TI Programmable 58/59

Surveying

Quick Reference Guide

CONTENTS

CALCULATING NOTES

Low Battery Indication

If the display flashes erratically, fades out, gives incorrect results or is inconsistent in any way, recharge the battery. Calculator operation can be resumed after several minutes of recharging.

Algebraic Hierarchy

Operations and functions are performed automatically in following order.

1. Math Functions (x^2, cos, etc.)
2. Exponentiation (y^x) and Roots ($\sqrt[x]{y}$)
3. Multiplication, Division
4. Addition, Subtraction
5. Equals

Order applies to each set of parentheses. You can use up to 8 pending operations and 9 open parentheses, except where noted.

Flashing Display

A display flashing off and on indicates that an invalid key sequence has taken place or that the limits of the display have been exceeded. See Appendix B in *Personal Programming* for possible causes.

CONVERSIONS

Angle Formats

2nd D.MS — DEGREES, MINUTES, SECONDS TO DECIMAL DEGREES — Converts an angle measured in degrees, minutes and seconds to its decimal degrees equivalent. INV 2nd D.MS reverses this conversion. Also used for time conversions. **Operates on display value only.** Submit 2 digits each for minutes and seconds. Entry and display format is DD.MMSSsss where DD is degrees, MM is minutes, SS is whole seconds and sss is fractional seconds.

Polar to Rectangular

R x⇄t θ 2nd P→R → y; x⇄t → x

Rectangular to Polar

x x⇄t y INV 2nd P→R → θ; x⇄t R

Only 4 pending operations are available for other uses when using D.MS or Polar/Rectangular conversions.

Angular Conversions

FROM \ TO	Degrees	Radians	Grads
Degrees		$\times \frac{\pi}{180}$	$\div 0.9$
Radians	$\times \frac{180}{\pi}$		$\times \frac{200}{\pi}$
Grads	$\times 0.9$	$\times \frac{\pi}{200}$	

STATISTICS

Initialize: [2nd] [Pgm] 1 [SBR] [CLR]
Data Entry: x_i [x⇄t] y_i [2nd] [Σ+]
Data Entry Removal: x_i [x⇄t] y_i [INV] [2nd] [Σ+]
Trendline Data Entry: x_1 [x⇄t], y_1 [2nd] [Σ+], y_2 [2nd] [Σ+], etc.
Trendline Point Removal: [x⇄t] [−] 1 [=] [x⇄t] y_i [INV] [2nd] [Σ+]

Calculations	Key Sequence
Mean of y-array then x-array	[2nd] [$\bar{x}$] [x⇄t]
Standard Deviation (N − 1 Weighting) of y-array then x-array (N Weighting) of y-array then x-array	 [INV] [2nd] [$\bar{x}$] [x⇄t] [INV] [2nd] [Op] 11 [$\sqrt{x}$] [x⇄t] [$\sqrt{x}$]
Variance (N Weighting) of y-array then x-array (N − 1 Weighting) of y-array then x-array	 [2nd] [Op] 11 [x⇄t] [2nd] [$\bar{x}$] [x^2] [x⇄t] [x^2]
Y-Intercept	[2nd] [Op] 12
Slope after y-intercept	[x⇄t]
Correlation Coefficient	[2nd] [Op] 13
y′ for new x	[2nd] [Op] 14
x′ for new y	[2nd] [Op] 15

SPECIAL CONTROL OPERATIONS

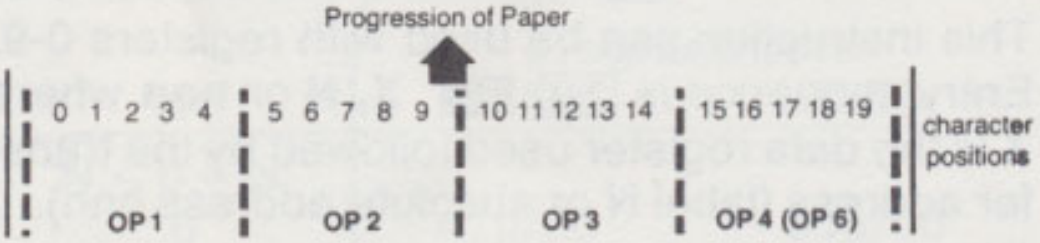
Each special control operation is called by pressing [2nd] [Op] **nn** where **nn** is the 2-digit code assigned to each operation (short form addressing can be used here). These operations use up to 4 pending operations and 1 subroutine level.

Code nn	Function
00*	Initialize print register.
01*	Alphanumerics for far left quarter of print column.
02*	Alphanumerics for inside left quarter of print column.
03*	Alphanumerics for inside right quarter of print column.
04*	Alphanumerics for far right quarter of print column.
05*	Print the contents of the print register.
06*	Print last 4 characters of OP 04 with current display.
07*	Plot ÷ in column 0-19 as specified by the display.
08*	List the labels currently used in program memory.
09	Bring specified library program into program memory.
10	Apply signum function to display register value.
11	Calculate variances.
12	Calculate slope and intercept.
13	Calculate correlation coefficient.
14	Calculate new y prime (y') for an x in the display.
15	Calculate new x prime (x') for a y in the display.
16	Display current partition of memory storage area.
17	Repartition memory storage area.
18	If no error condition exists in a program, set flag 7.
19	If an error condition exists in a program, set flag 7.
20-29	Increment a data register 0-9 by 1.
30-39	Decrement a data register 0-9 by 1.

*Designed specifically for use with optional PC-100A Print Cradle

ALPHANUMERIC PRINT CODES

The first seven control operations allow you to create and print out alphanumeric messages. Twenty characters can be printed on each line. They are assembled and stored in groups of 5 characters at a time as shown below.



