

TI Programmable 59

RPN Simulator

Using the power of your *Solid State Software*[™] module

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INTRODUCTION

Your calculator contains a removable *Solid State Software** module which places a large library with a variety of programs at your fingertips the instant you turn the calculator on. Each *Solid State Software* module contains up to 5000 program steps. Within seconds, you can replace the Master Library Module with an optional module, ranging from Applied Statistics to Aviation, to tailor your calculator to solve a series of professional problems with minimal effort. Your *Solid State Software* library does not take up valuable memory space needed for your own programs. In fact, you can call a library program as a subroutine from a program of your own without interruption.

USING THIS MANUAL

After this brief introduction, you will find the description, a keystroke cross-reference, user instructions and an example of translating instructions from the Hewlett-Packard-67 to the TI-59 using the RPN-Simulator. Also included is general information regarding the program.

RUNNING SOLID STATE SOFTWARE PROGRAMS

First of all, to eliminate any possibility of having any pending operations or previous results interfering with your current program, turn your calculator off for a couple of seconds, and back on again. This off/on sequence is the assumed starting point for the example in this manual. Now press the key sequence [2nd] [Pgm] [0] [1] [SBR] [Write] to call and run the identification program. Notice the display goes blank except for a faint "[" at the far left which indicates that calculations are taking place. After about 15 seconds, "13." will appear in the display. This displayed number indicates that the RPN Simulator is installed in the calculator. If the display is flashing after running the identification subroutine, refer to "In Case of Difficulty" in the SERVICE INFORMATION Appendix of the Owner's Manual.

Before you begin using the *Solid State Software* programs on your own, here are a few things to keep clearly in mind until you become familiar with your calculator.

1. Press [CLR] before running a program if you are not sure of the status of the calculator. (To be completely sure of calculator status, turn it off and on again — but remember that this will clear the program memory.)
2. There is no visual indication of which *Solid State Software* program has been called. If you have any doubts, the safest method is to call the desired program with [2nd] [Pgm] mm, where mm is the two-digit program number. The calculator will remain at this program number until another program is called, [RST] is pressed or the calculator is turned off.
3. A flashing display normally indicates an improper key sequence or that a numerical limit has been exceeded. When this occurs, always repeat the program sequence and check that each step is performed as directed by the User Instructions. Any unusual limits of a program are given in the User Instructions or related notes. The In Case of Difficulty portion of Appendix A in the Owner's Manual may be helpful in isolating a problem.

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4. Some of the *Solid State Software* programs may run for several minutes depending on input data. If you desire to halt a running program, press the [RST] key. This is considered as an emergency halt operation which returns control to the main memory. A program must be recalled to be run again.

DOWNLOADING SOLID STATE SOFTWARE PROGRAMS

If you need to examine a *Solid State Software* program, it can be downloaded into the main program memory.* This will allow you to single step through a program in or out of the learn mode. It also allows using the program list or trace features of the optional printer. The only requirement for downloading a *Solid State Software* program is that the memory partition be set so there is sufficient space in the main program memory to receive the downloaded program. The key sequence to download a program is [2nd] [Pgm] mm [2nd] [Op] 09, where mm is the program number to be downloaded. This procedure places the requested program into program memory beginning at program location 000. The downloaded program writes over any instructions previously stored in that part of program memory. Remember to press [RST] before running or tracing the downloaded program.

Please note that RPN Simulator programs 1, 3, and 54 require repartitioning of the TI-59 calculator in order to have sufficient space to download. The partitioning for RPN-1 is 4 [Op] 17; the partitioning for RPN-3, 2 [Op] 17; and the partitioning for RPN-54, 3 [Op] 17. The partitioning must be performed before the downloading sequence.

REMOVING AND INSTALLING MODULES

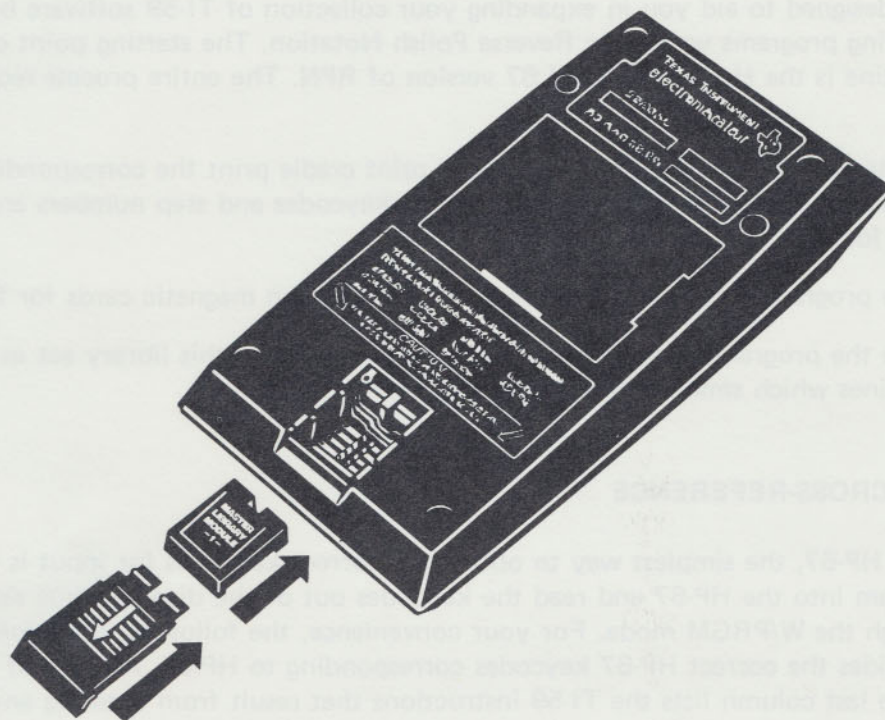
The Master Library Module is installed in the calculator at the factory, but can easily be removed or replaced with another. It is a good idea to leave the module in place in the calculator except when replacing it with another module. Be sure to follow these instructions when you need to remove or replace a module.

CAUTION

Be sure to touch some metal object before handling a module to prevent possible damage by static electricity.

1. **Turn the calculator OFF.** Loading or unloading the module with the calculator ON may cause the keyboard or display to lock out. Also, shorting the contacts can damage the module or calculator.
2. Slide out the small panel covering the module compartment at the bottom of the back of the calculator. (See diagram on page 3).
3. Remove the module. You may turn the calculator over and let the module fall out into your hand.
4. Insert the module, notched end first with the labeled side up into the compartment. The module should slip into place effortlessly.
5. Replace the cover panel, securing the module against the contacts.

