ELECTRICAL ENGINEERING I PROGRAM

Electrical Engineering I

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Radio Shack®

TRS-80

POCKET COMPUTER SOFTWARE

INSTRUCTION MANUAL

Electrical Engineering I

Radio Shack®
A DIVISION OF TANDY CORPORATION
FORT WORTH, TEXAS 76102

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Introduction

The Pocket Computer Electrical Engineering I package consists of six programs that cover seventeen functions. A brief description of each program function is given below.

1. Complex Calculator (COMPLEX is the name on the tape)
   A reverse polish notation calculator which operates on complex numbers.

Complex Impedance Calculator for a Passive Circuit (IMPCALC is the name on the tape)

2. Complex Impedance Calculator computes the effective complex impedance of a network.

3. Capacitive Reactance Calculator computes the reactance of a capacitor at a given frequency.

4. Inductive Reactance Calculator computes the reactance of an inductor at a given frequency.

Low Frequency Transistor Amplifier Design (AMPDES is the name on the tape)

5. Transistor Biasing computes the bias resistors required for a low frequency transistor amplifier.

6. Heat Sink Calculations computes the heat sink required for a transistor amplifier.

7. Linear Equation Solutions (SIMEQ is the name on the tape)
   Solves a set of linear equations with up to eight unknowns.

Filters (FILTERS is the name on the tape)

8. m Derived Lowpass computes the component values required for an m derived low pass filter.

9. m Derived Hipass computes the component values required for an m derived high pass filter.

10. Active Lowpass Filter computes the component values required for an active low pass filter.

11. Active Hipass Filter computes component values required for an active high pass filter.

12. Active Band Pass Filter computes component values required for an active band pass filter.

Engineering Tables (TABLES is the name on the tape)

13. AWG to R/FT computes the resistance per foot for a given wire gauge.

14. Current to Wire Size computes the minimum wire size required for a given current.

15. Resistance Color Code to Value converts the color bands on a resistor to a resistance value.

16. Capacitor Color Code to Value converts the color dots of a five dot 1957 RETMA capacitor to a capacitance value.

17. RF Coil Design computes the number of turns required for an RF coil on an air core.

Using the EEI Programs

Load the programs using the [C][L][O][A][D] command, specifying the name of the particular program you want. The program names are shown along with the program descriptions at the beginning of this manual.

All of the EEI programs operate with the computer in the DEF mode.

As with all computers, very large positive or negative values may be subject to slight rounding or truncation errors. Some operations tend to magnify these errors; however, in most cases these errors will be negligible.

Using the Printer and Pocket Computer Interface

The programs in the Electrical Engineering I package were not designed to require the use of the printer and Pocket Computer Interface. However, if you use a printer with the programs, they will operate substantially the same with the following exceptions:

1. The menu will be printed when the [SHFT] [SPC] function is selected.

2. Input data to the various menu selections will only be displayed on the LCD.

3. All results from program calculations will be printed.

4. When the printer is logically connected to the Pocket Computer, it is no longer necessary to press Enter to view each menu selection or successive results from program calculations.

Complex Calculator (COMPLEX)

The Complex Calculator uses reverse polish notation for input. Reverse polish notation refers to the entering of a quantity or quantities followed by the operation to be performed. This technique removes the need for parentheses.

Your TRS-80 Pocket Computer keyboard is used in a manner similar to a calculator. Figure 1 shows the relationship between the keys and the complex functions.

A plastic keyboard overlay is included in the EEI package to serve as a guide when using the Complex Calculator. Figure 1 shows the relationship between the normal key labels and the key labels as they appear on the overlay. Under Function, you will see the overlay key functions; under Key Used, the normal key functions are shown.

Figure 1 — The Overlay

Function	+	—	*	/	R➡P	P➡R	SIN	COS	TAN	LN
Key Used	A	S	D	F	G	H	J	K	L	=

Function	e^x	ASN	ACS	ATN	Log X Base Y	X^Y	1/X	Input	
Key Used	Z	X	C	V	B	N	M	SPC	ENTER

The Input key ([SHFT][SPC]) has several subfunctions associated with it. Refer to Figure 2 (on page 10), for the subfunctions of the Input key.

To load the Complex Calculator, type [C][L][O][A][D]["][C][O][M][P][L][E][X]["] and press [ENTER]. After the program is loaded, the prompt sign, (>) will appear. Press [I] [SHFT][SPC] and the computer will display the copyright notice, initialize the calculator, and display R=. It will then wait for the real part of the first number.

Type the number and press [ENTER]. The computer will display I= and will wait for you to enter the imaginary part of the number.

Type the number and press [ENTER]. The computer will again display R= and wait for either a number or a function request.

After the results of a function request are displayed, pressing [ENTER] will cause R= to be displayed. The results are displayed with the real part of the answer on the left and the imaginary part on the right.

Figure 2 — One of these characters entered as the first character of the line will activate the corresponding function.

[I] — Initialize the Complex Calculator. This command will display the copyright notice and clear all entries from the stack. This should be done between problems. If this is not done, stack underflow or overflow may occur, and erroneous values could appear.

[C] — Copy the top of the stack into the next level. This command will copy the last number (either entered or computed) into the next position in the stack. A stack overflow will result if too many entries are inserted on the stack. One possible use of this command is to copy a number in order to square it.

[P] — Remove and display the top of the stack. This command will remove the last entered or computed value from the stack and display it. If you remove an entry by mistake, it can be replaced by pressing [ENTER]. If more items are removed than were put on the stack, underflow will result. A possible use of this command is to remove an incorrect value from the stack.

If the error message INVALID, RE-ENTER appears, re-enter the desired function.

Example Problem
Add: 3+j2 to 4+j9

The display will show:	You type:
>	[I] [SHFT] [SPC] (clear stack)
R=	[3] [ENTER]
I=	[2] [ENTER]
R=	[4] [ENTER]
I=	[9] [ENTER]
R=	[SHFT] [A] (plus)
7 11	[ENTER]
R=	

At this point, multiply the last result by 5 +j3.

The display will show:	You type:
R=	[5] [ENTER]
I=	[3] [ENTER]
R=	[SHFT] [D] (times)
2 76	[ENTER]

The display will show:	You type:
R=	

Divide the last result by 3 – j6.

The display will show:	You type:
R=	[3] [ENTER]
I=	[ ] [6] [ENTER]
R=	[SHFT] [F] (divide)
–10 5.333333333	[ENTER]
R=	

Subtract –8 + j.333333333 from the last result.

The display will show:	You type:
R=	[ ] [8] [ENTER]
I=	[.] [3] [3] [3] [3] [3] [3] [3] [3] [3] [ENTER]
R=	[SHFT] [S] (minus)
–2 5	

Find sin (2 + j3) + cos (2 + j3).

The display will show:	You type:
>	[I] [SHFT] [SPC] (clear stack)
R=	[2] [ENTER]
I=	[3] [ENTER]
R=	[SHFT] [K] (cosine)
–4.189625689 –9.109227887	[C] [SHFT] [SPC] (copy stack)
R=	[SHFT] [D] (times)
–65.42506928 76.32851032	[ENTER]
R=	[2] [ENTER]
I=	[3] [ENTER]
R=	[SHFT] [J] (sine)
9.154499141 –4.168906958	[C] [SHFT] [SPC] (copy stack)
R=	[SHFT] [D] (times)

The display will show:	You type:
66.4250693 −76.32851033 1.00000002 −0.00000001	[SHFT] [A] (plus)

Find ln (2 + j3)

The display will show:	You type:
>	[I] [SHFT] [SPC] (clear stack)
R=	[2] [ENTER]
I=	[3] [ENTER]
R=	[SHFT] [=] (find LN)

1.282474679 9.82793E−01

Find tan (−.0029707247),j 1.013601147)

The display will show:	You type:
>	[I] [SHFT] [SPC]
R=	[−] [.] [0] [0] [2] [9] [7] [0] [7] [2] [4] [7] [ENTER]
I=	[1] [.] [0] [1] [3] [6] [0] [1] [1] [4] [7] [ENTER]
R=	[SHFT] [V] (ATN)
1.67757871 2.487113237 3.00000043 9.77384E−01	[SHFT] [G] (R P)

This result is the magnitude/phase angle (in radians).