Each printed character is represented by a two-digit, row-column address code according to the following table:

	0	1	2	3	4	5	6	7
0		0	1	2	3	4	5	6
1	7	8	9	A	B	C	D	E
2	-	F	G	H	I	J	K	L
3	M	N	O	P	Q	R	S	T
4	.	U	V	W	X	Y	Z	+
5	×	*	(	)	e	<	>	,
6	↑	%	'	/	=	"	≠	≤
7	≥	?	÷	◊	Π	∠	Σ	Σ

For instance, A is code 13 and + is code 47

PROGRAMMING NOTES

Labels

Any key on the keyboard can be used as a label except [2nd], [LRN], [Ins], [Del], [SST], [BST], [Ind] and the numbers 0-9.

DSZ

This instruction can be used with registers 0-9. Entry sequence is [2nd] [Dsz] **X, N** or **nnn** where X is the data register used followed by the transfer address (label N or absolute address nnn).

Flags

Ten flags are available (0-9). Entry sequence for setting, resetting or testing flags is the flag instruction, flag number, then transfer address (testing only).

MEMORY PARTITIONING

Memory area is partitioned in sets of 10 registers where each register can hold a data value or 8 program instructions. To check placement of current partition, press [2nd] [Op] **16.** To repartition, enter number of sets (N) of 10 data registers needed and press [2nd] [Op] **17.**

N	Program/Data	
	TI-58	TI-59
N < 0 = N		
0	479/00	959/00
1	399/09	879/09
2	319/19	799/19
3	**239/29***	719/29
4	159/39	639/39
5	079/49	559/49
6	000/59	**479/59***
7	Flashing	399/69
8	Flashing	319/79
9	Flashing	239/89
10	Flashing	159/99
N > 10	Flashing	159/99

*Partition when calculator is turned on.

PROGRAM KEY CODES

Key Code	Key	Key Code	Key	Key Code	Key
00	0	39	cos	72*	STO Ind
↓	↓	40	Ind	73*	RCL Ind
09	9	42	STO	74*	SUM Ind
10	E'	43	RCL	75	−
11	A	44	SUM	76	Lbl
12	B	45	y^x	77	x≥t
13	C	47	CMs	78	Σ+
14	D	48	Exc	79	$\bar{x}$
15	E	49	Prd	80	Grad
16	A'	50	|x|	81	RST
17	B'	52	EE	83*	GTO Ind
18	C'	53	(	84*	Op Ind
19	D'	54	)	85	+
20	CLR	55	÷	86	St flg
22	INV	57	Eng	87	If flg
23	ln x	58	Fix	88	D.MS
24	CE	59	Int	89	π
25	CLR	60	Deg	90	List
27	INV	61	GTO	91	R/S
28	log	62*	Pgm Ind	92*	INV SBR
29	CP	63*	Exc Ind	93	.
30	tan	64*	Prd Ind	94	+/−
32	x:t	65	×	95	=
33	x^2	66	Pause	96	Write
34	$\sqrt{x}$	67	x=t	97	Dsz
35	1/x	68	Nop	98	Adv
36	Pgm	69	Op	99	Prt
37	P→R	70	Rad		
38	sin	71	SBR		

*Merged codes

RECORDING MAGNETIC CARDS (TI-59 Only)

Display When Write Pressed, Card Entered	Calculator Response
1, 2, 3, 4	Writes a card side with this number from the bank of this number (program and/or data) and records current partition on card.
−1, −2, −3, −4	Writes and protects card side with this number from the bank with this number. Also records current partition on card.
Any other number	Card is passed but not recorded. Rightmost two integer digits of display are flashed.

If the display is flashing any value when trying to read or record a card, the card is passed but not read or recorded and the rightmost two integers in the display are flashed.

The calculator should be in standard display format when reading or recording cards.

Only the integer portion of the display is recognized, i.e., 1.234 = 1.

READING MAGNETIC CARDS
(TI-59 Only)

Display When Card Entered	Calculator Response
0	Reads information into bank number listed on card if current partition matches that on card. If partition incorrect, card is passed, but not read — display flashes card side passed.
1, 2, 3, 4	Expects card with this side number to be read — displays that side number. If another side is entered or if partition is incorrect, card is passed but not read — display flashes card side passed.
−1, −2, −3, −4	Forces side to be read into this bank number regardless of the partition or the number on the card. A protected program cannot be forced into any bank or alternate partition.
Any other number	Card is passed but not read — rightmost two integers in display flash.

LIBRARY USER INSTRUCTIONS

The remainder of this booklet contains the User Instructions for each program of the library.

REMOVING AND INSTALLING MODULES. The library module 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.
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.

SURVEYING LIBRARY DIAGNOSTIC

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
	Diagnostic/Module Check			
A1	Select Program		[2nd] [Pgm] 01	
A2	Run Diagnostic		[SBR] [=]	4.[1, 2]
	or			
A3	Library Module Check		[SBR] [2nd] [R/S]	4.[2]
	Initialize Linear Regression			
B1	Select Program		[2nd] [Pgm] 01	
B2	Initialize Linear Regression		[SBR] [CLR]	0.

NOTES:
1. This output is obtained if the calculator is operating properly.
2. The number 4 indicates the Surveying Library.

