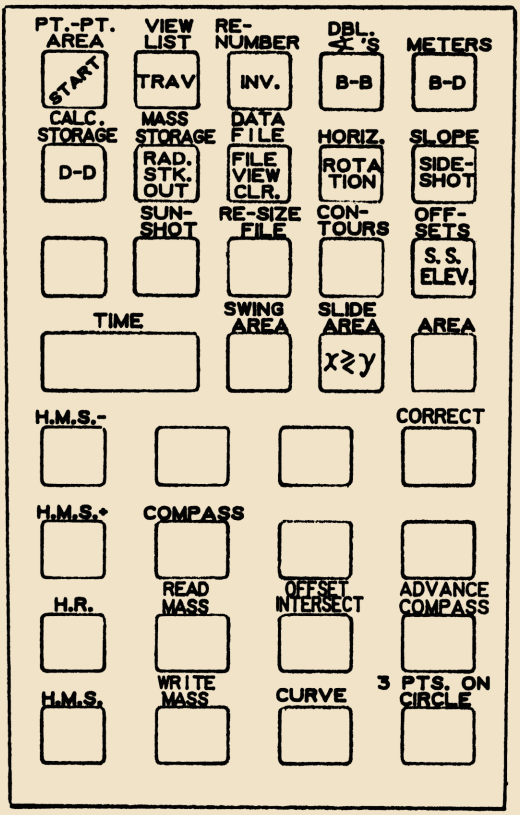
"KEYS" SURVEYING MODULE

OPERATION MANUAL



"KEYS" SURVEYING MODULE

MANUAL

BY

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CONTENTS (Cont.)

INTRODUCTION:

"KEYS" Provides surveying routines accessible by either a direct or shifted keystroke as identified on the keyboard diagram on the cover.

The required calculator configuration to run KEYS is as follows- HP41CX or HP41CV plus extended function module. Either one of these configurations allows you to store 62 points. With the addition of each "extended memory module" (up to two) it is possible to store an additional 119 points, to a maximum of 300 points.

INSTRUCTIONS:

1. Turn calc. off
2. Insert "KEYS" module
3. Press and hold the clear key
4. Turn calc. on
5. Release the clear key
6. Press XEQ
7. Press ALPHA
8. Press K E Y S
9. Press ALPHA

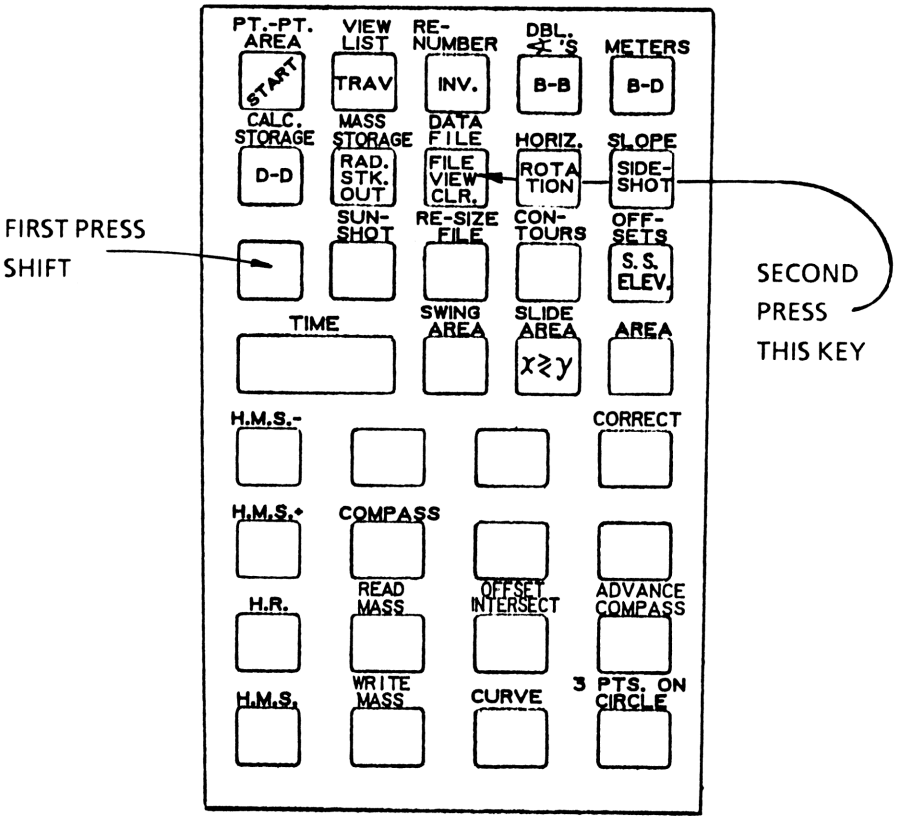
The routines will be assigned to the keys as identified on the keyboard diagram on the cover.