*Unless the library is a protected, special-purpose library.



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Don't touch the contacts inside the module compartment as damage can result.

PROGRAM DESCRIPTION

This library is designed to aid you in expanding your collection of TI-59 software by converting and simulating programs written in Reverse Polish Notation. The starting point of the conversion routine is the Hewlett-Packard 67 version of RPN. The entire process requires only three steps:

- Enter the HP-67 keycodes and watch your print cradle print the corresponding TI-59 keystrokes in a program-listing format. HP-67 keycodes and step numbers are also printed for easy reference.
- Key the program back into your TI-59 and record it on magnetic cards for future use.
- Execute the program on your TI-59. Programs included in this library act as subroutines which simulate the RPN instructions.

KEYSTROKE CROSS-REFERENCE

If you have an HP-67, the simplest way to obtain the correct keycodes for input is to load the RPN program into the HP-67 and read the keycodes out of the display while single-stepping through the W/PRGM mode. For your convenience, the following *Keystroke Cross-Reference* provides the correct HP-67 keycodes corresponding to HP-65, HP-67 and HP-97 keystrokes. The last column lists the TI-59 instructions that result from entering any legal keycode.

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KEYSTROKE CROSS-REFERENCE

	HP-65	HP-67	HP-97	HP-67 KEYCODE	TI-59 INSTRUCTIONS
DATA ENTRY					
Digits	[0] to [9]	[0] to [9]	[0] to [9]	00 to 09	[0] ¹ to [9]
Decimal Point	[.]	[.]	[.]	83	[.] ¹
Change Sign	[CHS]	[CHS]	[CHS]	42	[+/-]
Enter Exponent	[EEX]	[EEX]	[EEX]	43	[EE] ²
Pi	[g] [π]	[h] [π]	[f] [π]	35 73	[2nd] [π]
CLEARING OPERATIONS					
Display	[CLX]	[CLX]	[CLX]	44	[0] ³
Registers	[f] [REG]	[f] [CL REG]	[f] [CL REG]	31 43	[2nd] [Pgm] 28 [A]
Stack	[f] [STK]	NA	NA	NA	NA
DISPLAY CONTROL					
Fixed Decimal (Direct)	[DSP] [.] [0] to [DSP] [.] [9]	[DSP] [0] to [DSP] [9]	[DSP] [0] to [DSP] [9]	23 00 to 23 09	[2nd] [Fix] [0] to [9]
Fixed Decimal (Indirect)	NA	[DSP] [i]	[DSP] [i]	23 24	[2nd] [Fix] [2nd] [Ind] 25
Scientific Mode	[DSP] [0] to [DSP] [9] ⁴	[g] [SCI]	[SCI]	32 23	[EE] [=]
Engineering Mode	NA	[h] [ENG]	[ENG]	35 23	[2nd] [Eng]
Normal Mode	See Note 5	[f] [Fix]	[Fix]	31 23	[INV] [2nd] [Eng]
MATH FUNCTIONS					
Addition	[+]	[+]	[+]	61	[2nd] [Pgm] 12 [A]
Subtraction	[-]	[-]	[-]	51	[2nd] [Pgm] 12 [B]
Multiplication	[X]	[X]	[X]	71	[2nd] [Pgm] 12 [C]
Division	[÷]	[÷]	[÷]	81	[2nd] [Pgm] 12 [D]
Exponentiation ¹⁶	[g] [y^x]	[h] [y^x]	[y^x]	35 63	[2nd] [Pgm] 13 [A]
Factorial	[g] [n!]	[h] [N!]	[f] [N!]	35 81	[2nd] [Pgm] 14 [A]
Absolute Value	[g] [ABS]	[h] [ABS]	[f] [ABS]	35 64	[STO] 29 [2nd] [x]

¹ If the stack lift is enabled, [2nd] [Pgm] 51 [A] precedes this instruction.

² When [EEX] is preceded by anything other than a numeric instruction, the resulting TI-59 code is [1] [EE]. See note 1.

³ [0] is used instead of [CLR] because [CLR] on the TI-59 also clears the scientific display mode.

⁴ The HP-65 also selects the fixed decimal mode when a scientific display is requested.

⁵ The HP-65 requires the selection of a fixed decimal mode to return to normal mode.

¹⁶ In the event that invalid arguments are entered, a flashing display results; however, the stack is also dropped contrary to the operation of the HP-67. The last x and display registers are not affected.

KEYSTROKE CROSS-REFERENCE (Contd.)

	HP-65	HP-67	HP-97	HP-67 KEYCODE	TI-59 INSTRUCTIONS
MATH FUNCTIONS (Contd.)					
Integer	[f] [INT]	[f] [INT]	[f] [INT]	31 83	[STO] 29 [2nd] [Int]
Fraction	[f ⁻¹] [INT]	[g] [FRAC]	[f] [FRAC]	32 83	[STO] 29 [INV] [2nd] [Int]
Round	NA	[f] [RND]	[f] [RND]	31 24	[2nd] [Pgm] 26 [A]
Reciprocal	[g] [1/x]	[h] [1/x]	[1/x]	35 62	[STO] 29 [1/x]
Square Root	[f] [\sqrt{x}]	[f] [\sqrt{x}]	[\sqrt{x}]	31 54	[STO] 29 [\sqrt{x}]
Square	[f ⁻¹] [\sqrt{x}]	[g] [x^2]	[x^2]	32 54	[STO] 29 [x^2]
Hour, Minute, Second Addition	[f] [D.MS+]	[h] [H.MS+]	[f] [H.MS+]	35 83	[2nd] [Pgm] 15 [A]
LOGARITHMIC FUNCTIONS					
Natural logarithm	[f] [LN]	[f] [LN]	[LN]	31 52	[STO] 29 [lnx]
e ^x	[f ⁻¹] [LN]	[g] [e ^x]	[e ^x]	32 52	[STO] 29 [INV] [lnx]
Common logarithm	[f] [LOG]	[f] [LOG]	[g] [LOG]	31 53	[STO] 29 [2nd] [log]
10 ^x	[f ⁻¹] [LOG]	[g] [10 ^x]	[f] [10 ^x]	32 53	[STO] 29 [INV] [2nd] [log]
TRIGONOMETRIC FUNCTIONS					
Sine	[f] [SIN]	[f] [SIN]	[SIN]	31 62	[STO] 29 [2nd] [sin]
Arc Sine	[f ⁻¹] [SIN]	[g] [SIN ⁻¹]	[f] [SIN ⁻¹]	32 62	[STO] 29 [INV] [2nd] [sin]
Cosine	[f] [COS]	[f] [COS]	[f] [COS]	31 63	[STO] 29 [2nd] [cos]
Arc Cosine	[f ⁻¹] [COS]	[g] [COS ⁻¹]	[f] [COS ⁻¹]	32 63	[STO] 29 [INV] [2nd] [cos]
Tangent	[f] [TAN]	[f] [TAN]	[TAN]	31 64	[STO] 29 [2nd] [tan]

KEYSTROKE CROSS-REFERENCE (Contd.)