The magnitude is the real part of the display shown on the left.

Converting Phase Angle to Degrees

The imaginary part is the phase angle, in radians, stored in B. The phase angle is B*180/π. You type [B] [*] [1] [8] [0] [/] [π] and press [ENTER]. The result, 55.99999996, will be displayed.

The magnitude and phase angle (in degrees), 3∡56°, can then be written.

Complex Impedance Calculator for a Passive Circuit (IMPCALC)

To load the Complex Impedance Calculator, type [C][L][O][A][D]["][I][M][P][C][A][L][C]["] and press [ENTER]. After the program has loaded, the prompt sign (>) will appear. Press [SHFT] [SPC] and the computer will display the program name, CMPLX Z CALCULATOR.

Pressing [SHFT] [SPC] also clears the data memories to zero and is necessary between functions. After the program name has been displayed, pressing [ENTER] will briefly display the copyright notice, followed by the name of the first function in the program. The name of additional functions will display each time you press [ENTER]. Press [SHFT] [SPC] to repeat the menu.

Complex Impedance Calculator

The Complex Impedance Calculator is used to compute the effective complex impedance of a network. There are eight subfunctions which are part of the Complex Impedance Calculator. These subfunctions are:

[SHFT] [A] — Initialize for computing a parallel impedance.

[SHFT] [S] — End a set of parallel impedances and add the effective impedance to the current computed impedance.

[SHFT] [Z] — Add a series impedance to the current computed impedance.

[SHFT] [D] — Use the currently computed impedance and prepare to combine it in parallel with other impedances.

[SHFT] [V] — Display the current impedance in magnitude and phase. The phase is in radians.

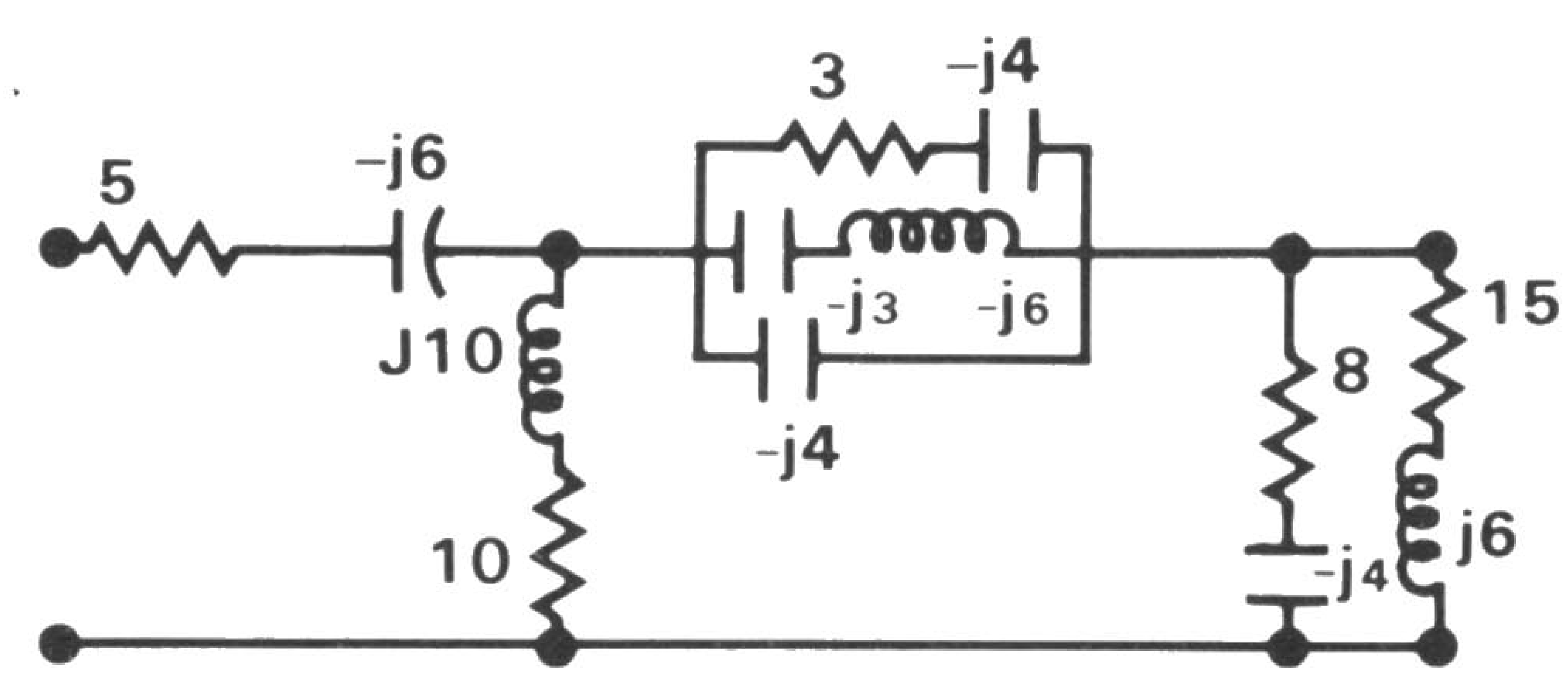
[SHFT] [F] — Display the current impedance in magnitude and phase. The phase is in degrees.

[SHFT] [B] — Display both the current impedance's real and imaginary parts.

[SHFT] [G] — Re-enter the parallel computation after finding a capacitive inductive reactance.

Computation of the impedance is started in the most distant branch of the circuit from the input. When a complex impedance is displayed, the real part is on the left and the imaginary part is on the right.

Example Problem
Compute the impedance of the following circuit:



The display will show:	You type:
>	[SHFT] [SPC] (to clear the calculator)
CMPLX Z CALCULATOR	[SHFT] [A]
R =	[1] [5] [ENTER]
I =	[6] [ENTER]
R =	[8] [ENTER]
I =	[–] [4] [ENTER]
R =	[SHFT] [S]
6.168855534 –1.05816135	[SHFT] [A]
R =	[3] [ENTER]
I =	[–] [4] [ENTER]
R =	[Ø] [ENTER]
I =	[3] [ENTER]
R =	[Ø] [ENTER]
I =	[–] [4] [ENTER]
R =	[SHFT] [S]

The display will show:	You type:
12.08666375 –4.838983269	[SHFT] [D]
R =	[1] [Ø] [ENTER]
I =	[1] [Ø] [ENTER]
R =	[SHFT] [S]
7.993605431 1.413598439	[SHFT] [Z]
R =	[5] [ENTER]
I =	[–] [6] [ENTER]
12.99360543 –4.586401561	[SHFT] [F]
13.77929103· –19.44169412	[SHFT] [V]
13.77929103 –3.39321 E–01	[SHFT] [B]
12.99360543 –4.586401561	

Capacitive Reactance ([SHFT] [C])

This program computes the reactance of a capacitor at a given frequency, leaving the value in the variable Z.

Press [SHFT] [C]. For F =, type the entry in Hz and press [ENTER]. For C =, type the entry in uf and press [ENTER]. The solution will be displayed in ohms.

Example Problem
Find the capacitive reactance of a .047 uf capacitor at 10000 Hz.