10. Press USER and these previously assigned KEYS are activated.

DATA FILES

A data file must be created in extended memory for coordinate storage by point number. To accomplish this press SHIFT (yellow key) SIN . You will see the label "DATA FILE" above the SIN key on the keyboard diagram which means it is a shifted keystroke. The program will prompt for "FILE NAME?" to be keyed in as a maximum of 7 characters in ALPHA Mode (See the back of your calculator for alpha keyboard). The letters on your keyboard become direct keystrokes and the numbers become shifted keystrokes when the calculator is in ALPHA Mode. A job number can also be used for the file name. After keying in the file name press R/S . Next the program will prompt for "FIRST POINT" which will generally be 1 but could be 200, 300, or 400 if you wanted to use a set of numbers of larger size. Key in and press R/S. Next the program will prompt for "LAST POINT" which will determine the size of the data file. Key in and press R/S .You may have more than one file at a time in your calculator so long as the total number of points does not exceed the limits set forth in the introduction. Also note that each file name occupies a space and reduces your total point capacity. After creating a file there are several other file operations following that you should read about before attempting to start calculations.

TO CREATE A DATA FILE



FILE VIEW AND FILE CLEAR

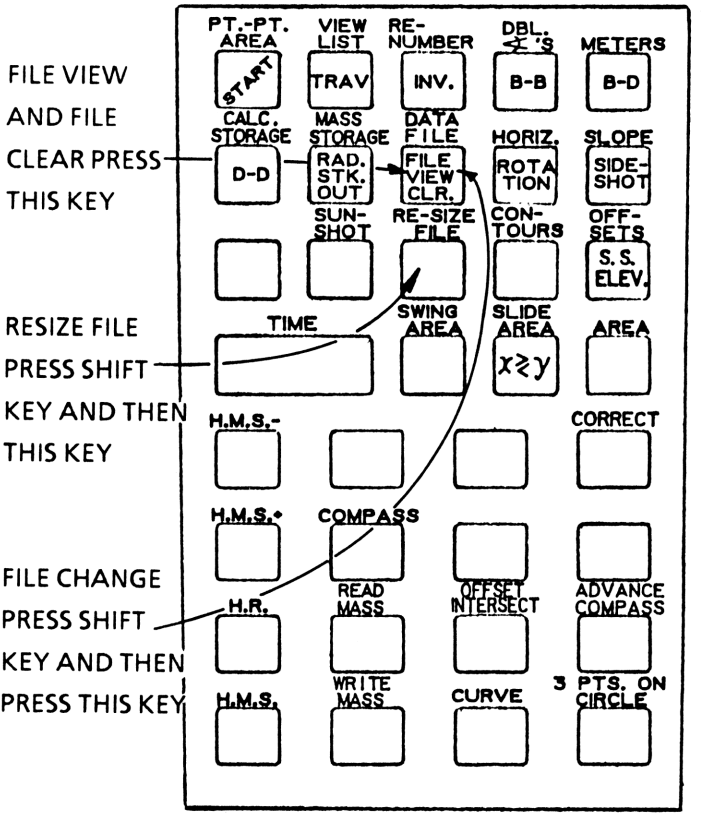
To view the name and size of your current data file press SIN . The type of file (mass file or calculator file) and name of file will flash on the screen, then the number of pts. will flash on the screen, then CLR-R/S will come on the screen. CLR-R/S is telling you "if you want to clear the file you just saw press R/S ". If not, just go into any other routine from there.

