TI PROGRAMMABLE 58/59

RPN Simulator

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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.

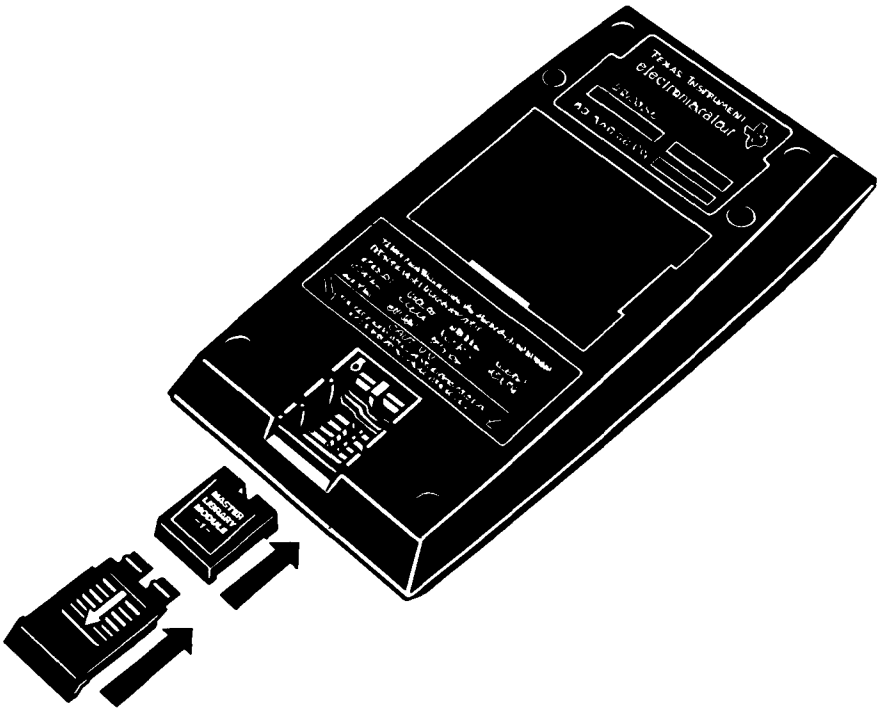
2. Slide out the small panel covering the module compartment at the bottom of the back of the calculator. (See diagram on page 3).

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.



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.

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

[6]The 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] [×] [1] to [STO] [×] [9][6]	[STO] [×] [0] to [STO] [×] [9]	[STO] [×] [0] to [STO] [×] [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] [×] [(i)]	[STO] [×] [(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

[6] The 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.
[8] This 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≷S]	[f] [P≷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 ↑]	[ENTER ↑]	[ENTER ↑]	41	[2nd] [Pgm] 51 [A]
Roll Up	[g] [R ↑]	[h] [R ↑]	[f] [R ↑]	35 54	[2nd] [Pgm] 52 [A]
Roll Down	[g] [R ↓]	[h] [R ↓]	[R ↓]	35 53	[2nd] [Pgm] 53 [A]
x Exchange y	[g] [x≷y]	[h] [x≷y]	[x≷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] to [LBL] [9]	[f] [LBL] [0] to [f] [LBL] [9]	[LBL] [0] to [LBL] [9]	31 25 00 to 31 25 09	[Lbl] (LBL)[9]
Upper Case Alphabetic	[LBL] [A] to [LBL] [E]	[f] [LBL] [A] to [f] [LBL] [E]	[LBL] [A] to [LBL] [E]	31 25 11 to 31 25 15	[2nd] [Lbl] [A] to [E][9]
Lower Case Alphabetic	NA	[g] [LBL f] [a] to [g] [LBL f] [e]	[LBL] [f] [a] to [LBL] [f] [e]	32 25 11 to 32 25 15	[2nd] [Lbl] [2nd] [A′] to [2nd] [E′]
TRANSFERS					
To Numeric Labels	[GTO] [0] to [GTO] [9]	[GTO] [0] to [GTO] [9]	[GTO] [0] to [GTO] [9]	22 00 to 22 09	[GTO] (LBL)[9]
To Upper Case Alphabetic Labels	[GTO] [A] to [GTO] [E]	[GTO] [A] to [GTO] [E]	[GTO] [A] to [GTO] [E]	22 11 to 22 15	[GTO] [A] to [E][9]
To Lower Case Alphabetic Labels	NA	[GTO] [f] [a] to [GTO] [f] [e]	[GTO] [f] [a] to [GTO] [f] [e]	22 31 11 to 22 31 15	[GTO] [2nd] [A′] to [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], [Inx], [CE], [CLR], [x≷t], [x^2], [$\sqrt{x}$], [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	TI-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]
$x \neq 0?$	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]
$x \neq y?$	[g] [x≠y]	[g] [x≠y]	[f] [x≠y?]	32 61	[x≷t] [RCL] 26 [x≷t] [2nd] [x=t] (LBL)[10]
$x \leq y?$	[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 TI-59 labels [INV], [lnx], [CE], [CLR], [x≷t], [x^2], [$\sqrt{x}$], [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.