AZIMUTH/BEARING TRAVERSE

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select Program		[2nd] [Pgm] 02	
	Select degree mode		[2nd] [Deg]	
2[1]	Initialize		[2nd] [E′]	0.000000
3[1]	Enter Reference North	Ref N	[2nd] [A′]	Ref N†
4[1]	Enter Reference East	Ref E	[R/S]	Ref E†
	Do Step 5 OR Step 6			
5a	Enter Azimuth (DDD.MMSS)[2]	Az	[A]	Az†
5b	Compute Bearing (DD.MMSS)		[R/S]	Brg†
5c	Compute Quadrant		[R/S]	Q†
6a	Enter Bearing (DD.MMSS)	Brg	[B]	Brg†
6b	Enter Quadrant	Q	[2nd] [B′]	Q†
6c	Compute Azimuth (DDD.MMSS)		[R/S]	Az†
7	Enter distance[3]	Dist	[C]	Dist†
	Do Step 8a, OR 8b, OR 8c			
8a	If Dist in 7 is horizontal	0†	[R/S]	Hz Dist†
8b	If slope Dist and vertical angle known, enter vertical angle (DD.MMSS)[4]	V∠†	[R/S]	Hz Dist†
8c	If slope Dist and zenith angle known, enter zenith angle (DD.MMSS)	Z∠†	[2nd] [C′]	Hz Dist†
9	Compute Departure		[D]	Dp†
10	Compute Latitude		[R/S]	Lt†
11	Compute next North		[R/S]	N†
12	Compute next East		[R/S]	E†
13[5]	Occupy next station and compute total distance		[E]	ΣHz Dist†

NOTES:

1. Do Steps 2, 3, and 4 *only if* this is the first leg of a traverse.
2. All angles are entered and displayed in DDD.MMSS format.
3. Distance may be entered in any unit, as long as this is consistent throughout the traverse. Note that this must be the same unit as that used in the reference coordinate expression.
4. Vertical angle is positive above the horizon, negative below.
5. Step 13 is omitted if the leg was a sideshot. Pressing [E] sums latitude, departure, and horizontal distance into the accumulating registers, and occupies the next station by storing the calculated N and E coordinates in registers designated for starting coordinates. Therefore, be certain that all previous calculations are correct before performing this step.
6. Program leaves calculator in fix 6 display format.
7. Steps 8a and 8b print an intermediate step, zenith angle.
8. Does not run in ENG.

† These values are automatically printed if the PC-100A is connected.

INVERSE TRAVERSE

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select Program Select degree mode		[2nd] [Pgm] 03 [2nd] [Deg]	
2[1]	Initialize		[2nd] [E′]	0.000000
3[1]	Enter Reference North	Ref N	[2nd] [A′]	Ref N†
4[1]	Enter Reference East	Ref E	[R/S]	Ref E†
5	Enter next North, compute Lt	N†	[A]	Lt†
6	Enter next East, compute Dp	E†	[B]	Dp†
7	Compute horizontal distance		[C]	Hz Dist†
8[2]	Compute bearing		[D]	Brg†
9	Compute quadrant		[R/S]	Q†
10	Compute azimuth		[R/S]	Az†
11[3]	Occupy next station and compute total Hz Dist thus far **For another leg, go to Step 5.**		[E]	ΣHz Dist†
12	Compute traverse area (only if program used for closure)		[RCL] [1] [7] [+] [( ] [RCL] [1] [0] [÷] [2] [=]	Area

NOTES:

1. Do Steps 2, 3, and 4 *only if* this is starting leg of a traverse.
2. All angles must be entered, and are displayed, in DDD.MMSS format. Distances are displayed in the same units as the coordinates used.
3. Do this step *only if* the traverse leg just calculated is not a sideshot. (See Note 5 under the Azimuth/Bearing Traverse User Instructions.) Be certain that all other calculations are correct before pressing [E].
4. Program leaves calculator in fix 6 display format.
5. Does not run in ENG.

† These values are automatically printed if the PC-100A is connected.

FIELD ANGLE TRAVERSE

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select Program		[2nd] [Pgm] 04	
	Select degree mode		[2nd] [Deg]	
2[1]	Enter Reference North	Ref N	[2nd] [A′]	Ref N†
3[1]	Enter Reference East	Ref E	[R/S]	Ref E†
4[1]	Enter Reference azimuth	Ref Az	[R/S]	Ref Az†
	Do Step 5a OR 5b OR 5c OR 5d			
5a[2]	Enter angle right (DD.MMSS)	∠R†	[A]	Azimuth†
5b	Enter angle left	∠L†	[+/−] [A]	Azimuth†
5c	Enter deflection right	DfR†	[B]	Azimuth†
5d	Enter deflection left	DfL†	[+/−] [B]	Azimuth†
6	Compute bearing		[R/S]	Brg†
7	Compute quadrant		[R/S]	Q†
8	Enter distance	Dist	[C]	Dist†
	Do Step 9a OR 9b OR 9c			
9a	If Dist in 7 is horizontal	0†	[R/S]	Hz Dist†
9b	If a slope Dist and vertical angle known, enter vertical angle (DD.MMSS)[3]	V∠†	[R/S]	Hz Dist†
9c	If a slope Dist and zenith angle known, enter zenith angle (DD.MMSS)	Z∠†	[2nd] [C′]	Hz Dist†
10	Compute departure		[D]	Dp†
11	Compute latitude		[R/S]	Lt†
12	Compute next North		[R/S]	N†
13	Compute next East		[R/S]	E†
14[4]	Occupy next station and compute total distance thus far		[E]	Σ Hz Dist†

NOTES:

1. Do Steps 2, 3, and 4 *only if* this is the first leg. The Reference Azimuth is that azimuth from which the field angle is measured (usually the azimuth of the previous leg).
2. All angles are entered and displayed in DDD. MMSS format. All distance units must be identical with those used for reference coordinates.
3. Vertical angle is positive above horizon, negative below.
4. Do this step only if the leg just computed is not a sideshot. (See Note 5 under the Azimuth/Bearing Traverse User Instructions.) Be certain that results are correct before doing this step.
5. Program leaves calculator in fix 6 display format.
6. Steps 5a and 5b print intermediate steps DfR and DfL, respectively.
7. Steps 9a and 9b print intermediate step, zenith angle.
8. Does not run in ENG.

† These values are automatically printed if the PC-100A is connected.