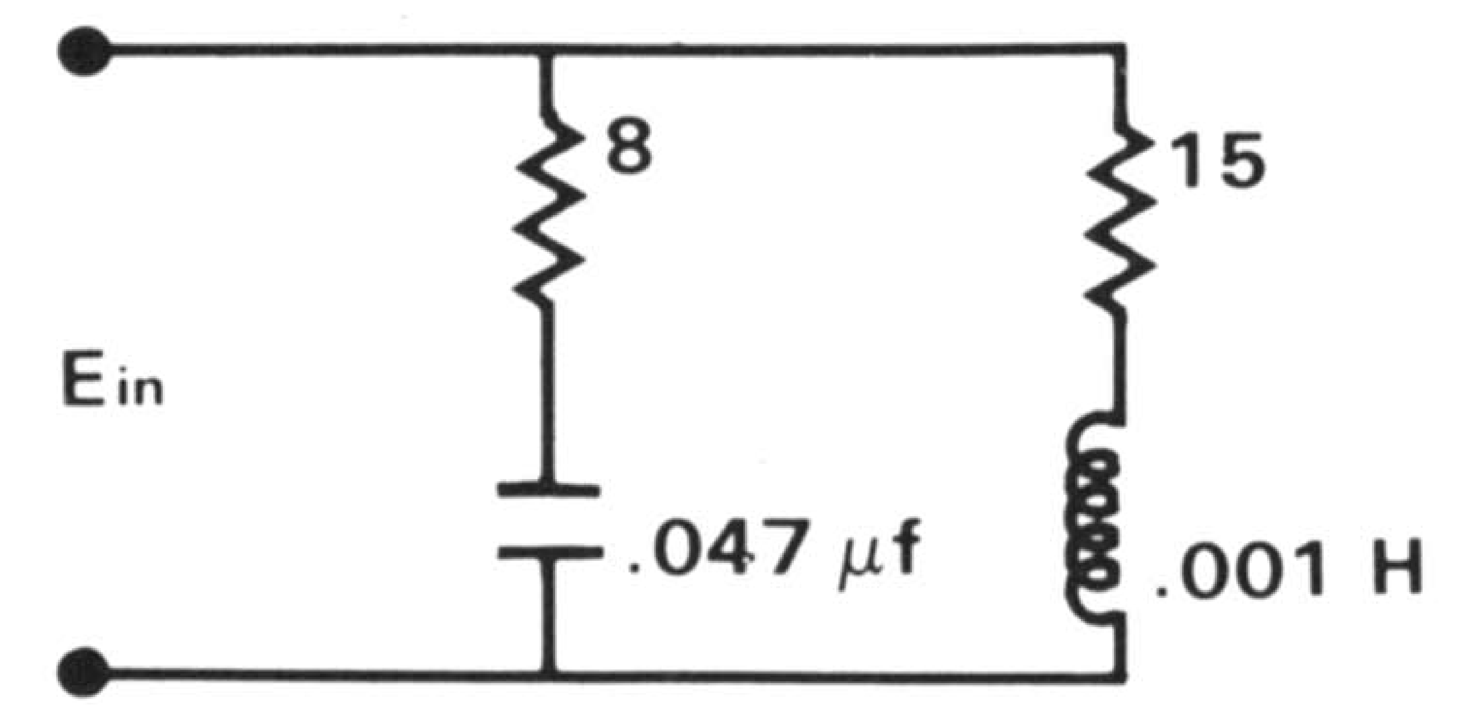
The display will show:	You type:
>	[SHFT] [C]
F =	[1] [0] [0] [0] [0] [ENTER]
C =	[.] [0] [4] [7] [ENTER]
CZ = −338.6275385	

Inductive Reactance ([SHFT] [X])

Inductive reactance computes the reactance of an inductor at a given frequency leaving the value in the variable Z.

Press [SHFT] [X]. For frequency (F=), type the entry in Hz, and press [ENTER]. For inductance (L=), type the entry in Henrys, and press [ENTER]. The solution will be displayed beside LZ =.

Example Problem
Find the impedance of the following circuit:



The display will show:	You type:
>	[SHFT] [SPC]
CMPLX Z CALCULATOR	[SHFT] [X]
F =	[1] [0] [0] [0] [0] [ENTER]
L =	[.] [0] [0] [1] [ENTER]
LZ = 62.83185307	[SHFT] [A]

The display will show:	You type:
R =	[1] [5] [ENTER]
I =	[Z] [ENTER]
R =	[SHFT] [C]
F =	[1] [Ø] [Ø] [Ø] [Ø] [ENTER]
C =	[.] [Ø] [4] [7] [ENTER]
CZ = −338.6275385	[SHFT] [G]
R =	[8] [ENTER]
I =	[Z] [ENTER]
R = 22.9Ø534159 75.67113622	[SHFT] [S]

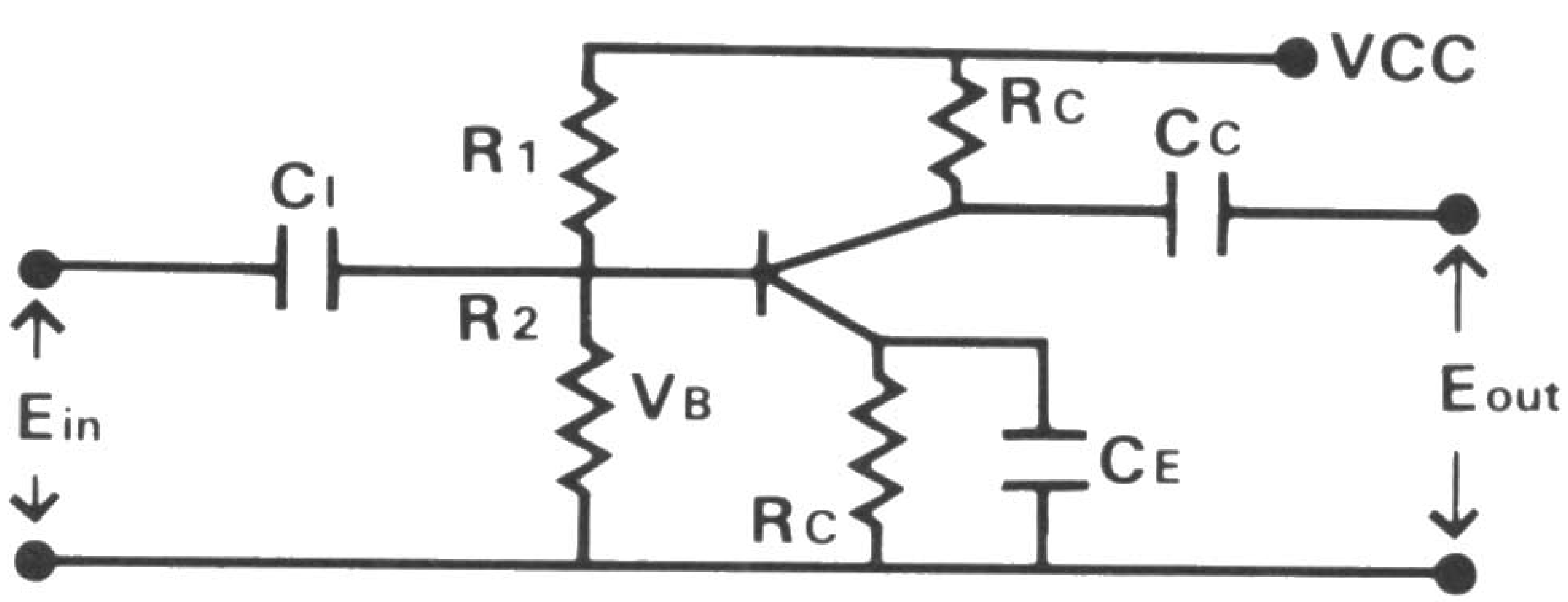
Low Frequency Transistor Amplifier Design (AMPEDS)

To load the Transistor Amplifier program, type [C][L][O][A][D]["][A][M][P][E][D][S]["] and press [ENTER]. After the program has loaded, the prompt sign (>) will appear. Press [SHFT][SPC] and the computer will display the program name, TRANSISTOR AMPS. Press [ENTER].