RESIZE FILE

To resize your current data file press SHIFT STO and the program will prompt for "FIRST PT." and "LAST PT." to be keyed in respectively followed by pressing R/S .

FILE CHANGE

To change from one data file to another press SHIFT SIN as you would to create a data file.
Answer the prompt for "FILE NAME" with the name of the file you wish to re-enter but when the prompt for "FIRST PT." appears don't answer it, just press R/S and the program will re-enter that already existing data file and will then prompt for "FIRST PT." and "LAST PT." to be keyed in as the same values they were when the file was created.


FILE VIEW
AND FILE
CLEAR PRESS
THIS KEY
RESIZE FILE
PRESS SHIFT
KEY AND THEN
THIS KEY
FILE CHANGE
PRESS SHIFT
KEY AND THEN
PRESS THIS KEY
PT.-PT. AREA
START
VIEW LIST
TRAV
RE-NUMBER
INV.
DBL. ∠'S
B-B
METERS
B-D
CALC. STORAGE
D-D
MASS STORAGE
RAD. STK. OUT
DATA FILE
FILE VIEW CLR.
HORIZ.
ROTATION
SLOPE
SIDE-SHOT
SUN-SHOT
RE-SIZE FILE
CON-TOURS
OFF-SETS
S.S. ELEV.
TIME
SWING AREA
SLIDE AREA
x≷y
AREA
H.M.S.-
CORRECT
H.M.S.+
COMPASS
H.R.
READ MASS
OFFSET INTERSECT
ADVANCE COMPASS
H.M.S.
WRITE MASS
CURVE
3 PTS. ON CIRCLE

CALCULATOR STORAGE

If you do not have a mass storage device, then your data files, which will contain the coordinates for the points you calculate will be in your calculator. The calculator will be in calculator storage mode when you have followed the instructions on page one which included clearing the calculator. If you were changing from mass storage to calculator storage you would press SHIFT X ≷ Y although that should not be necessary at this point.

To view the names, types and number of registers in the files in the calculator press SHIFT, ENTER, (not in the USER mode) then press 4.

MASS STORAGE

Equipment necessary for mass storage is an HP 82161A digital cassette drive or an HP 9114 disc drive. A minimum of 5000 point storage per disc or cassette is available. You will also need an HP 8260A HP-IL module to connect the HP-41 to the mass storage device.

Each cassette or disc must be initialized before data can be stored on it. To do this XEQ ALPHA N E W M ALPHA , then input 080. To receive further explanation on this, go to your HP-IL owners manual.

MASS STORAGE (cont.)

To use mass storage press SHIFT R↓ , then you will need to create a mass storage file using the same procedures as given previously for creating a storage file in the calculator. Clearing and re-entering of file will also operate in the same way as for a file in the calculator . Re-sizing a mass storage file is not possible; so to accomplish the same results, you will follow the procedure for re-sizing a file in the calculator but prior to that, you will need to have created a new file, with a different name, with enough size to meet your needs in mass storage. You should then re - enter the original file. You will be moving the contents of your original file to this new file. When you initiate the re-size file routine in mass storage mode, you will see "MOVE FILE" flash on the screen and then a prompt for "NEW FILE?". This would be the file you previously created. Next you will recieve a prompt for "FIRST POINT" and "LAST POINT". After answering these prompts, you could then clear the original file and move into the new file.

When working in mass storage, points will be stored on the medium (disc or tape) one at a time as you generate them and will not be in the calculator memory. The READ MASS and WRITE MASS routines provide a means to exchange data in blocks back and forth between the calculator and the mass storage device.