CIRCLE ARC TRAVERSE

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1[1]	Select Program		[2nd] [Pgm] 05	
	Select degree mode		[2nd] [Deg]	
2[2]	Enter central angle (DDD.MMSS)	C∠	[A]	C∠†
	Do Step 3a OR 3b			
3a	If C∠ measured clockwise		[B]	Azimuth†
3b	If C∠ measured counterclockwise		[2nd] [B′]	Azimuth†
4	Compute bearing		[R/S]	Brg†
5	Compute quadrant		[R/S]	Q†
6	Compute arc distance		[C]	Arc Dist†
	Do Step 7a OR 7b			
7a[3]	Compute and *include* sector area		[2nd] [C′]	A_{sect}†
7b	Compute and *exclude* sector area		[2nd] [D′]	$-A_{sect}$†
8	Compute departure		[D]	Dp†
9	Compute latitude		[R/S]	Lt†
10	Compute next North		[R/S]	N†
11	Compute next East		[R/S]	E†
12[4]	Occupy next station and compute total distance thus far		[E]	Σ Hz Dist†

NOTES:

1. Either the Azimuth/Bearing, Inverse, or Field Angle Traverse programs *must* have been used immediately before running this program to establish the center coordinates, reference azimuth, and radius of the arc.
2. All angles are entered and displayed in DDD.MMSS format.
3. Step 7 includes or excludes the sector area from the total traverse area found in the Closure and Inverse Traverse programs. (see text)
4. See Note 5 under the Azimuth/Bearing Traverse User Instructions. Be certain that the results obtained through Step 11 are correct before pressing [E]. To recover from an error noticed after **Step 6,** press [RCL] [0] [8] [−] [RCL] [0] [7] [=] [INV] [SUM] [0] [9]. To recover after **Step 7a,** press the above plus [2nd] [D′]. To recover after **Step 7b,** do the above for Step 6 plus [2nd] [C′].
5. Program leaves calculator in fix 6 display format.
6. Does not run in ENG.

† These values are automatically printed if the PC-100A is connected.

CLOSURE

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select Program Select degree mode **If done immediately after a Traverse program, go to Step 7.**[1]		[2nd] [Pgm] 06 [2nd] [Deg]	
2	Enter total distance traversed	Σ Hz Dist	[2nd] [C′]	Σ Hz Dist†
3[2]	Enter partial area (from R_{10})	A_{part}	[2nd] [D′]	A_{part}†
4[2]	Enter sector area (from R_{17})	A_{sect}	[STO] [1] [7]	A_{sect}†
5	Enter calculated North	N_{calc}	[A]	N_{calc}†
6	Enter calculated East	E_{calc}	[A]	E_{calc}†
7	Enter correct North	N_{corr}	[B]	N_{corr}†
8	Enter correct East	E_{corr}	[B]	E_{corr}†
9	Compute closure distance		[C]	C Dist†
10	Compute error bearing (DD.MMSSss)		[D]	Err Brg†
11	Compute quadrant		[E]	Q†
12[2]	Compute Area		[2nd] [A′]	Area†
13[3]	Compute precision ratio		[2nd] [B′]	Prec†

NOTES:

1. Provided that memories are intact.
2. See text for explanation.
3. $\frac{\text{C Dist}}{\Sigma \text{ Hz Dist}}$
4. Program leaves calculator in fix 6 display format.

† These values are automatically printed if the PC-100A is connected.

BALANCE — COMPASS RULE

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select Program **If done immediately after Closure, go to Step 9.**		[2nd] [Pgm] 07	
2	Initialize		[2nd] [E′]	0.000000
3[1]	Enter last calculated North	N_{calc}	[2nd] [A′]	N_{calc}†
4	Enter last calculated East	E_{calc}	[2nd] [A′]	E_{calc}†
5	Enter correct North	N_{corr}	[2nd] [B′]	N_{corr}†
6	Enter correct East	E_{corr}	[2nd] [B′]	E_{corr}†
7[2]	Enter total distance traversed	Σ Hz Dist	[2nd] [C′]	Σ Hz Dist†
8	Compute and store closing latitude and departure		[2nd] [D′]	0.†
9[3]	Enter starting North	N_s	[A]	N_s†
10	Enter starting East	E_s	[A]	E_s†
11	Enter unadjusted North	N	[B]	N†
12	Enter unadjusted East	E	[B]	E†
13	Compute adjusted North	N_{adj}	[C]	N_{adj}†

14	Compute adjusted East	E_{adj}	[D]	E_{adj}†
15	If more points then go to Step 11.		[E]	0.†

NOTES:

1. Steps 3-6 enter the end coordinates of the closure.
2. Does not include the closure distance.
3. Enter coordinates in the same order as traversed.
4. Program leaves calculator in fix 6 display format.

† These values are automatically printed if the PC-100A is connected.

BALANCE — TRANSIT RULE

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select Program		[2nd] [Pgm] 08	
	If done immediately following Closure, go to Step 9.			
2	Initialize		[2nd] [E′]	0.000000
3	Enter starting North	N_s	[2nd] [A′]	N_s†
4	Enter starting East	E_s	[2nd] [A′]	E_s†
5[1]	Enter next North	N	[2nd] [B′]	N†
6	Enter next East	E	[2nd] [B′]	E†
7	Compute Σ|Lt| and Σ|Dp|		[2nd] [C′]	0.†
	For next leg, go to Step 5[2]			
8	Compute closure latitude and departure		[2nd] [D′]	0.†
9	Enter starting North	N_s	[A]	N_s†
10	Enter starting East	E_s	[A]	E_s†
11[1]	Enter unadjusted North	N	[B]	N†
12	Enter unadjusted East	E	[B]	E†

13	Compute adjusted North		[C]	N_{adj}†
14	Compute adjusted East		[D]	E_{adj}†
15	If more points go to step 11[2]		[E]	0.†
16	Stop.			