	HP-65	HP-67	HP-97	HP-67 KEYCODE	TI-59 INSTRUCTIONS
TRIGONOMETRIC FUNCTIONS (Continued)					
Arc Tangent	[f ⁻¹] [TAN]	[g] [TAN ⁻¹]	[f] [TAN ⁻¹]	32 64	[STO] 29 [INV] [2nd] [tan]
ANGULAR MODE					
Degrees	[g] [DEG]	[h] [DEG]	[f] [DEG]	35 41	[2nd] [Deg]
Radians	[g] [RAD]	[h] [RAD]	[f] [RAD]	35 42	[2nd] [Rad]
Grads	[g] [GRD]	[h] [GRD]	[f] [GRD]	35 43	[2nd] [Grad]
CONVERSIONS					
Rectangular Coordinates to Polar	[f] [R→P]	[g] [→P]	[→P]	32 72	[2nd] [Pgm] 18 [A]
Polar Coordinates to Rectangular	[f ⁻¹] [R→P]	[f] [R←]	[→R]	31 72	[2nd] [Pgm] 19 [A]
Degrees to Radians	NA	[g] [→R]	[f] [D→R]	32 73	[2nd] [Pgm] 20 [A]
Radians to Degrees	NA	[f] [D←]	[f] [R→D]	31 73	[2nd] [Pgm] 21 [A]
Hours, Minutes, Seconds to Decimal Hours	[f ⁻¹] [→D.MS]	[f] [H←]	[f] [H.MS→]	31 74	[STO] 29 [2nd] [D.MS]
Decimal Hours to Hours, Minutes, Seconds	[f] [→D.MS]	[g] [→H.MS]	[f] [→H.MS]	32 74	[STO] 29 [INV] [2nd] [D.MS]
Decimal Integer to Octal	[f] [→OCT]	NA	NA	NA	NA
Octal Integer to Decimal	[f ⁻¹] [→OCT]	NA	NA	NA	NA
STATISTICS					
Data Accumulation	NA	[Σ+]	[Σ+]	21	[2nd] [Pgm] 22 [A]
Data Removal	NA	[h] [Σ-]	[f] [Σ-]	35 21	[2nd] [Pgm] 23 [A]
Mean	NA	[f] [\bar{x}]	[f] [\bar{x}]	31 21	[2nd] [Pgm] 24 [A]
Standard Deviation	NA	[g] [s]	[f] [s]	32 21	[2nd] [Pgm] 25 [A]
Recall Totals	NA	[RCL] [Σ+]	[RCL] [Σ+]	34 21	[2nd] [Pgm] 32 [A]
MEMORY OPERATIONS					
Primary Register Storage (Numeric)	[STO] [1] to [STO] [9] ⁶	[STO] [0] to [STO] [9]	[STO] [0] to [STO] [9]	33 00 to 33 09	[STO] 00 to 09

⁶The HP-65 has only nine data registers corresponding to the HP-67 op code suffixes 01-09.

KEYSTROKE CROSS-REFERENCE (Contd.)

	HP-65	HP-67	HP-97	HP-67 KEYCODE	TI-59 INSTRUCTIONS
MEMORY OPERATIONS (Contd.)					
Primary Register Storage (Alphabetic)	NA	[STO] [A] to [STO] [E]	[STO] [A] to [STO] [E]	33 11 to 33 15	[STO] 20 to 24
Primary Register Recall (Numeric)	[RCL] [1] to [RCL] [9]	[RCL] [0] to [RCL] [9]	[RCL] [0] to [RCL] [9]	34 00 to 34 09	[2nd] [Pgm] 34 to 43 [A] ⁷
Primary Register Recall (alphabetic)	NA	[RCL] [A] to [RCL] [E]	[RCL] [A] to [RCL] [E]	34 11 to 34 15	[2nd] [Pgm] 44 to 48 [A] ⁷
Primary Register Arithmetic					
Addition	[STO] [+] [1] to [STO] [+] [9] ⁶	[STO] [+] [0] to [STO] [+] [9]	[STO] [+] [0] to [STO] [+] [9]	33 61 00 to 33 61 09	[SUM] 00 to 09
Subtraction	[STO] [-] [1] to [STO] [-] [9] ⁶	[STO] [-] [0] to [STO] [-] [9]	[STO] [-] [0] to [STO] [-] [9]	33 51 00 to 33 51 09	[INV] [SUM] 00 to 09
Multiplication	[STO] [X] [1] to [STO] [X] [9] ⁶	[STO] [X] [0] to [STO] [X] [9]	[STO] [X] [0] to [STO] [X] [9]	33 71 00 to 33 71 09	[2nd] [Prd] 00 to 09
Division	[STO] [÷] [1] to [STO] [÷] [9]	[STO] [÷] [0] to [STO] [÷] [9]	[STO] [÷] [0] to [STO] [÷] [9]	33 81 00 to 33 81 09	[INV] [2nd] [Prd] 00 to 09
Store I	NA	[h] [ST I]	[STO] [I]	35 33	[STO] 25
Recall I	NA	[h] [RC I]	[RCL] [I]	35 34	[2nd] [Pgm] 49 [A] ⁷
x Exchange I	NA	[h] [x↔I]	[f] [x↔I]	35 24	[2nd] [Exc] 25
Indirect Storage	NA	[STO] [(i)]	[STO] [(i)]	33 24	[STO] [2nd] [Ind] ⁸ 25
Indirect Recall	NA	[RCL] [(i)]	[RCL] [(i)]	34 24	[2nd] [Pgm] 33 [A] ⁷
Indirect Register Arithmetic					
Addition	NA	[STO] [+] [(i)]	[STO] [+] [(i)]	33 61 24	[SUM] [2nd] [Ind] ⁸ 25
Subtraction	NA	[STO] [-] [(i)]	[STO] [-] [(i)]	33 51 24	[INV] [SUM] [2nd] [Ind] ⁸ 25
Multiplication	NA	[STO] [X] [(i)]	[STO] [X] [(i)]	33 71 24	[2nd] [Prd] [2nd] [Ind] ⁸ 25
Division	NA	[STO] [÷] [(i)]	[STO] [÷] [(i)]	33 81 24	[INV] [2nd] [Prd] [2nd] [Ind] ⁸ 25

⁶The HP-65 has only nine data registers corresponding to the HP-67 op code suffixes 01-09.

