Binary, Octal and Decimal codes. This table will be very useful when converting codes for the WRITE and TWRITE statements.

ASCII CODE TABLE

BINARY CODE	OCTAL CODE	ASCII CHARACTER	DECIMAL CODE
00 000 000	000	NU	0
00 000 001	001	SH	1
00 000 010	002	SX	2
00 000 011	003	EX	3
00 000 100	004	ET	4
00 000 101	005	EQ	5
00 000 110	006	AK	6
00 000 111	007	BELL	7
00 001 000	010	BS	8
00 001 001	011	HT	9
00 001 010	012	LF	10
00 001 011	013	VT	11
00 001 100	014	FF	12
00 001 101	015	CR	13
00 001 110	016	SO	14
00 001 111	017	SI	15
00 010 000	020	DL	16
00 010 001	021	D1	17
00 010 010	022	D2	18
00 010 011	023	D3	19
00 010 100	024	D4	20
00 010 101	025	NK	21
00 010 110	026	SY	22
00 010 111	027	EB	23

BINARY CODE	OCTAL CODE	ASCII CHARACTER	DECIMAL CODE
00 011 000	030	CN	24
00 011 001	031	EM	25
00 011 010	032	SB	26
00 011 011	033	EC	27
00 011 100	034	FS	28
00 011 101	035	GS	29
00 011 110	036	RS	30
00 011 111	037	US	31
00 100 000	040	space	32
00 100 001	041	!	33
00 100 010	042	"	34
00 100 011	043	#	35
00 100 100	044	$	36
00 100 101	045	%	37
00 100 110	046	&	38
00 100 111	047	' (apostrophe)	39
00 101 000	050	(	40
00 101 001	051	)	41
00 101 010	052	*	42
00 101 011	053	+	43
00 101 100	054	, (comma)	44
00 101 101	055	– (hyphen)	45
00 101 110	056	. (period)	46
00 101 111	057	/	47

BINARY CODE	OCTAL CODE	ASCII CHARACTER	DECIMAL CODE
00 110 000	060	0	48
00 110 001	061	1	49
00 110 010	062	2	50
00 110 011	063	3	51
00 110 100	064	4	52
00 110 101	065	5	53
00 110 110	066	6	54
00 110 111	067	7	55
00 111 000	070	8	56
00 111 001	071	9	57
00 111 010	072	:	58
00 111 011	073	;	59
00 111 100	074	<	60
00 111 101	075	=	61
00 111 110	076	>	62
00 111 111	077	?	63
01 000 000	100	@	64
01 000 001	101	A	65
01 000 010	102	B	66
01 000 011	103	C	67
01 000 100	104	D	68
01 000 101	105	E	69
01 000 110	106	F	70
01 000 111	107	G	71

BINARY CODE	OCTAL CODE	ASCII CHARACTER	DECIMAL CODE
01 001 000	110	H	72
01 001 001	111	I	73
01 001 010	112	J	74
01 001 011	113	K	75
01 001 100	114	L	76
01 001 101	115	M	77
01 001 110	116	N	78
01 001 111	117	O	79
01 010 000	120	P	80
01 010 001	121	Q	81
01 010 010	122	R	82
01 010 011	123	S	83
01 010 100	124	T	84
01 010 101	125	U	85
01 010 110	126	V	86
01 010 111	127	W	87
01 011 000	130	X	88
01 011 001	131	Y	89
01 011 010	132	Z	90
01 011 011	133	[	91
01 011 100	134	\	92
01 011 101	135	]	93
01 011 110	136	^	94
01 011 111	137	— (underscore)	95

BINARY CODE	OCTAL CODE	ASCII CHARACTER	DECIMAL CODE
01 100 000	140	`	96
01 100 001	141	a	97
01 100 010	142	b	98
01 100 011	143	c	99
01 100 100	144	d	100
01 100 101	145	e	101
01 100 110	146	f	102
01 100 111	147	g	103
01 101 000	150	h	104
01 101 001	151	i	105
01 101 010	152	j	106
01 101 011	153	k	107
01 101 100	154	l	108
01 101 101	155	m	109
01 101 110	156	n	110
01 101 111	157	o	111
01 110 000	160	p	112
01 110 001	161	q	113
01 110 010	162	r	114
01 110 011	163	s	115
01 110 100	164	t	116
01 110 101	165	u	117
01 110 110	166	v	118
01 110 111	167	w	119

BINARY CODE	OCTAL CODE	ASCII CHARACTER	DECIMAL CODE
01 111 000	170	x	120
01 111 001	171	y	121
01 111 010	172	z	122
01 111 011	173	{	123
01 111 100	174	¦	124
01 111 101	175	}	125
01 111 110	176	~	126
01 111 111	177	DEL	127

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