NOTES:

1. Enter coordinates in the same order as they were traversed.
2. Do not do Steps 5-7 or 11-15 for the closure. If no more legs, go to Steps 8 and 16 respectively.
3. Program leaves calculator in fix 6 display format.

† These values are automatically printed if the PC-100A is connected.

VERTICAL CURVE DESIGN

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select Program		[2nd] [Pgm] 09	
2	Initialize		[2nd] [E′]	0.000000
3a	Enter starting grade	g_1	[A]	g_1 †
3b	Enter ending grade	g_2	[A]	g_2 †
4a	Enter curve length	L†	[B]	Δg†
4b	or change of grade per station	Δg†	[2nd] [B′]	L†
	Do Steps 6–9a OR Steps 6–9b.			
6a	Enter Beginning station	Sta_B	[C]	Sta_B †
7a	Enter Elevation of Sta_B	$Elev_B$	[C]	$Elev_B$ †
8a	Compute Intersect station		[R/S]	Sta_I †
9a	Compute Elevation of Sta_I		[R/S]	$Elev_I$ †
	OR			
6b	Enter Intersect station	Sta_I	[2nd] [C′]	Sta_I †
7b	Enter Elevation of Sta_I	$Elev_I$	[2nd] [C′]	$Elev_I$ †
8b	Compute Beginning station		[R/S]	Sta_B †
9b	Compute Elevation of Sta_B		[R/S]	$Elev_B$ †
10	Compute Station at maximum or minimum elevation		[D]	Sta (↑/↓)†

11	Compute maximum or minimum elevation		[E]	Elev (↑/↓)†
	To find elevation of any curve station			
12	Enter Station	Sta†	[E]	Elev†

NOTES: 1. Program leaves calculator in fix 6 display format.

† These values are automatically printed if the PC-100A is connected.

HORIZONTAL CURVE DESIGN (1)

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select Program		[2nd] [Pgm] 10	
2	Initialize		[2nd] [E′]	0.000000
3	Enter Central Angle (DDD.MMSSss)	Δ	[2nd] [A′]	Δ† (DDD.MMSSss)
4a	If by Chord Definition, go to Step 5			
4b	If by Arc Definition		[2nd] [B′]	Δ†
5a	Enter Radius	R	[A]	R†
5b	or Tangent Distance	T†	[B]	R†
5c	or External Distance	E†	[C]	R†
5d	or Degree of Curve	D†	[D]	R†
5e	or Curve Length	L†	[E]	R†
6	Compute Tangent Distance		[R/S]	T†
7	Compute External Distance		[R/S]	E†
8	Compute Degree of Curve		[R/S]	D† (DDD.MMSSss)
9	Compute Curve Length		[R/S]	L†

NOTES: 1. Program leaves calculator in fix 6 display format.

† These values are automatically printed if the PC-100A is connected.

HORIZONTAL CURVE DESIGN (2) SY-11

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select Program		[2nd] [Pgm] 11	
	If run immediately after SY-10, go to Step 4.			
2	Initialize		[2nd] [E′]	0.000000
3	Enter Central Angle (DDD.MMSS)	Δ	[2nd] [A′]	Δ† (DDD.MMSSss)
4a	If by Chord Definition, go to Step 5			
4b	If by Arc Definition		[2nd] [B′]	Δ†
5a	Enter Radius	R	[A]	R†
5b	or Tangent Distance	T†	[B]	R†
5c	or External Distance	E†	[C]	R†
5d	or Degree of Curve	D†	[D]	R†
5e	or Curve Length	L†	[E]	R†
6	Compute Chord Length (P.C. to P.T.)		[R/S]	C†
7	Compute Middle Ordinate		[R/S]	M†
8	Compute Sector Area		[R/S]	A_{sect}†
9	Compute Segment Area		[R/S]	A_{seg}†
10	Compute Fillet Area		[R/S]	A_{fil}†

NOTES: 1. Program leaves calculator in fix 6 display format.

† These values are automatically printed if the PC-100A is connected.

HORIZONTAL CURVE LAYOUT

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Execute SY-10 through Step 9[1]			
2	Select Program		[2nd] [Pgm] 12	
3a	Enter P.I.	P.I.	[2nd] [A′]	P.C.
3b	or P.C.	P.C.	[2nd] [B′]	P.T.
	If printer is not available, go to Step 5.			
4	Compute and print the following: P.C. (then for each station on the curve)[2] Current Station Central angle from previous station Chord length from previous station Deflection angle from P.C.		[2nd] [C′]	
5	Enter Station I	Sta I	[A]	Sta I
6	Enter Station J[3]	Sta J	[A]	Sta J
7	Compute Central angle (I to J)		[B]	$C\angle_{I-J}$
8	Compute Chord length (I to J)		[C]	C_{I-J}

9	Compute Deflection Angle (PC to J)		[D]	Def_{PC-J}
	Optional:[4]			
10	Display P.C.		[2nd] [D′]	P.C.
11	Display P.T.		[E]	P.T.

NOTES:

1. SY-10 or other intervening calculations may be executed, but R_{02}-R_{08} must remain intact.
2. This step calculates these values for each full curve station and P.T. If any other station is desired, go to Step 5. Note that any result may be printed by manual command (i.e. – [prt].
3. If the current Station J is to become the new Station I, only Step 6 needs be done.
4. Steps 10 and 11 may be done any time after Step 4.
5. Program leaves calculator in fix 6 display format.