⁷[2nd] [A'] is used in place of [A] when the stack lift is disabled.

⁸This is a merged instruction on the TI-59. See page V-51 of *Personal Programming*.

KEYSTROKE CROSS-REFERENCE (Contd.)

	HP-65	HP-67	HP-97	HP-67 KEYCODE	TI-59 INSTRUCTIONS
MEMORY OPERATIONS (Contd.)					
Register Review	NA	[h] [REG]	[f] [REG]	35 74	[2nd] [Pgm] 29 [A]
Primary/Secondary Register Exchange	NA	[f] [P \rightleftharpoons S]	[f] [P \rightleftharpoons S]	31 42	[2nd] [Pgm] 30 [A]
Recall Last x	[g] [LST X]	[h] [LST X]	[f] [LAST X]	35 82	[2nd] [Pgm] 50 [A] ⁷
STACK OPERATIONS					
Enter	[ENTER \uparrow]	[ENTER \uparrow]	[ENTER \uparrow]	41	[2nd] [Pgm] 51 [A]
Roll Up	[g] [R \uparrow]	[h] [R \uparrow]	[f] [R \uparrow]	35 54	[2nd] [Pgm] 52 [A]
Roll Down	[g] [R \downarrow]	[h] [R \downarrow]	[R \downarrow]	35 53	[2nd] [Pgm] 53 [A]
x Exchange y	[g] [x \rightleftharpoons y]	[h] [x \rightleftharpoons y]	[x \rightleftharpoons y]	35 52	[2nd] [Exc] 26
Stack Review	NA	[g] [STK]	[f] [STACK]	32 84	[2nd] [Pgm] 27 [A]
PERCENTAGE					
Percentage	NA	[f] [%]	[%]	31 82	[2nd] [Pgm] 16 [A]
Percentage Change	NA	[g] [%CH]	[f] [%CH]	32 82	[2nd] [Pgm] 17 [A]
LABELS					
Numeric	[LBL] [0]	[f] [LBL] [0]	[LBL] [0]	31 25 00	[Lbl] (LBL) ⁹
	to [LBL] [9]	to [f] [LBL] [9]	to [LBL] [9]	to 31 25 09	
Upper Case Alphabetic	[LBL] [A]	[f] [LBL] [A]	[LBL] [A]	31 25 11	[2nd] [Lbl] [A] to [E] ⁹
	to [LBL] [E]	to [f] [LBL] [E]	to [LBL] [E]	to 31 25 15	
Lower Case Alphabetic	NA	[g] [LBL f] [a]	[LBL] [f] [a]	32 25 11	[2nd] [Lbl] [2nd] [A'] to
		to [g] [LBL f] [e]	to [LBL] [f] [e]	to 32 25 15	[2nd] [E'] ⁹
TRANSFERS					
To Numeric Labels	[GTO] [0]	[GTO] [0]	[GTO] [0]	22 00	[GTO] (LBL) ⁹
	to [GTO] [9]	to [GTO] [9]	to [GTO] [9]	to 22 09	
To Upper Case Alphabetic Labels	[GTO] [A]	[GTO] [A]	[GTO] [A]	22 11	[GTO] [A] to [E] ⁹
	to [GTO] [E]	to [GTO] [E]	to [GTO] [E]	to 22 15	
To Lower Case Alphabetic Labels	NA	[GTO] [f] [a]	[GTO] [f] [a]	22 31 11	[GTO] [2nd] [A'] to
		to [GTO] [f] [e]	to [GTO] [f] [e]	to 22 31 15	[2nd] [E'] ⁹
Indirect Labels	NA	[GTO] [(i)]	[GTO] [(i)]	22 24	NA

⁷ [2nd] [A'] is used in place of [A] when the stack lift is disabled.

⁹ Labels 0–9 are assigned to the TI-59 labels [INV], [lnx], [CE], [CLR], [x \rightleftharpoons t], [x²], [\sqrt{x}], [1/x], [STO], and [RCL], respectively, on their first occurrence. On the second occurrence of any label the next available label in the label list is selected.

KEYSTROKE CROSS-REFERENCE (Contd.)

	HP-65	HP-67	HP-97	HP-67 KEYCODE	T1-59 INSTRUCTIONS
SUBROUTINE CALLS					
To Numeric Labels	NA	[f] [GSB] [0] to [f] [GSB] [9]	[GSB] [0] to [GSB] [9]	31 22 00 to 31 22 09	[SBR] (LBL) ¹⁰
To Upper Case Alphabetic	[A] to [E]	[f] [GSB] [A] to [f] [GSB] [E]	[GSB] [A] to [GSB] [E]	31 22 11 to 31 22 15	[SBR] [A] to [E] ⁹
To Lower Case Alphabetic Labels	NA	[g] [GSB f] [a] to [g] [GSB f] [e]	[GSB] [f] [a] to [GSB] [f] [e]	32 22 11 to 32 22 15	[SBR] [2nd] [A'] to [2nd] [E']
Indirect	NA	[f] [GSB] [(i)]	[GSB] [(i)]	31 22 25	NA
DISPLAY COMPARISONS					
x = 0?	NA	[f] [x=0]	[f] [x=0?]	31 51	[2nd] [CP] [INV] [2nd] [x=t] (LBL) ¹⁰
x ≠ 0?	NA	[f] [x≠0]	[f] [x≠0?]	31 61	[2nd] [CP] [2nd] [x=t] (LBL) ¹⁰
x < 0?	NA	[f] [x<0]	[f] [x<0?]	31 71	[2nd] [CP] [2nd] [x≥t] (LBL) ¹⁰
x > 0?	NA	[f] [x>0]	[f] [x>0?]	31 81	[2nd] [Pgm] 57 [A] [2nd] [If flg] [4] (LBL) ¹⁰
x = y?	[g] [x=y]	[g] [x=y]	[f] [x=y?]	32 51	[x≧t] [RCL] 26 [x≧t] [INV] [2nd] [x=t] (LBL) ¹⁰
x ≠ y?	[g] [x≠y]	[g] [x≠y]	[f] [x≠y?]	32 61	[x≧t] [RCL] 26 [x≧t] [2nd] [x=t] (LBL) ¹⁰
x ≤ y?	[g] [x≤y]	[g] [x≤y]	[f] [x≤y?]	32 71	[2nd] [Pgm] 58 [A] [2nd] [If flg] [4] (LBL) ¹⁰
x > y?	[g] [x>y]	[g] [x>y]	[f] [x>y?]	32 81	[2nd] [Pgm] 59 [A] [2nd] [If flg] [4] (LBL) ¹⁰
FLAGS					
Setting Flags	[f] [SF 1] or [f] [SF 2] ¹¹	[h] [SF] [0] to [h] [SF] [3]	[f] [STF] [0] to [f] [STF] [3]	35 51 00 to 35 51 03	[2nd] [St flg] [0] to [3]