The copyright notice will flash briefly followed by the name of the first function in the program. Each time you press [ENTER], another function will be displayed. Press [SHFT][SPC] to repeat the menu.

Transistor Biasing ([SHFT][A])

This program is used to calculate the bias in the following circuit:



The formula assumes that C2, Ce, and Cc have zero impedance for the frequencies at which the amplifier will operate. Inputs are RE, VCC, VCE, IE range, Temperature range, Beta range, and tolerance of resistors to use. The program computes the standard resistance values necessary for correct biasing at the given tolerance.

Example Problem

Design a transistor amplifier with a VCC=12V, to operate between −25°C and 50°C, desired VCE=8V, IE range of .8 to 1.5 ma, Beta range of 50 to 150, and RE=200 ohms. Use 10% resistors.

The display will show:	You type:
>	[SHFT] [A]
VCC =	[1][2] (in volts) [ENTER]
R TOL =	[1][0] (in percent) [ENTER]
T MAX =	[5][0] (in degrees C) [ENTER]
T MIN =	[-][2][5] (in degrees C) [ENTER]
VCE =	[8] (in volts) [ENTER]
ICBO =	[.][0][0][2] (in ma) [ENTER]

The display will show:	You type:
IE MAX =	[1] [.] [5] (in ma) [ENTER]
IE MIN =	[.] [8] (in ma) [ENTER]
BETA MAX =	[1] [5] [Ø] [ENTER]
BETA MIN =	[5] [Ø] [ENTER]
RE =	[2] [Ø] [Ø] (in ohms) [ENTER]
R1 = 120000. (in ohms)	[ENTER]
R2 = 15000. (in ohms)	[ENTER]
RC = 3300. (in ohms)	[ENTER]
RE = 200. (in ohms)	[ENTER]
VB = 1.34 (in volts)	

Heat Sink Calculations ([SHFT] [Z])

Heat Sink Calculations computes the heat sink heat transfer characteristic required to meet the given conditions of junction temperature, ambient air temperature, the power to be dissipated in the junction, and the heat transfer characteristic of the junction to the case.

Press [SHFT] [Z]. The display will show T J. MAX =. Type the entry in degrees Centigrade and press [ENTER]. For T AIR =, type the entry in degrees Centigrade and press [ENTER]. For P J =, type the entry in watts and press [ENTER]. For THETA JC =, type the entry in degrees Centigrade/watts. REQUIRED THETA CA IS: will flash briefly. The solution will appear in degrees Centigrade/watts. Press [SHFT] [SPC] to return to the menu.

Example Problem

What heat sink is required for a transistor with a maximum junction temperature of 175°C, ambient air temperature of 4Ø°C and power dissipation of 3 watts? The heat transfer from the junction to the case is 27 C/W.

The display will show:	You type:
>	[SHFT] [Z]
T J. MAX =	[1] [7] [5] [ENTER]
T AIR =	[4] [Ø] [ENTER]

The display will show:	You type:
P J =	[3] [ENTER]
THETA JC =	[2] [7] [ENTER]
REQUIRED THETA CA IS: (flashes briefly)	
18. DEG C/W	

Linear Equation Solutions (SIMEQ)

To load the Linear Equations program, type [C][L][O][A][D][″][S][I][M][E][Q][″] and press [ENTER]. After the program is loaded, the prompt sign (>) will appear. Press [SHFT][SPC] and the computer will display the copyright notice briefly followed by the first entry point name. Each time [ENTER] is pressed a new function name will be displayed. This program is capable of solving up to seven simultaneous equations.

Example Problem
Solve the following simultaneous equations:

$$2 * X1 + 5 * X2 + 6 * X3 = 9$$

$$3 * X1 + 10 * X2 + 4 * X3 = 7$$

$$1 * X1 + 0 * X2 + 1 * X3 = 4$$

The display will show:	You type:
>	[SHFT] [A]
ORDER?	[3] [ENTER]
1 1 (flashes)	
?	[2] [ENTER]
1 2 (flashes)	
?	[4] [ENTER] (This entry is entered incorrectly on purpose.)
1 3 (flashes)	
?	[6] [ENTER]
(The computer makes a BEEP sound.)	(Enter right hand side of equation.)
?	[9] [ENTER]
2 1 (flashes)	
?	[3] [ENTER]
2 2 (flashes)	
?	[1][0] [ENTER]
2 3 (flashes)	
?	[4] [ENTER]
(BEEP sound)	(Enter right hand side of equation.)

The display will show:			You type:
?			7 ENTER
3	1	(flashes)	
?			1 ENTER
3	2	(flashes)	
?			0 ENTER
3	3	(flashes)	
?			1 ENTER
(BEEP sound)			(Enter right hand side of equation.)
?			4 ENTER

Displaying the Matrix (SHFT D)

After typing in your matrix, make sure all of the numbers are correct. To check the numbers, display the matrix. This function gives you a look at each number and lets you change it if it is incorrect. Below is part of the matrix which was just entered.

The display will show:			You type:
>			SHFT D
1	1	(flashes)	
2			ENTER
CHANGE(C) OR ENTER			ENTER
1	2	(flashes)	
4			ENTER
CHANGE(C) OR ENTER			C ENTER
NEW VALUE =			5 ENTER
1	3	(flashes)	
6			ENTER
CHANGE(C) OR ENTER			ENTER

If you type any character but [C] when asked for CHANGE(C) OR ENTER, the function will display the next element of the matrix.

Edit Entry ([SHFT] [F])

Edit Entry lets you change a particular entry without having to re-enter the entire equation. Press [SHFT] [F]. You will be asked for ROW?. Enter the row number and press [ENTER]. You are asked for COLUMN?. If you are interested in the right hand side of the equation, press [ENTER] without a column number. When the entry is displayed, the format takes the form of DISPLAY EQU, asking CHANGE(C) OR ENTER. Continuing with the example problem:

Check the correction in the previous example.

The display will show:	You type:
>	[SHFT] [F]
ROW?	[1] [ENTER]
COLUMN?	[2] [ENTER]
12 (flashes)	
5	[ENTER]
CHANGE(C) OR ENTER	[ENTER]

Solve the Equations (SHFT S)

When you are satisfied that the equations are properly entered, press SHFT S. It may take several minutes to solve a large set of equations, so be patient. When it is done, the computer will beep twice and display the variable number followed by its value. Run the corrected matrix to get the following results:

The display will show:	You type:
X(1.)=3.	ENTER
X(2.)=−Ø.6	ENTER
X(3.)=1.	ENTER

Redisplay Results (SHFT B)