EDM SLOPE REDUCTION — (SLOPE ANGLE)

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select Program Select degree mode		[2nd] [Pgm] 13 [2nd] [Deg]	
2	Initialize		[2nd] [E′]	earth Radius[1] †
3	Enter slope distance[2]	S Dist	[A]	S Dist†
4	Enter zenith angle[3]	Z∠	[B]	Z∠†
5	Enter height of DM unit	DMH	[C]	DMH†
6	Enter reflector height	RH	[R/S]	RH†
7	Enter theodolite height	ThH	[D]	ThH†
8	Enter target height	TH	[R/S]	TH†
9	Enter DM unit elevation	DM Elev	[E]	DM Elev†
10	Compute Hz Dist (IEL)		[2nd] [A′]	Hz Dist (IEL)†
11	Compute Hz Dist (SL)		[2nd] [B′]	Hz Dist (SL)†
12	Compute Δ Elev		[2nd] [C′]	Δ Elev†

NOTES:

1. A different value may be used by entering it at this point (after pressing [2nd] [E′]). Key in the desired value and press [STO] [0] [1], then continue.
2. All distances entered and displayed in feet unless Rad is altered to another unit.

3. Angle must be entered in decimal degrees. If angle is known in DD.MMSS, key in angle and press [2nd] [D.MS] [B] to enter in decimal degrees.
4. Program leaves calculator in fix 6 display format.

† These values are automatically printed if the PC-100A is connected.

EDM SLOPE REDUCTION — (Δ ELEVATION) SY-14

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select Program Select degree mode		[2nd] [Pgm] 14 [2nd] [Deg]	
2	Initialize		[2nd] [E′]	earth Radius[1] †
3	Enter slope distance[2]	S Dist	[A]	S Dist†
4	Enter DM unit elevation	DM Elev	[B]	DM Elev†
5	Enter reflector elevation	R Elev	[C]	R Elev†
6	Enter DM unit height	DMH	[D]	DMH†
7	Enter reflector height	RH	[E]	RH†
8	Compute Hz Dist (IEL)		[2nd] [A′]	Hz Dist (IEL)†
9	Compute Hz Dist (SL)		[2nd] [B′]	Hz Dist (ISL)†
10	Enter specified elevation and compute Hz Dist	EL_{sp}†	[2nd] [C′]	$Hz\ Dist_{sp}$†

NOTES:
1. If another value is desired, key in that value and press [STO] [0] [1], then continue.
2. All distances entered and displayed in feet unless Rad is altered to another unit.
3. Program leaves calculator in fix 6 display format.

† These values are automatically printed if the PC-100A is connected.

STADIA REDUCTIONS AND TRAVERSE

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select Program Select degree mode		[2nd] [Pgm] 15 [2nd] [Deg]	
2	Initialize[1]		[2nd] [E′]	0.000000
3	Enter reference elevation[2]	Ref Elev	[A]	Ref Elev†
4	Enter instrument height	Inst H	[B]	Inst H†
5	Enter stadia interval	Intv'l	[C]	Intv'l†
6a 6b	**Enter** vertical angle[2] **OR** zenith angle[2]	Vert ∠ 90 Z∠	[D] [−] [=] [D]	Vert ∠† 90. Vert ∠†
7	Enter rod reading[3]	rod read'g	[E]	Rod Read'g†
8	Compute horizontal distance		[2nd] [A′]	Hz Dist†
9	Compute change in elevation		[2nd] [B′]	Δ Elev†
10	Compute elevation of next station		[R/S]	Elev†
	For another reduction from the same point, go to Step 5. **For a traverse, continue.**			
11	Display current station # and occupy next station[3]		[2nd] [C′]	Sta #†
12	**Do Steps 4–11 for next station.**			

	Otherwise, go to Step 13 to distribute closure error.			
13	Enter computed elevation of station[4]	Elev	[2nd] [D′]	Elev†
14	Enter Hz Dist *to* station and compute corrected elevation	Hz Dist	[R/S]	$Elev_c$†
	(Repeat Steps 13 and 14 for each leg in the same order as traversed.)			

NOTES:

1. Program assumes K = 100 and C = 1. Different values may be entered immediately after Step 2 by:
   Entering K, pressing [STO] [0] [1]
   Entering C, pressing [STO] [0] [2].
2. Distance may be entered in any unit. Angles must be entered in DD.MMSS format.
3. An entry error in Steps 4–7 may be corrected by repeating that step and continuing. If [2nd] [C′] has been pressed:
   Enter the previous elevation and press [STO] [1] [0]
   Enter the previous station # and press [STO] [1] [1]
   Enter the sum of the previously calculated horizontal distances and press [STO] [1] [4]
   Then go to the erroneous step, correct, and continue
4. If an error is made in Steps 13 and 14, do the following:
   Press [2nd] [B′], ignore display, then
   Go to Step 13 and begin again.
5. Program leaves calculator in fix 6 display format.

† These values are automatically printed if the PC-100A is connected.

INTERSECTION — (BEARING/BEARING) SY-16

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select Program Select degree mode		[2nd] [Pgm] 16 [2nd] [Deg]	
2	Initialize		[2nd] [E′]	0.000000
3	Enter N_1	N_1	[A]	N_1 †
4[1]	Enter E_1	E_1	[A]	E_1 †
5	Enter N_2	N_2	[B]	N_2 †
6[1]	Enter E_2	E_2	[B]	E_2 †
7	Enter Brg_1 (DD.MMSS)	Brg_1	[C]	Brg_1 †
8[1]	Enter $Quadrant_1$	Q_1	[C]	Q_1 †
9	Enter $Bearing_2$ (DD.MMSS)	Brg_2	[D]	Brg_2 †
10[1]	Enter $Quadrant_2$	Q_2	[D]	Q_2 †
11	Compute N_I		[E]	N_I †
12	Compute E_I		[2nd] [A′]	E_I †

NOTES:
1. To correct an entry error in Steps 4, 6, 8, or 10, go back to the preceding step.
2. Program leaves calculator in fix 6 display format.

† These values are automatically printed if the PC-100A is connected.