READ MASS

This routine prompts for a set of points to be transferred from the mass storage device to the calculator. To use this routine press SHIFT 1. The calculator will prompt for "FIRST POINT" to be input then press R/S. The calculator will then prompt for "LAST POINT" to be input then press R/S. Provided that your current file exists both in the calculator and on the mass storage medium the points covered will be duplicated from the mass storage medium to the calculator.

WRITE MASS

This routine prompts for a set of points to be transferred from the calculator to the mass storage device. To use this routine press SHIFT 0. The calculator will prompt for "FIRST POINT" to be input then press R/S. The calculator will then prompt for "LAST POINT" to be input then press R/S. Provided that your current file exists both in the calculator and on the mass storage medium the points covered will be duplicated from the mass storage medium.

FLAGS OPERATE AS FOLLOWS:

To set flag press SHIFT 7 , then the flag number in two digit form. To clear flags, press SHIFT 8, then the flag number in two digit form. Flags 0,1,2,3, and 4 are visible on the display when set. Setting or clearing a flag will cause the program to run differently.

Set flag 01 (S.F. 01)

When traversing, inversing or using pt. to pt. area to include a curved boundary for area. See instructions for "AREA".

When using OFFSETS FROM A CURVE. See instructions for OFFSETS FROM A CURVE.

When using HORIZONTAL CURVE STAKEOUT. See instructions for HORIZONTAL CURVE STAKEOUT.

When solving D-D (distance - distance) intersections in a counter- clockwise direction. See instructions for D-D intersections.

Set flag 03

When zenith angles are used (in sideshots only). To recieve zenith angle prompts, enter distance as a negative number when in TRAVERSE routine.

Set flag 04

When you want Doubled Angles and Meters (in sideshots only) or set flag 05 each time after angle entry in TRAVERSE routine.

AUTOMATIC ENTRIES:

When you are in TRAVERSE routine and the program prompts for CD (angle code), if you just press R/S, it will automatically use the last angle code you used. When you are in any routine that prompts for PT, if you just press R/S, it will automatically use the next consecutive point number. When you receive a prompt for zenith angle, if you just press R/S, it will automatically use a 90° 00' 00" angle.

CONSECUTIVE POINT NUMBERING

When using PT. TO PT. AREA, COORD. LIST, TRAVERSE, INVERSE, RADIAL STAKEOUT, or SIDESHOTS and you wish to run a set of points consecutively, you can input the first point number, then a decimal followed by the last point number in four digit form. For example, if you wanted to inverse from point 105 through point 126 consecutively when the prompt for PT is received, input it as 105.0126 and press R/S .

ENTER AND ASSIGN:

During any routine when you call up a point if you want to assign new coordinates to that point, enter the point number as a negative number.

START

The first key on the first row is the "START" key. After pressing this key, the calculator display will show "START". This is a prompt or question asking for your starting point number. This routine also serves to zero up all registers for area calculations and traverse balancing routines. Key in the point number then press R/S. If that point has not been used, the calculator will prompt for N? (northing) and E? (easting). Always press R/S after an entry. If it already has coordinates for that point or after you put in the coordinates, that point becomes your "currently occupied point" to be abbreviated COP from here on. It then advances to TRAVERSE and will ask for an ANGLE. With the exception of COORDINATE. LIST, if a point has a northing and easting of 0.00000 the program considers it "unused" and will prompt for coordinates. COORDINATE. LIST will print 0.00000 for northing and easting of any unused points. If you wish to use zero for northing and easting simply make one 0.000001 instead of 0.00000.

TRAVERSE

Your traverse begins at the COP. Begin by pressing the TRAVERSE key and the program will prompt for ANGLE. If you simply press R/S , a 90' 00' 00' angle will be automatically entered, otherwise when it prompts for ANGLE input the value and press R/S . If the angle is a field angle you have to START on the backsite point and INVERSE OR TRAVERSE to the COP before you begin traversing with a field angle. Next the program will prompt for CD (angle code). You will need to use angle code 1, 2, 3, 4, 5, 6, 7, 8, or 9 in the following cases.