[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] or [f^{-1}] [SF 2][11]	[h] [CF] [0] to [h] [CF] [3]	[f] [CLF] [0] to [f] [CLF] [3]	35 61 00 to 35 61 03	[INV] [2nd] [St flg] [0] to [3]
Testing Command-Cleared	[f] [TF 1] or [f] [TF 2][11,12]	[h] [F?] [0] or [h] [F?] [1]	[f] [F?] [0] or [f] [F?] [1]	35 71 00 or 35 71 01	[INV] [2nd] [If flg] [0] or [1]
Testing Test-Cleared Flags	NA	[h] [F?] [2] or [h] [F?] [3]	[f] [F?] [2] or [f] [F?] [3]	35 71 02 or 35 71 03	[INV] [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]

[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.

[12] The 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.

[13] The 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.

[14] If 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≷t] [4] [2nd] [Write] [x≷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]

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

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:

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

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13.

and leaves "13." in the display.

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

[3]Using 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.

[4]The [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.

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

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

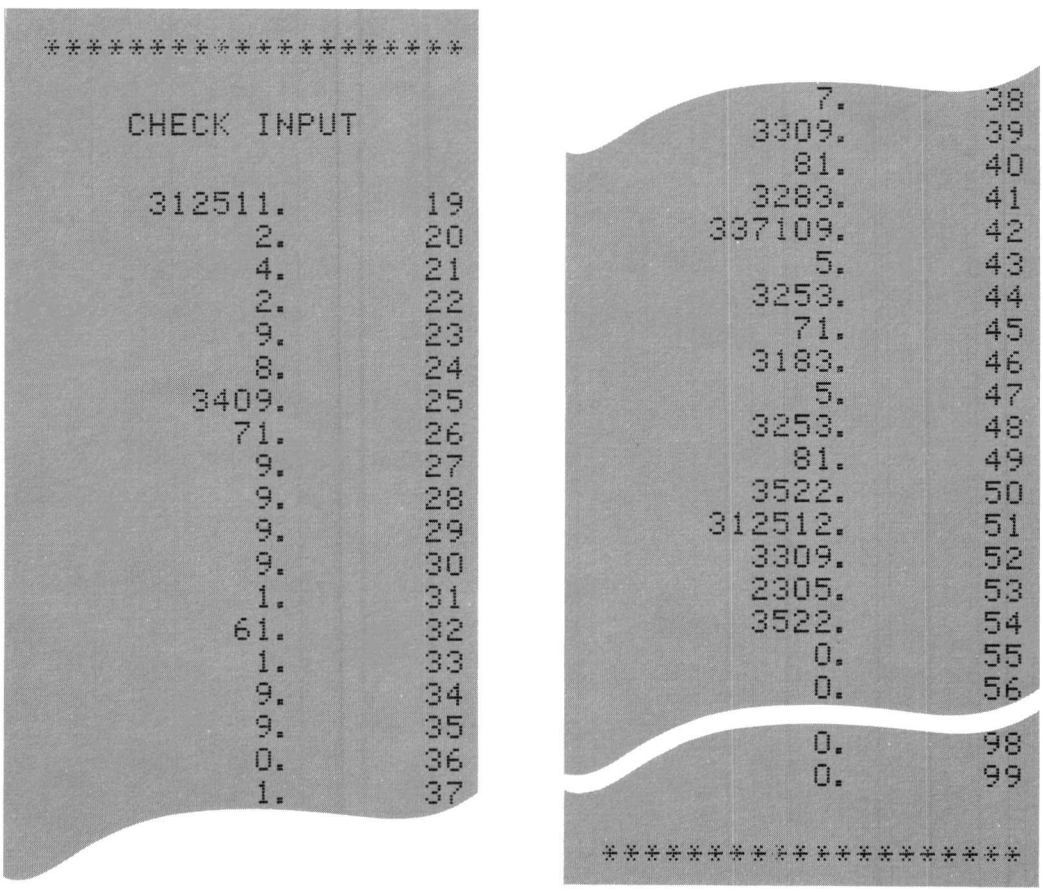
CONVERSION EXAMPLE

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] [×] [9]	33 71 09