INTERSECTION — (DISTANCE/DISTANCE) SY-17

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select Program Select degree mode		[2nd] [Pgm] 17 [2nd] [Deg]	
2	Initialize		[2nd] [E′]	0.000000
3	Enter N_1	N_1	[A]	N_1 †
4[1]	Enter E_1	E_1	[A]	E_1 †
5	Enter N_2	N_2	[B]	N_2 †
6[1]	Enter E_2	E_2	[B]	E_2 †
7	Enter $Dist_1$	$Dist_1$	[C]	$Dist_1$ †
8	Enter $Dist_2$	$Dist_2$	[D]	$Dist_2$ †
9[2]	Compute ϕ		[E]	ϕ †
10	Compute Az_{12}		[2nd] [A′]	Az_{12} †
11[2]	Compute N_I		[2nd] [B′]	N_I †
12[2]	Compute E_I		[2nd] [C′]	E_I †

NOTES:
1. To correct an entry in Steps 4 or 6, go back to the preceding step.
2. The computed solution is always clockwise from point 1 to 2.
3. Program leaves calculator in fix 6 display format.

† These values are automatically printed if the PC-100A is connected.

INTERSECTION — (BEARING/DISTANCE)

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select Program		[2nd] [Pgm] 18	
	Select degree mode		[2nd] [Deg]	
2	Initialize		[2nd] [E′]	0.000000
3	Enter N_1	N_1	[A]	N_1 †
4	Enter E_1 [1]	E_1	[A]	E_1 †
5	Enter N_2	N_2	[B]	N_2 †
6	Enter E_2 [1]	E_2	[B]	E_2 †
7	Enter bearing of line 1 (DD.MMSS)	Brg_1	[C]	Brg_1 †
8	Enter quadrant of Brg_1 [2]	Q_1	[D]	Q_1 †
9	Enter $Dist_2$	$Dist_2$	[E]	$Dist_2$ †
10	Compute distance from point 1 to point 2		[2nd] [A′]	$Dist_{12}$ †
11	Compute azimuth from point 1 to point 2		[2nd] [B′]	Az_{12} †
12	Compute N_I		[2nd] [C′]	N_I †
13	Compute E_I		[2nd] [D′]	E_I †

NOTES: 1. To correct an entry error in Steps 4 and 6, go back to the previous step.

2. For the solution nearest point 1, enter the bearing *into* point 1 (from intersection). For the solution farthest from point 1, enter the bearing *out of* point 1. Only the quadrant will differ, so for the second solution, do Steps 8, 10–13.
3. Program leaves calculator in fix 6 display format.

† These values are automatically printed if the PC-100A is connected.

INTERSECTION OF A PERPENDICULAR FROM A POINT TO A LINE SY-19

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select Program Select degree mode		[2nd] [Pgm] 19 [2nd] [Deg]	
2	Initialize		[2nd] [E′]	0.000000
3	Enter N_B	N_B	[A]	N_B †
4	Enter E_B [1]	E_B	[A]	E_B †
5	Enter N_O	N_O	[B]	N_O †
6	Enter E_O [1]	E_O	[B]	E_O †
7	Enter Bearing (DD.MMSS)	Brg	[C]	Brg†
8	Enter Quadrant [1]	Q	[C]	Q†
9	Compute N_I		[D]	N_I †
10	Compute E_I		[E]	E_I †
11	Compute $Dist_{OI}$		[2nd] [A′]	$Dist_{OI}$ †
12	Compute $Dist_{BI}$		[2nd] [B′]	$Dist_{BI}$ †

NOTES:

1. To correct an entry error in Steps 4, 6 or 8, go back to the previous step.
2. Program leaves calculator in fix 6 display format.

† These values are automatically printed if the PC-100A is connected.

THREE-POINT RESECTION

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select program 20		[2nd] [Pgm] 20	
2	Enter appropriate case number (see Figure 1)	CASE NO. (1-3)	[2nd] [E′]	0.000
3	Enter north coordinate of point A	A NORTH	[A]	A_N †
4	Enter east coordinate of point A	A EAST	[R/S]	A_E †
5	Enter north coordinate of point B	B NORTH	[B]	B_N †
6	Enter east coordinate of point B	B EAST†	[R/S]	Azimuth BA†
7	Display distance BA		[x≥t]	Dist BA†
8	Enter north coordinate of point C	C NORTH†	[C]	C_N †
9	Enter east coordinate of point C	C EAST†	[R/S]	Azimuth CA†
10	Display distance CA		[x≥t]	Dist CA†
11	Enter angle P1 (DDD.MMSS)	P1 (DDD.MMSS)†	[D]	P1 (decimal)†
12	Enter angle P2 (DDD.MMSS) **Clockwise P2 is positive. Counter-clockwise P2 is negative.**	P2 (DDD.MMSS)†	[E]	|P2| (decimal)†
13	Calculate P_N, P_E		[2nd] [D′] [x≥t]	P_N † P_E †
14	Calculate azimuth AP and distance AP		[2nd] [A′] [x≥t]	Azimuth AP† Dist AP†
15	Calculate azimuth BP and distance BP		[2nd] [B′] [x≥t]	Azimuth BP† Dist BP†
16	Calculate azimuth CP and distance CP		[2nd] [C′] [x≥t]	Azimuth CP† Dist CP†

NOTES:

1. Azimuths are printed in the format DDD.MMSS.
2. $0 < P1 < 180, 0 < P2 < 180$
3. Program leaves calculator in fix 3 or fix 6 display format.
4. Does not run in ENG.

† These values are automatically printed if the PC-100A is connected.