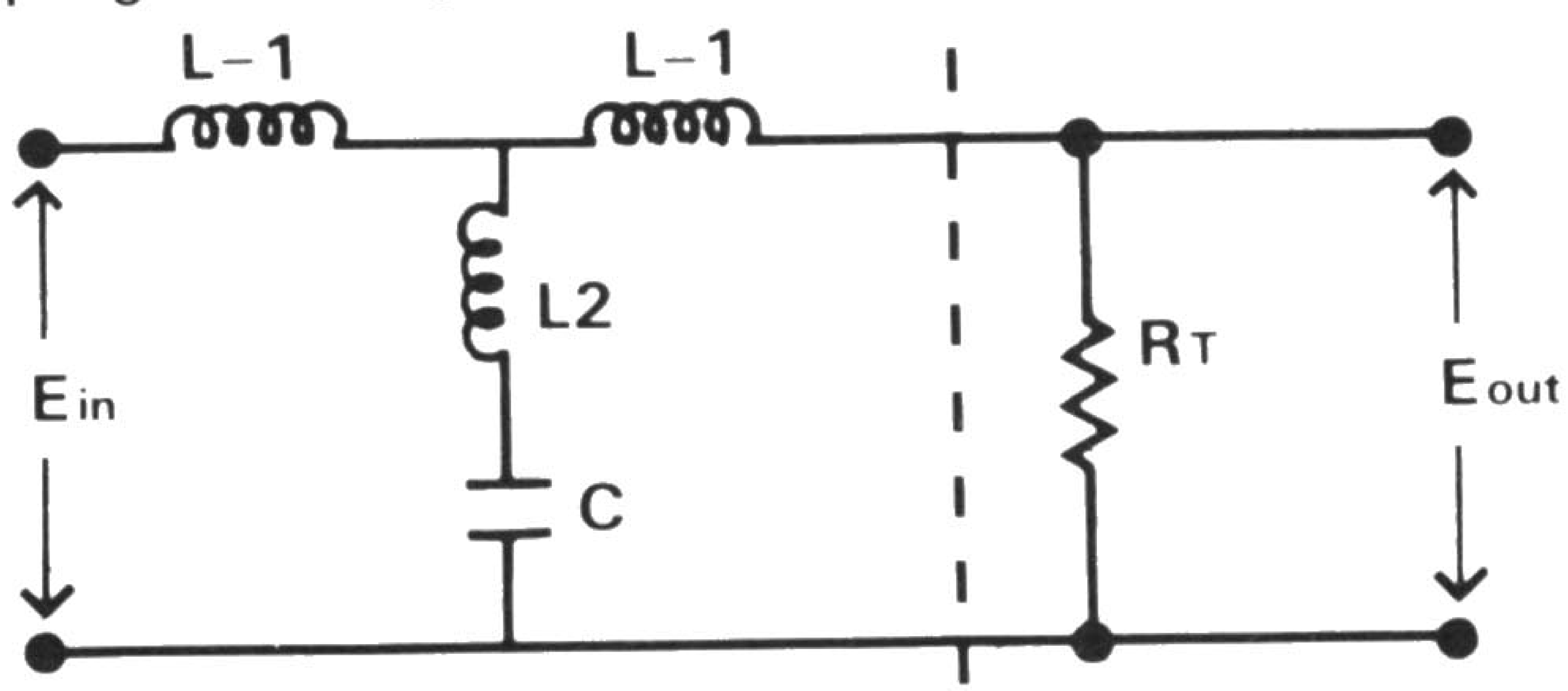
The algorithm used for the solution of the simultaneous equations will destroy the original matrix. In order to re-examine the results, type SHFT B. This will cause the same solutions to be displayed again.

Filters (FILTERS)

To load Filters, type [C] [L] [O] [A] [D] ["] [F] [I] [L] [T] [E] [R] [S] ["] and press [ENTER]. After the program has loaded, the prompt sign (>) will appear. Press [SHFT] [SPC], and the computer will display FILTERS. Press [ENTER], and the copyright notice will flash briefly, followed by the name of the first entry. Each time you press [ENTER] the next entry will be displayed. Press [SHFT] [SPC] to repeat the menu.

m Derived Lowpass ([SHFT] [A])

This program computes values for the following circuit:



Inputs are cut off frequency, maximum attenuation frequency, and the termination resistance (RT).

Press [SHFT] [A]. The display will show FC =. Type the entry in Hz and press [ENTER]. For F MXATN =, type the entry in Hz, and press [ENTER]. For TERM RESIS = type the entry in ohms, and press [ENTER]. The result for L1 will be displayed in mH. Press [ENTER]. The result for L2 will be displayed in mH. Press [ENTER]. The result for C will be displayed in uf. Press [SHFT] [SPC] to return to the menu.

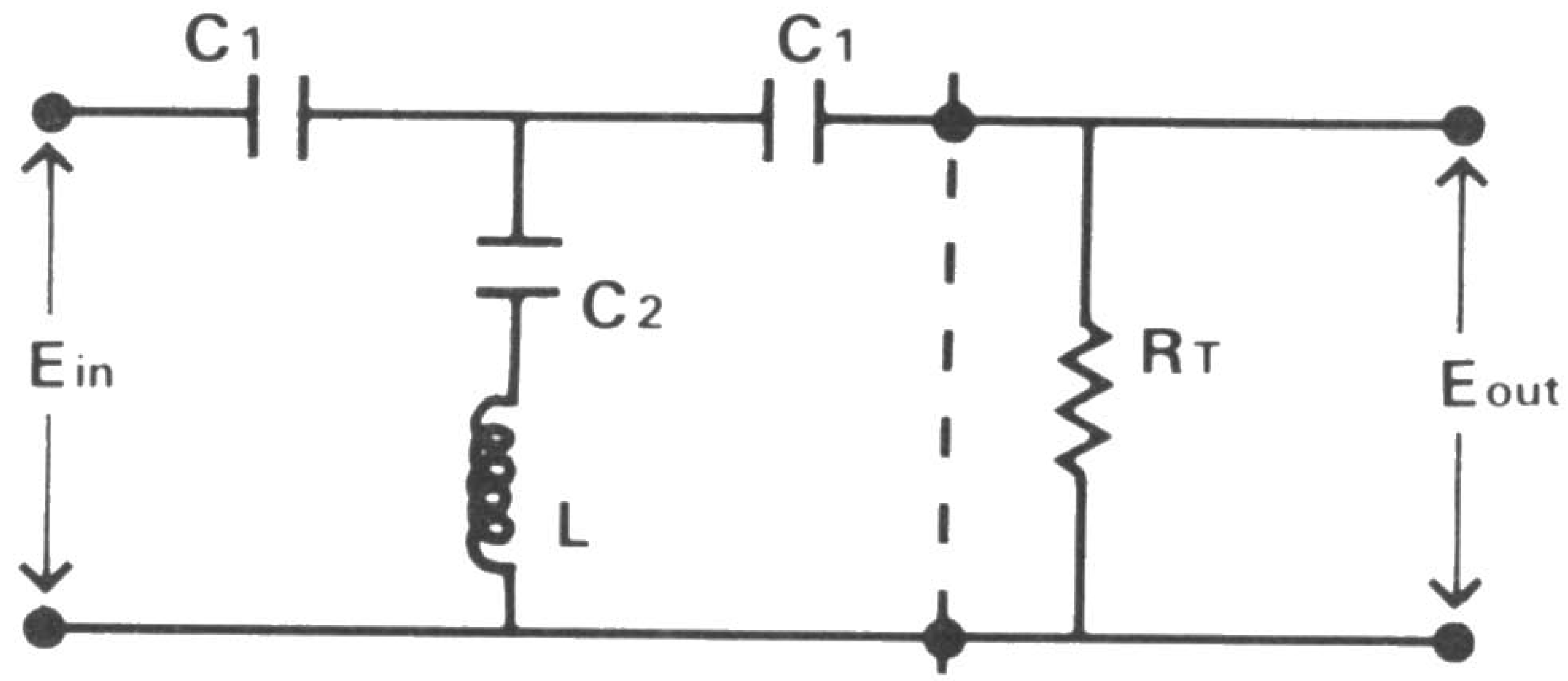
Example Problem

Design an m Derived lowpass filter with a cutoff frequency of 1000 Hz, a maximum attenuation frequency of 1700 Hz and a termination resistance of 100 ohms.