007	[RCL] [9]	34 09	025	[5]	05
008	[×]	71	026	[g] [10^x]	32 53
009	[9]	09	027	[×]	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



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
(A)   001   11  A

            2.

002   002   36 PGM
      003   51  51
      004   11  A
      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  A

           71.

008   013   36 PGM
      014   12  12
      015   13  C

            9.

009   016   36 PGM
      017   51  51
      018   11  A
      019   09  9
```

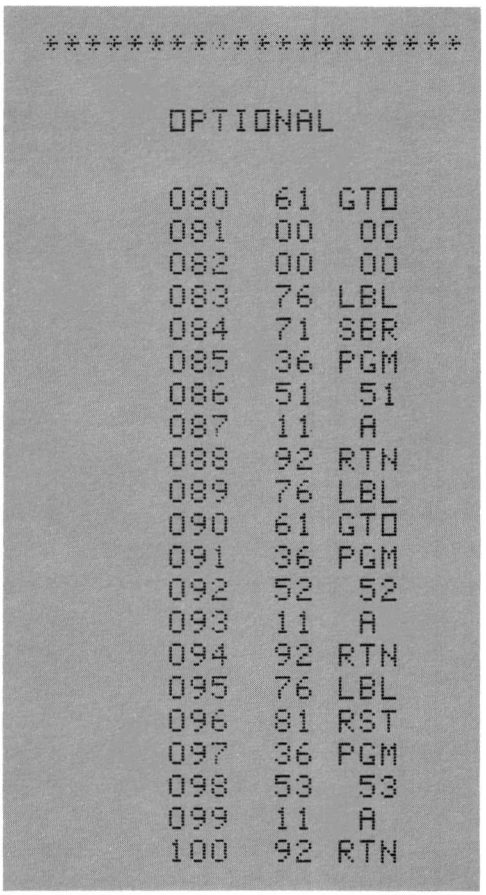
```
            9.

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  A

            1.

015   027   36 PGM
      028   51  51
      029   11  A
      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 STO
      037   09   09

               81.

022   038   36 PGM
      039   12   12
      040   14   D

             3283.

023   041   42 STO
      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 STO
      052   29   29
      053   22 INV
      054   28 LOG

               71.

027   055   36 PGM
      056   12   12
      057   13   C
```

```
             3183.

028   058   42 STO
      059   29   29
      060   59 INT

               5.

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

             3253.

030   065   42 STO
      066   29   29
      067   22 INV
      068   28 LOG

               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 STO
      076   09   09

             2305.

035   077   58 FIX
      078   05   05

             3522.