⁹ Labels 0–9 are assigned to the T1-59 labels [INV], [Inx], [CE], [CLR], [x≧t], [x²], [√x], [1/x], [STO], and [RCL], respectively, on their first occurrence. On the second occurrence of any label the next available label in the label list is selected.

¹⁰ The next available label in the label list is chosen.

¹¹ Since flag 2 is a command-cleared flag on the HP-67, the user is advised to associate flags 1 and 2 with HP-67 flags 0 and 1 when working with an HP-65.

KEYSTROKE CROSS-REFERENCE (Contd.)

	HP-65	HP-67	HP-97	HP-67 KEYCODE	TI-59 INSTRUCTIONS
FLAGS (Contd.)					
Clearing Flags	[f ⁻¹] [SF 1]	[h] [CF] [0]	[f] [CLF] [0]	35 61 00	[INV]
	or [f ⁻¹] [SF 2] ¹¹	to [h] [CF] [3]	to [f] [CLF] [3]	to 35 61 03	[2nd] [St flg] [0] to [3]
Testing Command-Cleared	[f] [TF 1]	[h] [F?] [0]	[f] [F?] [0]	35 71 00	[INV]
	or [f] [TF 2] ^{11,12}	or [h] [F?] [1]	or [f] [F?] [1]	or 35 71 01	[2nd] [If flg] [0] or [1]
Testing Test-Cleared Flags	NA	[h] [F?] [2]	[f] [F?] [2]	35 71 02	[INV]
		or [h] [F?] [3]	or [f] [F?] [3]	or 35 71 03	[2nd] [If flg] [2] or [3]
LOOPING					
DSZ	[g] [DSZ] ¹³	[f] [DSZ]	[f] [DSZ] [I]	31 33	[2nd] [Pgm] 55 [A] [2nd] [If flg] [4] (LBL) ¹⁰
ISZ	NA	[f] [ISZ]	[f] [ISZ] [I]	31 34	[2nd] [Pgm] 56 [A] [2nd] [If flg] [4] (LBL) ¹⁰
DSZ Indirect	NA	[g] [DSZ(i)]	[f] [DSZ] [(i)]	32 33	[2nd] [Pgm] 63 [A] [2nd] [If flg] [4] (LBL) ¹⁰
ISZ Indirect	NA	[g] [ISZ(i)]	[f] [ISZ] [(i)]	32 34	[2nd] [Pgm] 64 [A] [2nd] [If flg] [4] (LBL) ¹⁰
OUTPUT					
Print (-x-)	NA	[f] [-x-]	[PRINT x]	31 84	[2nd] [Pause] [2nd] [Pause] [2nd] [Pause] [2nd] [Pause] [2nd] [Pause] ¹⁴
Pause	NA	[h] [PAUSE]	[f] [PAUSE]	35 72	[2nd] [Pause]
TERMINATION					
Run/Stop	[R/S]	[R/S]	[R/S]	84	[R/S]
Return	[RTN]	[h] [RTN]	[RTN]	35 22	[INV] [SBR] ¹⁵

¹⁰The next available label in the label list is chosen.

¹¹Since flag 2 is a command-cleared flag on the HP-67, the user is advised to associate flags 1 and 2 with HP-67 flags 0 and 1 when working with an HP-65.

¹²The HP-65 can also test to see if the flag is not set. In this case, simply remove the TI-59 [INV] instruction from the translated program.

¹³The HP-65 decrements R8 rather than I. In order to ensure proper operation, the user should modify HP-65 programs to reflect this difference before translation. Also, the simulation program will decrement past zero where the HP-65 [DSZ] instruction will not.

¹⁴If the optional print cradle is used with the simulation program, these instructions may be replaced with a TI-59 [2nd] [Prt] instruction.

¹⁵[INV] [SBR] on the TI-59 is merged to form the [RTN] instruction as keycode 92.

KEYSTROKE CROSS-REFERENCE (Contd.)

	HP-65	HP-67	HP-97	HP-67 KEYCODE	TI-59 INSTRUCTIONS
CARDS					
Recording Data	NA	[f] [W/DATA]	[f] [WRITE DATA]	31 41	[x \geq t] [4] [2nd] [Write] [x \geq t] ¹⁷
Merging Programs	NA	[g] [MERGE]	[f] [MERGE]	32 41	NA
NO OPERATION	[g] [NOP]	[h] [SPACE]	[f] [PRINT: SPACE]	35 84	[2nd] [NOP]

¹⁷The translation program generates [x \geq t] 4 [INV] [2nd] [Write] [x \geq t]. This must be corrected by deleting the [INV] instruction.

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USER INSTRUCTIONS

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Place calculator on PC-100A or PC-100C printer and select program ^{1,2}		[2nd] [Pgm] 01	
2	Initialize ²		[E]	0.
	ENTER DATA USING METHOD I OR METHOD II			
	Method I			
3	Enter HP-67 keycode (1–6 digits) —Repeat as needed	keycode	[A]	0.
4	After all instructions have been translated ⁶		[D]	0.
	Method II			
5a	Initialize multiple entry ³		[B]	0.
5b	Enter HP-67 keycode (1–6 digits) —Repeat 5b as needed	keycode	[R/S]	keycode
6a	Check input data (correct data using instructions 8–10) ^{4,5}		[C]	0.
6b	Translate instructions		[R/S]	0.
7	After all instructions have been translated ⁶		[D]	0.
8	To change an input keycode, simply store the correct keycode in the data register indicated on the right side of the tape	keycode	[STO] n n	keycode
9	Enter appropriate data register number and insert space for an additional keycode if needed	reg. no.	[2nd] [A']	0.
10	Enter appropriate data register number and delete keycode if needed Return to step 6a after correcting input	reg. no.	[2nd] [B']	0.