The display will show:	You type:
>	[SHFT] [A]
FC =	[1] [0] [0] [0] [ENTER]
F MXATN =	[1] [7] [0] [0] [ENTER]
TERM RESIS =	[1] [0] [0] [ENTER]
L1 = 12.87	[ENTER]
L2 = 3.4	[ENTER]
C =2.57	

m Derived Hipass ([SHFT] [S])

This program computes values for the following circuit:



Inputs, are cutoff frequency, maximum attenuation frequency, and termination resistance.

Press [SHFT] [S] and the display will show FC =. Type the entry in Hz and press [ENTER]. The display will show F MXATN=. Type the entry in Hz and press [ENTER]. For TERM RESIS =, type the entry in ohms and press [ENTER]. The display will show C1 in uf. Press [ENTER]. The display will show C2 in uf. Press [ENTER]. The display will show L = in mH. Press [SHFT] [SPC] to return to the menu.

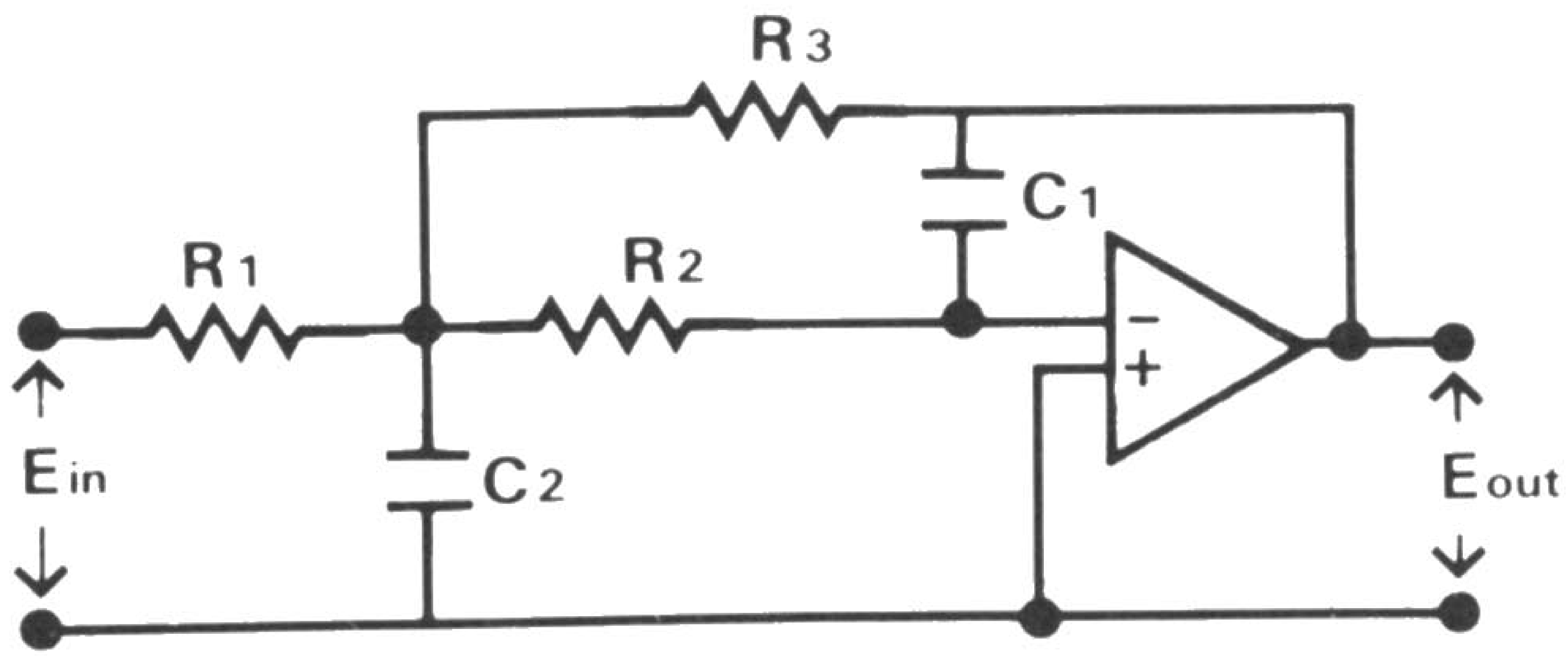
Example Problem

Design an m Derived hipass filter with a cutoff frequency of 1000 Hz, a maximum attenuation frequency of 700 Hz, and a terminating resistance of 100 ohms.

The display will show:	You type:
>	[SHFT] [S]
FC =	[1] [0] [0] [0] [ENTER]
F MXATN =	[7] [0] [0] [ENTER]
TERM RESIS =	[1] [0] [0] [ENTER]
C1 = 2.23	[ENTER]
C2 = 4.64	[ENTER]
L = 11.15	

Active Lowpass Filter ([SHFT] [Z])

This program computes values for the following circuit:



Inputs are a value for C1, the cutoff frequency is Hz, the passband voltage gain, and the peaking factor (see Table 1).

Press [SHFT] [Z]. The display will show FC=. Type the entry in Hz and press [ENTER]. For G =, type the entry in dB, and press [ENTER]. For C1 =, type the entry in uf and press [ENTER]. For PEAKING =, type the entry and press [ENTER]. C2 = is shown with the solution in uf. Press [ENTER]. R1 = is shown with the solution in ohms. Press [ENTER]. R2 = is shown with the solution in ohms. R3 = is shown with the solution in ohms. Press [SHFT] [SPC] to return to the menu.

Example Problem

Design an active lowpass filter with a cutoff frequency of 1000 Hz, a passband voltage gain of 30 dB, a peaking factor of .8, and a value of C1=.047 uf.

The display will show:	You type:
>	[SHFT] [Z]
FC =	[1] [0] [0] [0] [ENTER]
G =	[3] [0] [ENTER]
C1 =	[.] [0] [4] [7] [ENTER]
PEAKING =	[.] [8] [ENTER]
C2 = 9.582940626	[ENTER]
R1 = 42.83337201	[ENTER]
R2 = 1354.510154	[ENTER]
R3 = 41.52038224	

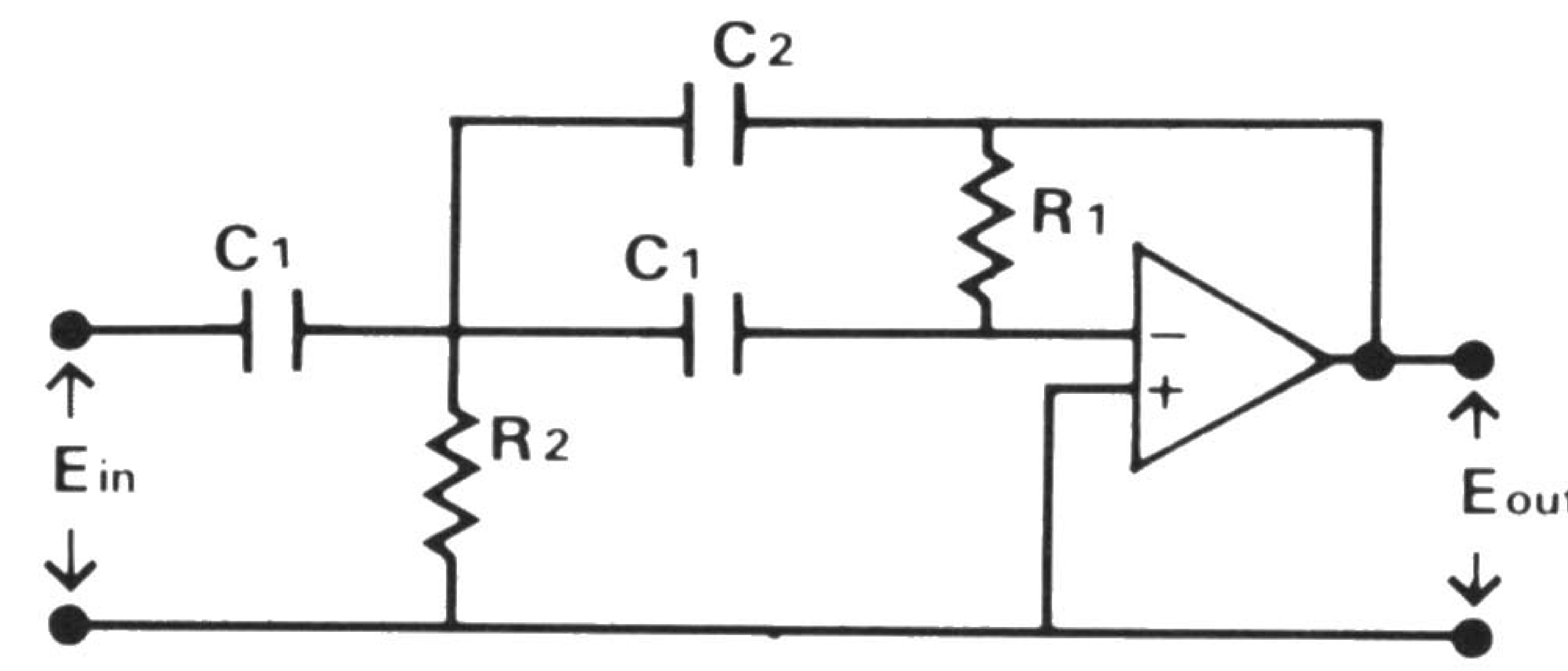
Table 1 — Peaking Factor vs Eout/Ein at cutoff frequency.