CODE 1 = N.E. bearing or N. Azimuth
CODE 2 = S.E. bearing
CODE 3 = S.W. bearing or S. Azimuth
CODE 4 = N.W. bearing
CODE 5 = pt. to pt. direction (explained below)
CODE 6 = angle left
CODE 7 = angle right
CODE 8 = defl. left
CODE 9 = defl. right

CODE 5 signals a direction defined with two point numbers, the second of which should be input as four digit number after the decimal point.

An additional feature of angle code 5 is the ability to turn an angle to the right of a direction defined by two points. After defining a direction by two points (12.0013 for example) and the prompt for angle code appears, key in 5 decimal and angle to the right as if you were on the second of the two points, backsighting the first. The degrees of the angle must be in three digits (.090 for example) followed by minutes and seconds, if any.

Next the program will prompt for "DIST". to be keyed in and press R/S . If you need to input a zenith angle, enter the distance as a negative value and "ZEN∢"prompt will come next.

Next the program will prompt for "PT." to be keyed in, then press R/S .The program then advances to that point and will prompt for the angle to the next point.

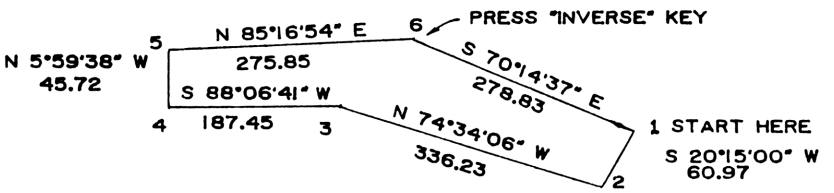
INVERSE

When you initiate INVERSE, the program will prompt for a point number. Input the number to be inversed to and press R/S.

The program will display the bearing, press R/S and the program will display the distance. Press R/S again and it will prompt for the next point to be inversed to.

EXAMPLE

DISPLAY	USER INSTRUCTION
	Press first key in first row
START	Input starting point number (1) and press R/S
ANGLE	Input 20.15 and press R/S
CD (angle code)	Input 3 and press R/S
DIST.	Input 60.97 and press R/S
PT (point number)	Input 2 and press R/S
ANGLE	Continue as explained above to point 6
ANGLE	Press third key in first row
PT (point number)	Input point to inverse to (1) and press R/S
S 70.1437 E	Display is bearing in degrees, minutes, and seconds. Press R/S
D = 278.83	Display is distance to point 1



B - B (bearing - bearing)

This routine begins at the COP. You can "START" at the beginning point (see START on page 11). Press fourth key on first row. The calculator will prompt for "ANGLE" which is to be input in either a point to point direction form or angular form as it would be from your COP going towards the intersect point. Press R/S and the calculator will prompt for CD (angle code). Input angle code (see angle code instructions on pg. 12) Press R/S and the calculator will prompt for INT PT. (intersect point) to be input, then press R/S. The next prompt is for "ANGLE" to be input in either the direction from the intersect point to the end point or vice versa. Then press R/S and the calculator will prompt for CD (angle code). Input angle code (see angle code instructions on pg. 12). Then press R/S and the calculator will prompt for END PT. Input end point and press R/S. The calculator will display the bearing from the COP to the intersect point. Press R/S again and the calculator will display the distance from the COP to the intersect point which will now be your COP. Press R/S and the calculator goes into the INVERSE routine and will prompt for PT (point to inverse to). You could inverse to any point from here or if you want to inverse to the end point, do not input any number, just press R/S and the calculator will give you the bearing from the COP going to the end point. Press R/S again and the calculator will give the distance to the end point.

B-D (bearing-dist.)