NOTES:

¹Pressing [SBR] [2nd] [Write] after selecting the program prints

RPN SIMULATOR

13.

and leaves "13." in the display.

²Pressing [2nd] [St flg] 9 after initialization allows the program to be run without a printer. See *Use Without Printer* in the GENERAL INFORMATION section.

³Using the multiple entry method should require no more than 3 entry cycles. Eighty-one entries are allowed on the first cycle. Fewer entries may be allowed for successive cycles as part of memory may be used for other purposes. In any case, when the calculator has accepted the maximum number of entries possible, it automatically executes step 6a. Naturally, if you run out of keycodes before the calculator's memory is filled, you will have to execute step 6a manually.

⁴The [INV] [2nd] [List] function is used to print the input data. This may be stopped by pressing [R/S] before proceeding to step 6b. If flag 9 has been set, no input will be checked; however, [C] must still be pressed in order to translate instructions.

⁵Note that the editing operations function similarly to the TI-59 [2nd] [Ins] and [2nd] [Del] instructions.

⁶See *Optional Instructions* in the GENERAL INFORMATION section.

CONVERSION EXAMPLE

Convert the following random number program written for an HP-67. The seed (0<x<199017) is entered on key [B] and uniformly distributed numbers are generated using key [A].

STEP	KEYSTROKE	KEYCODE	STEP	KEYSTROKE	KEYCODE
001	[f] [LBL] [A]	31 25 11	019	[1]	01
002	[2]	02	020	[7]	07
003	[4]	04	021	[STO] [9]	33 09
004	[2]	02	022	[÷]	81
005	[9]	09	023	[g] [FRAC]	32 83
006	[8]	08	024	[STO] [X] [9]	33 71 09
007	[RCL] [9]	34 09	025	[5]	05
008	[X]	71	026	[g] [10 ^x]	32 53
009	[9]	09	027	[X]	71
010	[9]	09	028	[f] [INT]	31 83
011	[9]	09	029	[5]	05
012	[9]	09	030	[g] [10 ^x]	32 53
013	[1]	01	031	[÷]	81
014	[+]	61	032	[h] [RTN]	35 22
015	[1]	01	033	[f] [LBL] [B]	31 25 12
016	[9]	09	034	[STO] [9]	33 09
017	[9]	09	035	[DSP] [5]	23 05
018	[0]	00	036	[h] [RTN]	35 22

ENTER	PRESS	DISPLAY	COMMENTS	PRINT
	[2nd] [Pgm] 01	0.	Select program	
	[E]	0.	Initialize	
	[B]	0.	Initialize multiple entry	
312511	[R/S]	312511.		
2	[R/S]	2.		
4	[R/S]	4.		
2	[R/S]	2.		
9	[R/S]	9.		
8	[R/S]	8.		
3409	[R/S]	3409.		
71	[R/S]	71.		
9	[R/S]	9.		
9	[R/S]	9.		
9	[R/S]	9.		
9	[R/S]	9.		
1	[R/S]	1.		
61	[R/S]	61.		
1	[R/S]	1.		
9	[R/S]	9.		

ENTER	PRESS	DISPLAY	COMMENTS	PRINT
9	[R/S]	9.		
0	[R/S]	0.		
1	[R/S]	1.		
7	[R/S]	7.		
3309	[R/S]	3309.		
81	[R/S]	81.		
3283	[R/S]	3283.		
337109	[R/S]	337109.		
5	[R/S]	5.		
3253	[R/S]	3253.		
71	[R/S]	71.		
3183	[R/S]	3183.		
5	[R/S]	5.		
3253	[R/S]	3253.		
81	[R/S]	81.		
3522	[R/S]	3522.		
312512	[R/S]	312512.		
3309	[R/S]	3309.		
2305	[R/S]	2305.		
3522	[R/S]	3522.		
	[C]	0.	Check input	See tape below

CHECK INPUT

312511.	19
2.	20
4.	21
2.	22
9.	23
8.	24
3409.	25
71.	26
9.	27
9.	28
9.	29
9.	30
1.	31
61.	32
1.	33
9.	34
9.	35
0.	36
1.	37

7.	38
3309.	39
81.	40
3283.	41
337109.	42
5.	43
3253.	44
71.	45
3183.	46
5.	47
3253.	48
81.	49
3522.	50
312512.	51
3309.	52
2305.	53
3522.	54
0.	55
0.	56
0.	98
0.	99

ENTER

PRESS

DISPLAY

COMMENTS

[R/S]

Translate program

In interpreting the translated instructions, the HP-keycode is centered on the tape, and the HP-step numbers are in the first column of the tape. The second column contains TI-step numbers; the third column, TI-keycodes; and the fourth column, TI-instructions.

312511.

001	000	76	LBL
(R)	001	11	R

2.

002	002	36	PGM
	003	51	51
	004	11	R
	005	02	2

4.

003	006	04	4
-----	-----	----	---

2.

004	007	02	2
-----	-----	----	---

9.

005	008	09	9
-----	-----	----	---

8.

006	009	08	8
-----	-----	----	---

3409.

007	010	36	PGM
	011	43	43
	012	11	R

71.

008	013	36	PGM
	014	12	12
	015	13	C

9.

009	016	36	PGM
	017	51	51
	018	11	R
	019	09	9

9.

010	020	09	9
-----	-----	----	---

9.

011	021	09	9
-----	-----	----	---

9.

012	022	09	9
-----	-----	----	---

1.

013	023	01	1
-----	-----	----	---

61.

014	024	36	PGM
	025	12	12
	026	11	R

1.

015	027	36	PGM
	028	51	51
	029	11	R
	030	01	1

9.

016	031	09	9
-----	-----	----	---

9.

017	032	09	9
-----	-----	----	---

0.

018	033	00	0
-----	-----	----	---

1.

019	034	01	1
-----	-----	----	---

7.

020 035 07 7

3309.

021 036 42 STD
037 09 09

81.

022 038 36 PGM
039 12 12
040 14 D

3283.

023 041 42 STD
042 29 29
043 22 INV
044 59 INT

337109.

024 045 49 PRD
046 09 09

5.

025 047 36 PGM
048 51 51
049 11 A
050 05 5

3253.