Peaking Factor	Eout/Ein (in dB)
.1	20
.2	14
.4	8
.6	5
.8	2
1.0	0

Peaking Factor	Eout/Ein (in dB)
1.2	-2
1.4	-3
1.6	-4
1.8	-5
2.0	-6

Active Hipass Filter (SHFT X)

This program computes values for the following circuit:



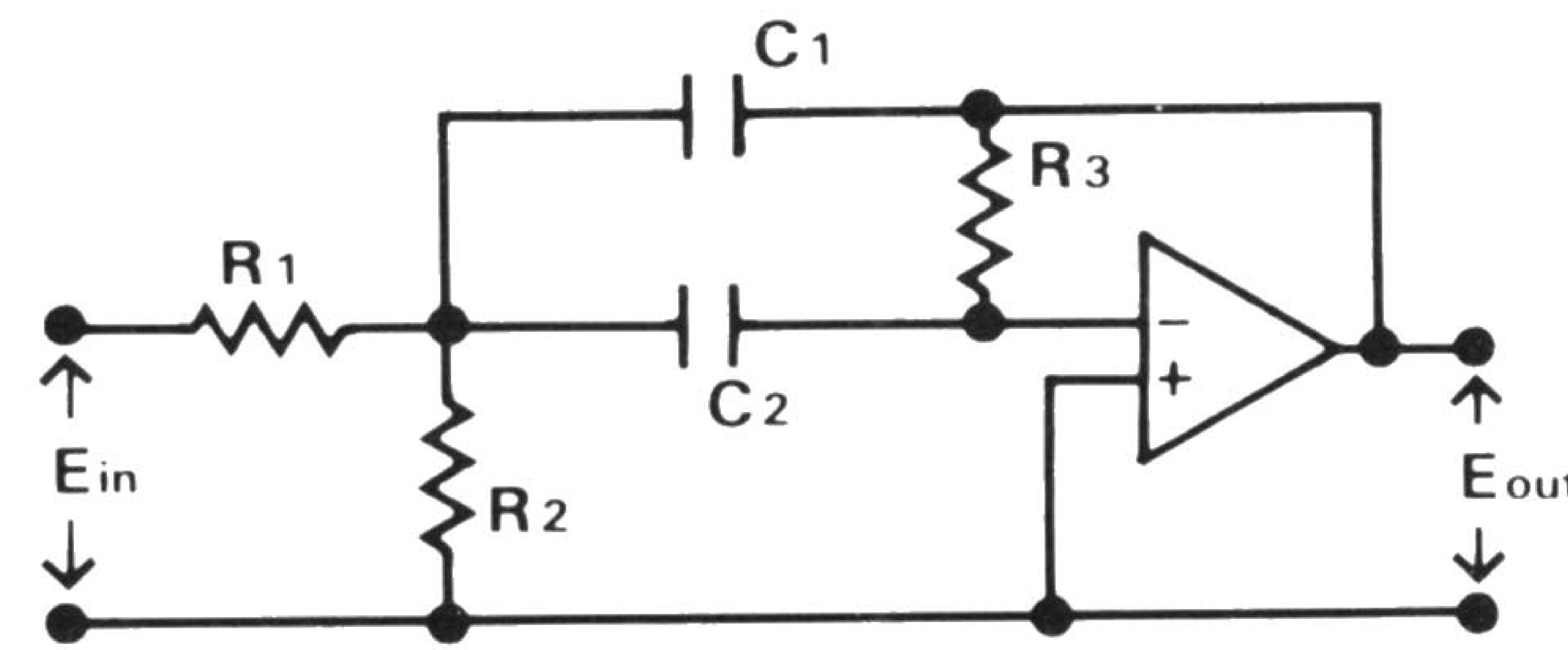
Inputs are a value for C1, the cutoff frequency in Hz, the passband voltage gain, and the peaking factor (see Table 1). Press **SHFT** **X**. The display will show FC =. Type the entry in Hz and press **ENTER**. For G =, type the entry in dB and press **ENTER**. For C1 =, type the entry in uf and press **ENTER**. For PEAKING =, type the entry and press **ENTER**. For C2 =, the solution is shown in uf. Press **ENTER**. For R1 =, the solution is shown in ohms. Press **ENTER**. For R2 =, the solution is shown in ohms. Press **SHFT** **SPC** to return to the menu.

Design an active high pass filter with a cutoff frequency of 700 Hz, a passband voltage gain of 10 dB, peaking factor of .75, and a value of C1=.047.

The display will show:	You type:
>	[SHFT] [X]
FC =	[7] [Ø] [Ø] [ENTER]
G =	[1] [Ø] [ENTER]
C1 =	[.] [Ø] [4] [7] [ENTER]
PEAKING =	[.] [7] [5] [ENTER]
C2 = Ø.Ø14862705	[ENTER]
R1 = 47243.73597	[ENTER]
R2 = 1566.405624	

Active Band Pass Filter ([SHFT] [C])

Values for the following circuit are computed in this program.



Inputs are the values for C1 and C2, the center frequency in Hz, midband voltage gain, and the 3 dB bandwidth in Hz. Press [SHFT] [C]. CF = is displayed. Type the entry in Hz and press [ENTER]. Type the entry in dB for G = and press [ENTER]. For 3 DB BW =, type the entry in Hz and press [ENTER].

For C1 =, type the entry in uf, and press [ENTER]. For C2 =, type the entry in uf and press [ENTER]. The display will show R1 =, with the solution in ohms. Press [ENTER]. The display will show R2 = with the solution in ohms. Press [ENTER]. The display will show R3 = with the solution in ohms. Press [SHFT] [SPC] to return to the menu.

Example Problem

Design an active bandpass filter with a center frequency of 1ØØØ Hz, a midband voltage gain of 3Ø dB, a 3dB bandwidth of 1ØØ Hz, and C1 = C2 = .Ø47 uf.