This routine begins at the COP. You can "START" at the beginning point (see START on page 11). Press fifth key on first row. The calculator will prompt for "ANGLE" which is to be input in either a point to point direction form or angular form as it would be from your COP going towards the intersect point. Press R/S and the calculator will prompt for CD (angle code). Input angle code (see angle code instruction on page 12). Press R/S and the calculator will prompt for INT. PT. (intersect point) to be input, then press R/S. The next prompt is for D = (distance =) to be input then press R/S. The calculator will prompt for END PT. to be input and press R/S. The caluclator will display the distance for the first of the two available solutions for the bearing distance intersection. If you want to use the first solution, just press R/S; but if not, press X ≷ Y (reassigned to the EEX key) and the display will show the distance for the second solution after which you press R/S and the calculator will display the bearing from the COP to the intersect point. Press R/S again and the calculator will display the distance from the COP to the intersect point which will now be your COP. Press R/S and the calculator goes into the INVERSE routine and will prompt for "PT" (point to inverse to). You could inverse to any point from here, but it you just press R/S without any input, the calculator will inverse to the END PT.

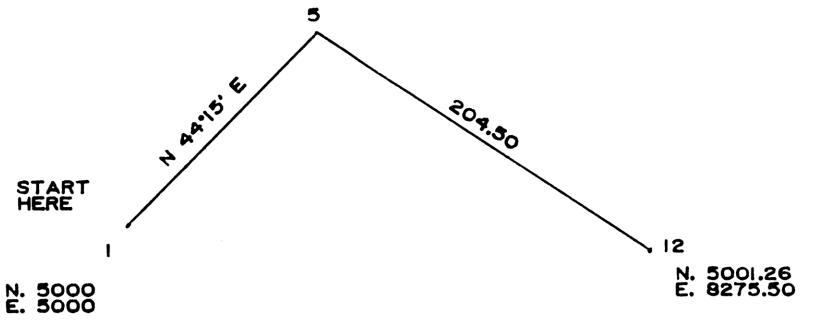
D-D (distance-distance)

This routine begins at the COP. You can START at the beginning point (See START on page 11). Press first key on the second row. The calculator will prompt for D.1 = (distance one =) which is to be input and press R/S. The calculator will prompt for INT. PT. (intersect point) to be input and press R/S. The calculator will prompt for D.2 = (distance two =) to be input and press R/S. The calculator will prompt for END PT. to be input but before pressing R/S if you want the solution to run counter clockwise, you must S.F. 01 (set flag 01) before pressing R/S. The calculator will give the bearing from the COP to the intersect point. Press R/S and the calculator will display the distance from the COP to the intersect point which will now be your COP. Press R/S and the calculator goes into the INVERSE routine and will prompt for "PT." (point to inverse to). You could inverse to any point from here but if you just press R/S without any input, the calculator will inverse to the END PT.

B-D EXAMPLE

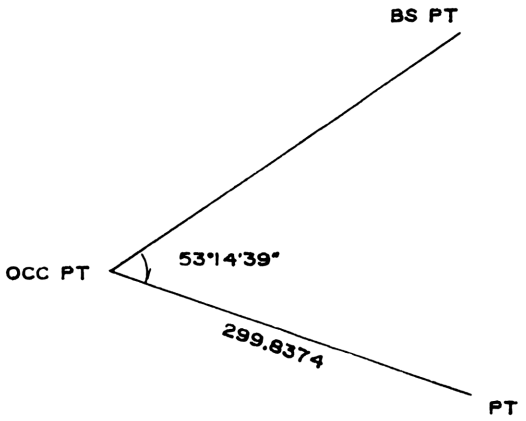
DISPLAY	USER INSTRUCTION
	Press first key on first row (START)
"START"	Input 1, press CHS (change sign), press R/S
"N = ?"	Input 5000, press R/S
"E = ?"	Input 8000 press R/S
ANGLE	Press fifth key on first row (B-D)
ANGLE	Input 44.15, press R/S
CD	Input 1, press R/S
INT. PT.	Input 5, press R/S
D = ?	Input 204.50, press R/S
END PT.	Input 12, press CHS, press R/S
N = ?	Input 5001.26, press R/S
E = ?	Input 8275.50, press R/S
136.3728	Display is first solution, press R/S
N44.1500E	Display is bearing, press R/S
D = 136.3728	Display is distance, press R/S
PT	Input 12, press R/S
S 61.5203 E	Display is bearing to end point, press R/S
D = 204.50	Display is distance to end point

NOTE: Pressing CHS (change sign) when inputting point numbers will cause prompts for coordinates.