026 051 42 STD
052 29 29
053 22 INV
054 28 LDG

71.

027 055 36 PGM
056 12 12
057 13 C

3183.

028 058 42 STD
059 29 29
060 59 INT

5.

029 061 36 PGM
062 51 51
063 11 A
064 05 5

3253.

030 065 42 STD
066 29 29
067 22 INV
068 28 LDG

81.

031 069 36 PGM
070 12 12
071 14 D

3522.

032 072 92 RTN

312512.

033 073 76 LBL
(B) 074 12 B

3309.

034 075 42 STD
076 09 09

2305.

035 077 58 FIX
078 05 05

3522.

036 079 92 RTN

GENERAL INFORMATION

OPTIONAL INSTRUCTIONS

Pressing [D] immediately after completing the translation prints out the following optional instructions.

```
*****  
  
      OPTIONAL  
  
      080  61  GTO  
      081  00  00  
      082  00  00  
      083  76  LBL  
      084  71  SBR  
      085  36  PGM  
      086  51  51  
      087  11  A  
      088  92  RTN  
      089  76  LBL  
      090  61  GTO  
      091  36  PGM  
      092  52  52  
      093  11  A  
      094  92  RTN  
      095  76  LBL  
      096  81  RST  
      097  36  PGM  
      098  53  53  
      099  11  A  
      100  92  RTN
```

The [GTO] 000 is used to simulate the wrap-around feature of many RPN calculators; i.e., if your original program requires the first step to logically follow the last step, this instruction sequence should immediately follow the main body of the TI-59 program.

The remaining instructions may be used to manipulate the simulated stack registers. If these instructions are included, the following operations are available from the keyboard:

[SBR] [SBR] —Simulates the [ENTER ↑] function.

[SBR] [GTO] —Simulates the [R ↑] function.

[SBR] [RST] —Simulates the [R ↓] function.

ACCURACY

The TI-59 carries 13 digits of accuracy internally. This can cause output discrepancies when the original program is written for a calculator with a different accuracy level. For example, the first three numbers generated by the above HP-67 random number program when using π as a seed are

.88598, .08557, and .68228.

However, the resulting TI-59 program generates these numbers:

.88598, .08556, and .54354.

POWER-UP DISPLAY MODE

The TI-59 display is in a floating point mode at power-up. If the original program is written for a calculator which powers up in a different display mode, you may wish to place the TI-59 in the same display mode before running your program.

SCIENTIFIC DISPLAY

The use of the scientific display mode can cause problems in that Hewlett-Packard calculators use two different keys for entering exponents and selecting the scientific display mode where the TI-59 uses the same key for both functions. For example, in the HP-67 random number program above, 10,000 is entered into the display by the key sequence 5 [g] [10^x]. A more common practice is to use the sequence [EEX] 5. However, the resulting TI-59 code places the calculator's display in the scientific mode. The solution is to include an [INV] [EE] in the TI-59 code where needed or to use the first sequence.

Another difficulty is that the TI-59 will not go into scientific mode directly from engineering mode. For example, the [g] [SCI] instruction of the HP-67 is translated as [EE] [=]; however, if the TI-59 is in engineering mode when this sequence is encountered, it will remain in engineering mode unless the sequence is modified to [INV] [2nd] [ENG] [EE] [=].

LABELS

The TI-59 allows each label to be assigned only once. The following table illustrates the correspondence between the first occurrence of an HP-67 label and the TI-59 label assigned to it:

HP-67	TI-59	HP-67	TI-59	HP-67	TI-59
[A] - [E]	[A] - [E]	[2]	[CE]	[6]	[\sqrt{x}]
[a] - [e]	[2nd] [A'] - [2nd] [E']	[3]	[CLR]	[7]	[1/x]
[0]	[INV]	[4]	[x \geq t]	[8]	[STO]
[1]	[lnx]	[5]	[x ²]	[9]	[RCL]

If one of these labels occurs again, the next available label in the following list is selected for use in the TI-59 program:

[SUM]	[2nd] [CP]	[2nd] [x=t] *	[2nd] [Dsz]
[y ^x]	[2nd] [tan]	[2nd] [Nop]	[2nd] [Adv]
[EE]	[2nd] [Pgm]	[2nd] [Op]	[2nd] [Prt]
[(]	[2nd] [P→R] *	[2nd] [Rad]	
[)]	[2nd] [sin]	[2nd] [Lbl]	
[÷]	[2nd] [cos]	[2nd] [x≥t] *	
[X]	[2nd] [CMs]	[2nd] [Σ+]	
[−]	[2nd] [Exc]	[2nd] [x̄]	
[+]	[2nd] [Prd]	[2nd] [Grad] *	
[.]	[2nd] [x]	[2nd] [St flg] *	
[+/-]	[2nd] [Eng]	[2nd] [If flg] *	
[=]	[2nd] [Fix]	[2nd] [D.MS] *	
[2nd] [CLR] *	[2nd] [Int]	[2nd] [π]	
[2nd] [INV] *	[2nd] [Deg]	[2nd] [List] *	
[2nd] [log]	[2nd] [Pause] *	[2nd] [Write] *	

*The following keycodes are altered from their original spelling in the output listing:

KEYS	KEYCODE	OUTPUT	KEYS	KEYCODE	OUTPUT
[2nd] [CLR]	20	CL'	[2nd] [Grad]	80	GRD
[2nd] [INV]	27	IN'	[2nd] [St flg]	86	STF
[2nd] [P→R]	37	P/R	[2nd] [If flg]	87	IFF
[2nd] [Pause]	66	PAU	[2nd] [D.MS]	88	DMS
[2nd] [x=t]	67	EQ	[2nd] [List]	90	LST
[2nd] [x≥t]	77	GE	[2nd] [Write]	96	WRT

It is doubtful that any of your programs will ever require a merged instruction label; however, if one does, these labels will have to be loaded into program memory synthetically. For example, to enter label [2nd] [Pgm] [2nd] [Ind] (keycode 62), press: [STO] 62 [BST] [BST] [2nd] [Lbl] [SST]. This sequence makes use of the [STO] instruction to merge the 6 and 2 into a single op code and then replaces it with the [2nd] [Lbl] instruction. The merged instruction labels and their appropriate keystrokes are listed in the following table:

KEY SEQUENCE	PRINT
[STO] 62 [BST] [BST] [2nd] [Lbl] [SST]	PG *
[STO] 63 [BST] [BST] [2nd] [Lbl] [SST]	EX *
[STO] 64 [BST] [BST] [2nd] [Lbl] [SST]	PD *
[STO] 72 [BST] [BST] [2nd] [Lbl] [SST]	ST *
[STO] 73 [BST] [BST] [2nd] [Lbl] [SST]	RC *
[STO] 74 [BST] [BST] [2nd] [Lbl] [SST]	SM *
[STO] 82 [BST] [BST] [2nd] [Lbl] [SST]	HIR
[STO] 83 [BST] [BST] [2nd] [Lbl] [SST]	GO *
[STO] 84 [BST] [BST] [2nd] [Lbl] [SST]	OP *
[STO] 92 [BST] [BST] [2nd] [Lbl] [SST]	RTN

When a label is repeated, it may be necessary to modify transfers to the label in the output program as shown below.