The display will show:	You type:
>	[SHFT] [C]
CF =	[1] [Ø] [Ø] [Ø] [ENTER]
G =	[3] [Ø] [ENTER]
3 DB BW =	[1] [Ø] [Ø] [ENTER]
C1 =	[.] [Ø] [4] [7] [ENTER]
C2	[.] [Ø] [4] [7] [ENTER]
R1 1Ø7Ø 8343	[ENTER]
R2 2Ø1 1124377	[ENTER]
R3 67725 5Ø77	

EE Tables (TABLES)

To load the Tables program, type [C][L][O][A][D] ["][T][A][B][L][E][S]["] and press [ENTER]. After the program has loaded, the prompt sign (>) will appear. Press [SHFT] [SPC] and the computer will display the program name, EE TABLES. Press [ENTER] and the copyright notice will appear briefly. The first menu option will be shown. Press [ENTER] to see each option in turn. After the last item is shown, press [SHFT] [SPC] to repeat the menu.

AWG to R/FT ([SHFT] [A])

The AWG to R/FT program is used to calculate the resistance of a foot of wire, given the gauge. The program assumes copper wire. The value returned is in ohms.

Example Program
What is the resistance per foot of AWG 12 copper wire?

The display will show:	You type:
>	[SHFT] [A]
AWG =	[1] [2] [ENTER]
R/FT = 1.619403559E−03	

To find the resistance of 50 feet of AWG 12, type [R] [*] [5] [0] and press [ENTER]. The result, 8.097017795E−02 (.0809 ohms), is shown.

Current to Wire Size ([SHFT] [S])

The Current to Wire Size program is used to calculate the lowest gauge wire required to carry a given current.

Note: The insulation characteristics of the wire are not considered in the calculation.

Example Problem
What size wire is required to carry 10 amps?

The display will show:	You type:
>	[SHFT] [S]
I =	[1] [0] [ENTER]
AWG = 13.	

Resistance Color Code to Value ([SHFT] [Z])

The Resistance Color Code program converts the color code bands on a resistor to a resistance value.

(You can enter "gray" as gray or grey. Purple can also be entered as violet.)

Example Problem

Find the resistance of a resistor whose color code is green, red, yellow, and gold.

Press [SHFT] [Z]. INPUT BAND 1. flashes briefly. For COLOR, type [G][R][E][E][N] and press [ENTER]. INPUT BAND 2. will flash briefly. For COLOR, type [R][E][D] and press [ENTER]. INPUT BAND 3. will flash briefly. For COLOR, type [Y][E][L][L][O][W] and press [ENTER]. INPUT BAND 4. will flash briefly. For COLOR, type [G][O][L][D] and press [ENTER]. R = 520000. will be displayed. TOL = 5.% will be displayed.

Capacitor Color Code to Value ([SHFT] [C])

The Capacitor Color Code program converts the color code dots on a capacitor to a value. Capacitance is displayed in microfarads.

For example, to find the capacitance of a capacitor whose color code is yellow, purple, gray, and white press [SHFT] [C]. INPUT DOT 1. will flash briefly on the display. For COLOR, type [Y][E][L][L][O][W] and press [ENTER]. INPUT DOT 2. will flash briefly. For COLOR, type [P][U][R][P][L][E] (or [V][I][O][L][E][T]) and press [ENTER]. INPUT DOT 3. will flash briefly. For COLOR, type [G][R][A][Y] (or [G][R][E][Y]) and press [ENTER]. INPUT DOT 4. will flash briefly. For COLOR, type [W][H][I][T][E] and press [ENTER]. The display will show:

C = 0.47 TOL = 10.% .

RF Coil Design ([SHFT] [L])

The RF Coil Design program determines the number of turns of wire to be close wound on an air core form. Input is the gauge of wire, the diameter of the form to be used, and the desired inductance (in microhenries).

Press [SHFT] [L]. For L =, type the entry in uH and press [ENTER]. For AWG =, type the entry (gauge number) and press [ENTER]. For DIAMETER =, type the entry in inches and press [ENTER]. The display will show the result for NUMBER OF TURNS .

Example Problem
How many turns are required for a 1Ø uH coil to be wound from 16 gauge wire on a 1 inch form?

The display will show:	You type:
>	[SHFT] [L]
L =	[1] [Ø] [ENTER]
AWG =	[1] [6] [ENTER]
DIAMETER =	[1] [ENTER]
NUMBER OF TURNS = 27.58982Ø22	

Appendix A — Backups

A Backup is a tape copy of a program and is an extremely effective method of insuring that an accident or equipment fault will not result in the loss of software. Your first action as owner of the Electrical Engineering I Package should be to make working copies of the original cassette(s) and then put the originals away in a safe place. Although it may be possible to make direct copies using two cassette recorders or on cassette duplicating equipment, the most RELIABLE method is to use the computer itself to make the Backups. Also, for frequently used programs, you may wish to put them on separate cassettes for easier loading. Here are step-by-step instructions for making a Backup:

1. Connect the Cassette Interface to the cassette recorder and install the computer in the Cassette Interface.

2. Place the cassette containing the program(s) to be copied in the recorder and either rewind the tape to the beginning or position the tape to a blank area just prior to the desired program. Place the recorder in the "PLAY" mode.

3. Turn on the computer, make sure that it is either in the DEF or RUN mode and type in:
[C][L][O][A][D]["][N][A][M][E]["] ("NAME" is the name of the program to be copied).

4. When the program has been loaded into the computer and the cassette has stopped, remove the cassette and replace it with the cassette which is to receive the program copy. Either rewind the tape to the beginning or position it to the point where the copy is to start. You should leave about ten seconds of blank tape if the copy is to start at the beginning of the cassette or about five seconds of blank space if the copy is to follow another program on the same cassette. Place the recorder in the "RECORD" mode.

5. Make sure that the computer is in either the DEF or RUN mode and type in:
[C][S][A][V][E]["][N][A][M][E]["]

The recorder will start and record your program.

6. Now rewind the cassette to the blank space just prior to the program, put the recorder into the "PLAY" mode and type in:
[C][L][O][A][D][?]["][N][A][M][E]["]

This is the computer's verifying function and the recorder will start and compare the cassette copy with the program in the computer's memory. If the copy is good, the recorder will stop at the end of the program and the > prompt will re-appear on the display. If an error occurred during the verification, you'll get an error display such as: 5 ....

If this happens, check the recorder volume setting and try the CLOAD? function once more. If you still get an error, the tape copy is probably bad and you should CSAVE the program once again and re-verify if. You may find that some brands of tape, especially the cheaper brands may not be of sufficient quality to insure reliable copying. Radio Shack Supertape or TRS-80 certified cassettes are recommended for best results.

7. Repeat Steps 1 through 6 for each program to be Backed-up.

8. Put the original cassettes away in a safe place and use them ONLY for making working copies.

Appendix B — Maintenance

Maintenance of your Pocket Computer System is not difficult and attention to the simple points listed below should provide best reliability and satisfaction.

1. Keep your program cassettes in their boxes when not in use and don't expose them to extremes of temperature or magnetic fields. **NEVER** touch the exposed surface of the tape on the front edge of the cassette.

2. Clean and demagnetize the tape heads in the recorder at regular intervals. Follow the recommendations in the cassette recorder's manual.

3. Experience has shown that best program loading and saving reliability is achieved by operating the cassette recorder on batteries rather than AC.

4. Use only fresh alkaline type batteries in the recorder and Cassette Interface.

5. Always press the recorder's "STOP" key immediately after loading or saving a program. This will release the pressure on the rubber roller which pulls the tape so that the roller will not develop a permanent "flat" at the point of contact with the tape.

6. **ALWAYS** turn the computer OFF before installing it in, or removing it from the Cassette Interface.

7. After removing the computer from the Cassette Interface, be sure to re-install the protective plug to keep dirt out of the connector on the computer. Never touch the exposed contacts on the Cassette Interface.

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NOTE: Good data processing procedure dictates that the user test the program, run and test sample sets of data, and run the system in parallel with the system previously in use for a period of time adequate to insure that results of operation of the computer or program are satisfactory.

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