036   079   92 RTN
```

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≷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] [$\bar{x}$]	
[+]	[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

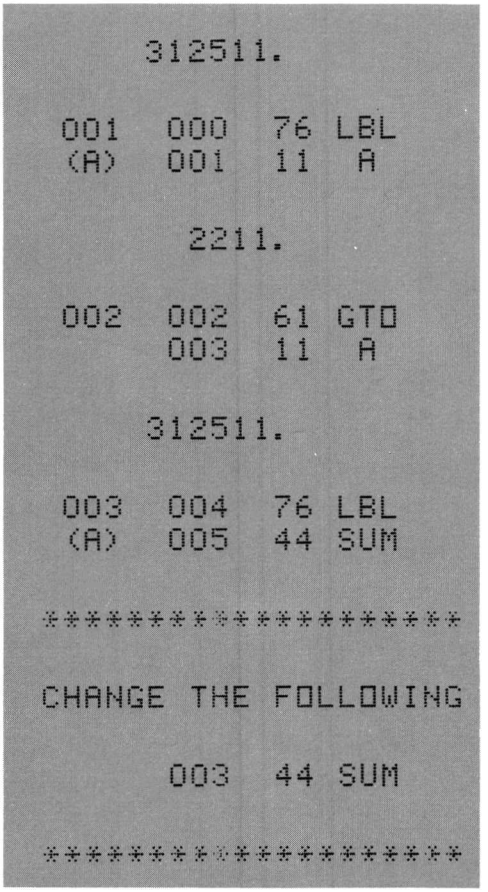
It is doubtful that any of your programs will ever require a merged instruction label; however, if one does, these labels will have to be loaded into program memory synthetically. For example, to enter label [2nd] [Pgm] [2nd] [Ind] (keycode 62), press: [STO] 62 [BST] [BST] [2nd] [Lbl] [SST]. This sequence 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]

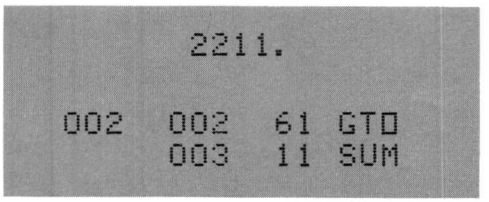


First occurrence of label [A].

Transfer to second occurrence of label [A].

Second occurrence of label [A].

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



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 GTO
      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 STO
      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 STO
      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

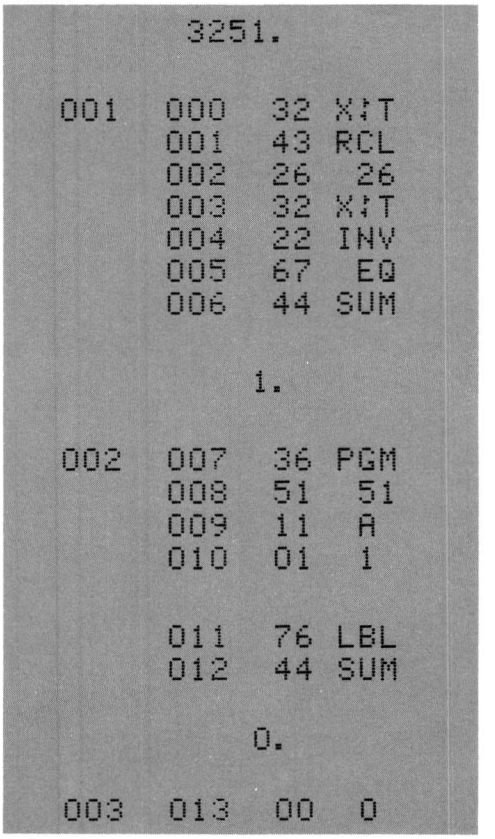
You may find that certain "trick" sequences will not operate properly after being translated. The following HP-67 sequence, for example, places 10 in the display if x and y are equal and 0 if they are not:

[g] [x=y]

[1]

[0]

Translating this program, we obtain



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.