The following is a translation of the HP-67 sequence:

[f] [LBL] [A]

[GTO] [A]

[f] [LBL] [A]

312511.

001 000 76 LBL
(A) 001 11 A

First occurrence of label [A].

2211.

002 002 61 GTO
003 11 A

Transfer to second occurrence of label [A].

312511.

003 004 76 LBL
(A) 005 44 SUM

Second occurrence of label [A].

CHANGE THE FOLLOWING

003 44 SUM

Since the transfer in Step 2 is to label [A] in step 3, the transfer address must be modified as follows:

2211.

002 002 61 GTO
003 11 SUM

The resulting TI-59 code is as follows and can be entered into your calculator's memory using the instructions on V-45 in *Personal Programming*:

```

000 76 LBL
001 11 A
002 61 GTO
003 44 SUM
004 76 LBL
005 44 SUM

```

CONDITIONAL INSTRUCTIONS

Conditional instructions are handled by performing the opposite test used in the original code and transferring around the next instruction block if the test requirements are satisfied.

One problem, however, is that the HP-65, unlike the HP-67, skips the next two instructions. Often the two HP-65 instructions can be represented by a single HP-67 instruction as in the following example.

Example 1:

STEP	HP-65 KEYSTROKES	HP-67 KEYSTROKES	HP-67 KEYCODE
1	[g] [x=y]	[g] [x=y]	32 51
2	[GTO]	[GTO] [1]	22 01
3	[1]		

In this case the translated program would operate correctly. But the following example requires some modification.

Example 2:

STEP	HP-65 KEYSTROKES	HP-67 KEYSTROKES*	HP-67 KEYCODE
1	[g] [x=y]	[g] [x=y]	32 51
2	[RCL] [1]	[RCL] [1]	34 01
3	[STO] [2]	[STO] [2]	33 02

*Note that the HP-67 sequence does not perform the same function as the HP-65 sequence in this case.

Example 1:

This routine is translated correctly because [GTO][1] is merged into a single step in the HP-67

3251.			
001	000	32	X↑T
	001	43	RCL
	002	26	26
	003	32	X↑T
	004	22	INV
	005	67	EQ
	006	44	SUM
2201.			
002	007	61	GTD
	008	23	LNx
	009	76	LBL
	010	44	SUM

Example 2:

This routine is translated incorrectly as the HP-67 sequence does not perform the same function as the HP-65 sequence.

3251.			
001	000	32	X↑T
	001	43	RCL
	002	26	26
	003	32	X↑T
	004	22	INV
	005	67	EQ
	006	44	SUM
3401.			
002	007	36	PGM
	008	35	35
	009	11	A
	010	76	LBL
	011	44	SUM
3302.			
003	012	42	STD
	013	02	02

The solution to the problem is to modify the output sequence such that [LBL][SUM] follows the translation of step 3 as shown here.

000	32	X↑T
001	43	RCL
002	26	26
003	32	X↑T
004	22	INV
005	67	EQ
006	44	SUM
007	36	PGM
008	35	35
009	11	A
010	42	STD
011	02	02
012	76	LBL
013	44	SUM

ERROR CONDITIONS

HP-67 programs halt when an error is encountered. To duplicate this feature on the TI-59, press [2nd] [St flg] [8] before running a program.

Not all errors are handled in the same manner. The HP-67, for example, will not overflow a data register where the TI-59 will. Also, the simulation program drops the stack when invalid arguments for the Y^x function are entered where the HP-67 does not.

UNTRANSLATABLE INSTRUCTIONS

Due to the incompatibility of the HP-67 and TI-59 instruction sets, certain instructions cannot be handled by this library. These include

[GTO] [(i)]
[f] [GSB] [(i)]
[g] [MERGE]

Also, the octal conversion provided in the HP-65 is not simulated by this library.

Finally, the data entry flag (flag 3 of the HP-67) is not simulated by the TI-59. A solution to this problem is to alter the flag 3 test to an $X \neq 0$ test and enter 0 whenever no input is required during execution of the translated program. Another solution would be to require the user to manually set flag 3 when making an input if this test is required.

UNTRANSLATABLE SEQUENCES

You may find that certain “trick” sequences will not operate properly after being translated. The following HP-67 sequence, for example, places 10 in the display if x and y are equal and 0 if they are not:

[g] [x=y]
[1]
[0]

Translating this program, we obtain

```

3251.

001 000 32 X:T
      001 43 RCL
      002 26 26
      003 32 X:T
      004 22 INV
      005 67 EQ
      006 44 SUM

1.

002 007 36 PGM
      008 51 51
      009 11 A
      010 01 1

      011 76 LBL
      012 44 SUM

0.

003 013 00 0

```

The difficulty here is that the stack is lifted when 10 is placed in the display; but does not lift for 0. That routine may or may not run correctly depending on the requirements of the original program.

USE WITHOUT PRINTER

The use of a printing unit is highly recommended when translating programs. However, if flag 9 is set following initialization (step 2 of the User Instructions), the program may be used without a printer. In this case, the calculator displays the TI-59 step number for about four seconds followed by the corresponding keycode.

RUNNING TRANSLATED PROGRAMS

Most translated programs can be run using the original user instructions. However, there are two problems that may occur.

When user-accessible labels are given multiple assignments in the original program, the user instructions will have to be modified according to the label assignments made by the translation routine. These assignments are shown on the output tape as illustrated in the *Labels* section.

Also, if the automatic stack lift feature is required on input, it will have to be duplicated manually by pressing [SBR] [SBR] (See *Optional Instructions*) before entering an input value and continuing with program execution. The execution of many programs, however, does not require that the stack be lifted when an input is made. Whether this operation is needed can best be determined by experimenting with the translated program.

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NOTES

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NOTES

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