RADIAL STAKEOUT

Press second key on second row. The calculator will prompt for "OCC PT" (occupy point number) to be input, then press R/S. The calculator will prompt for "BS PT" (backsite point number) to be input, then press R/S. The calculator prompts for "PT" (stakeout point) to be input, then press R/S. The calculator displays AR = 53.1439 which is the angle to the right of the backsite in degrees, minutes, and seconds. Press R/S again and the calculator displays D = 299.8374 which is the distance from the occupied point to the stakeout point. Press R/S again and the calculator prompts for "PT" (stakeout point) to be input, then press R/S. This routine will continue until you initiate another routine. If a printer is attached and you want a stakeout to several consecutive points, see page 10 for consecutive point numbering.



ROTATION (TRANSLATION)

Press fourth key on second row. The calculator will prompt for OCC PT. (occupy point or base point) to be input, then press R/S. The calculator will prompt for BS PT. (backsite point or reference point) to be input, then press R/S. The caculator then displays the existing bearing between the OCC PT. and the BS PT. Press R/S again and the calculator will display the existing distance between the OCC PT. and the BS PT. enabling you to confirm this with your record distance before continuing. If the distance is not within your tolerance, you can back out of the rotation and go to any other routine without affecting any points. Press R/S again and the calculator will flash ROTATE TO- and then prompt for "ANGLE" to be input as bearing, azimuth, or field angle. Press R/S and the calculator will prompt for CD (angle code) to be input, then press R/S. The calculator will prompt for SCL. (scale factor) to be input, then press R/S. Normally a scale factor of one is used and if this is the case, no input is required; just press R/S and one will be used. The calculator will prompt for N? (northing to be used for OCC PT.) to be input, then press R/S. The calculator will prompt for E? (easting to be used for OCC PT.) to be input, then press R/S.

ROTATION (TRANSLATION) cont.

The calculator will prompt for FRM PT (from point number) to be input as the beginning point for the first set you wish to rotate. Press R/S and the calculator will prompt for THRU PT (thru point number) to be input as the last point for the first set you wish to rotate. Press R/S and the calculator will rotate that set of points and return to the prompt for FRM PT ready to rotate another set of points. This will continue until you initiate another routine.

SIDESHOTS

Press the fifth key on the second row. The calculator will prompt OCC PT. (occupy point) to be input, then press R/S. The calculator will prompt BS PT. (backsite point) to be input, then press R/S. The calculator will prompt for "ANGLE" (angle right only) to be input, then press R/S. No prompt for angle code is used here because all angles are considered to be to the right. If flag 04 is set (see page 9), the calculator will display the doubled angle to be viewed, then press R/S. The calculator will prompt for D = (distance) to be input, then press R/S. If flag 04 is set (see page 9), meters will be displayed, then press R/S. If the distance is input as a negative value, the calculator will prompt for zenith angles for the remainder of the sideshots from that setup allowing for slope reduction. You can also set flag 03 (see page 9) if you wish to use slope reduction for all sideshots. If slope reduction is used, the calculator will prompt for ZEN $\measuredangle$ (zenith angle) to be input, then press R/S. If no slope reduction is used, the calculator will prompt for PT (point number) to be input, then press R/S. The calculator will prompt for "ANGLE" and continue until another routine is initiated.

S. S. ELEV. (SIDESHOTS WITH TRIG ELEVATIONS)

This function provides for the reduction of trigonometric levels as side shots are entered. Although the elevations are not stored, they are displayed for recording. Correction for curvature of the earth is applied to these levels.