BORROW PIT VOLUME

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select Program		[2nd] [Pgm] 21	
2	Initialize		[2nd] [E′]	0.
	For each prism			
3	Enter altitude or length[1]	ALT:L	[A]	ALT:L†
4	Enter base or width[1]	Base: W	[B]	Base: W†
5	Identify section as triangle OR rectangle		[C] [D]	3.† 4.†
6	Enter corner depth (repeat for each corner)[2]	Corner depth†	[E]	# of corner entries left
	Optional – Display for current section			
7	Altitude or length		[2nd] [A′]	Alt:L†
8	Base or width		[2nd] [B′]	Base: W†
9	Cumulative volume so far		[2nd] [C′]	Σ Vol†
10	Section volume		[2nd] [D′]	Sect Vol†
11	Go to Step 3 for next prism			

NOTES:

1. Do Steps 3 and 4 as needed. (See Example)
2. To recover from a mistake before the last corner depth is entered, go to Step 3; otherwise, begin again.

† These values are automatically printed if the PC-100A is connected.

EARTHWORK VOLUME (BY AVERAGE END AREA)

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select Program		[2nd] [Pgm] 22	
2	Initialize		[2nd] [E′]	1.
	For each point[1]			
3a	Enter elevation	Elev	[A]	Elev†
3b	Enter distance from centerline	Dist	[B]	Dist†
	For each station			
4	Enter interval from previous station (zero for 1st station)	Intv'l	[C]	Intv'l†
5	Calculate[2]		[D]	Next Station #†
	Optional – Display results			
6	Display station area		[2nd] [A′]	Sta Area†
7	Display station volume		[2nd] [B′]	Sta Vol†
8	Display cumulative volume		[2nd] [C′]	Σ Vol†
9	Display next station number		[2nd] [D′]	Next Sta #†

NOTES: 1. Step 3a and b must be performed together. Points are entered consecutively in either a clockwise or counterclockwise direction.

2. To correct an error made before [D] is pressed (or after [D] if the values below are known), do the following:
   Press [2nd] [A′] and [2nd] [C′] to find the needed values
   Press [2nd] [E′], then
   Store the present Station number in R_{10}
   Store the previous Station Area in R_{07}
   Store the previous Σ Volume in R_{12}
   Then go to Step 3 and continue.

† These values are automatically printed if the PC-100A is connected.

TRIANGLE SOLUTION (1)

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1a	Select Program		[2nd] [Pgm] 23	
1b	Select angular mode			
	Knowing SSS			
2	Enter a	a	[A]	a†
3	Enter b	b	[B]	b†
4	Enter c	c	[C]	c†
5	Calculate ∠A		[2nd] [A′]	∠A†
6	Calculate ∠B		[D]	∠B†
7	Calculate ∠C		[E]	∠C†
	Knowing SS∠			
8	Enter a	a	[A]	a†
9	Enter b	b	[B]	b†
10	Enter ∠A	∠A	[C]	∠A†
11	Calculate c		[2nd] [B′]	c†
12	Calculate ∠B		[D]	∠B†
13	Calculate ∠C		[E]	∠C†
	Knowing S∠S			
14	Enter a	a	[A]	a†
15	Enter b	b	[B]	b†
16	Enter ∠C	∠C	[C]	∠C†
17	Calculate c		[2nd] [C′]	c†
18	Calculate ∠B		[D]	∠B†
19	Calculate ∠A		[E]	∠A†
	To Calculate Area			
20	Select Program		[2nd] [Pgm] 24	
21	Calculate Area		[2nd] [C′]	Area†

NOTES:

1. Does not run in ENG.
2. Cannot recalculate values without first reentering data.

† These values are automatically printed if the PC-100A is connected.

TRIANGLE SOLUTION (2)

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1a 1b	Select Program Select angular mode		[2nd] [Pgm] 24	
	Knowing ∠S∠			
2	Enter a	a	[A]	a†
3	Enter ∠B	∠B	[B]	∠B†
4	Enter ∠C	∠C	[C]	∠C†
5	Calculate ∠A		[2nd] [A′]	∠A†
6	Calculate b		[D]	b†
7	Calculate c		[E]	c†
	Knowing S∠∠			
8	Enter a	a	[A]	a†
9	Enter ∠A	∠A	[B]	∠A†
10	Enter ∠C	∠C	[C]	∠C†
11	Calculate ∠B		[2nd] [B′]	∠B†
12	Calculate b		[D]	b†
13	Calculate c		[E]	c†
14[1]	Calculate Area		[2nd] [C′]	Area†

NOTES:

1. a, b, c are stored in $R_{00\text{-}02}$ by solving a triangle. They may be stored from the keyboard, if desired.
2. Cannot recalculate values without first reentering data.

† These values are automatically printed if the PC-100A is connected.

CURVE SOLUTION

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select Program		[2nd] [Pgm] 25	
2	Select degree mode		[2nd] [Deg]	
	Do any one of the following pairs:			
3a	Enter R	R	[A]	R†
4a	Enter Δ (DDD.MMSS)	Δ†	[R/S]	L†
3b	Enter R	R	[B]	R†
4b	Enter C	C†	[R/S]	L†
3c	Enter R	R	[C]	R†
4c	Enter L	L†	[R/S]	C†
3d	Enter C	C	[D]	C†
4d	Enter Δ (DDD.MMSS)	Δ†	[R/S]	L†
3e	Enter Δ (DDD.MMSS)	Δ	[E]	Δ (DDD.dddddd)†
4e	Enter L	L†	[R/S]	C†
	Do Steps 5–7 as needed			
5a	Calculate Δ and		[2nd] [A′]	Δ (DDD.MMSSss)†
5b	R		[R/S]	R†
6a	Calculate L and		[2nd] [B′]	L†
6b	C		[R/S]	C†
7a	Calculate A and		[2nd] [C′]	A†
7b	a		[R/S]	a†

NOTES: 1. Δ must be less than 180°.

2. Program leaves calculator in fix 6 display format.

† These values are automatically printed if the PC-100A is connected.

TEXAS INSTRUMENTS
INCORPORATED
DALLAS, TEXAS

Printed in U.S.A. 1015755-4