Press the fifth key on the third row. The calculator will prompt for REF ELEV (reference elevation) to be input, then press R/S. If no value is input for this prompt and R/S is pressed, the calculator will go on to a prompt for H.I. ELEV (elevation of instrument) to be input, then press R/S. Using this prompt would allow you to set up over your bench mark or turning point measuring up to the instrument to get the H.I. ELEV. If you used the H.I. ELEV prompt, the next prompt would be H. Rod (height of rod) to be input, then press R/S. If the prompt for REF ELEV was answered, the next two calculator prompts would be "REF ZEN∠" (reference zenith angle) to be input and press R/S and then a prompt for "REF SLP DST" (reference slope distance) to be input and press R/S. After these prompts have been answered, the calculator goes to SIDESHOTS and will display reduced elevations as you go through side shot entry.

AREA

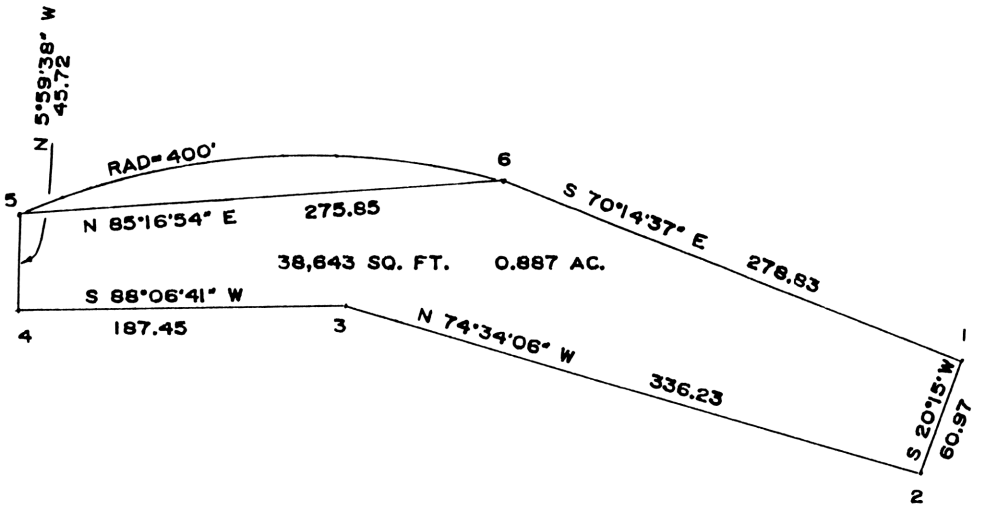
This routine is initiated by pressing the yellow shift key and then the fourth key on the fourth row after traversing, running intersections, or inversing your way around a figure and closing on your starting point. The square feet are then displayed. Press R/S and the acreage is displayed.

To include a curved boundary for area, the P.C. of the curve is to be input normally, but when the calculator prompts for point number at the P.T. of the curve, you must input the point number, then S.F. 01 (set flag 01), then press R/S. See page 9 for instructions on setting flags. The calculator will prompt for "RADIUS" to be input as a positive value if the segment of the curve adds to your area or as a negative value if the segment of the curve takes away from your area. Press R/S and the calculator will give you the chord of the curve. Press R/S and the calculator will give you the radius of the curve. Press R/S and the calculator will give you the delta of the curve.

(cont.)

AREA (CONT.)

Press R/S and the calculator will give you the arc of the curve. Press R/S and the calculator will give you the chord bearing. Press R/S and the calculator will give you the chord distance. Press R/S and the calculator will prompt for "PT" (point number) for normal input again.



AREA EXAMPLE

DISPLAY	USER INSTRUCTION
	Press first key on first row
"START"	Input starting point number (1) and press R/S
"ANGLE"	Input 20.1500 and press R/S
CD =	Input angle code (3) and press R/S
D. =	Input distance 60.97 and press R/S
PT	Input point number 2 and press R/S
"ANGLE"	Input 74.3406 and press R/S
CD =	Input angle code (4) and press R/S
D =	Input 336.23 and press R/S
PT	Input 3 and press R/S
"ANGLE"	Input 88.0641 and press R/S
CD =	Input 3 and press R/S
D =	Input 187.45 and press R/S
PT	Input 4 and press R/S
"ANGLE"	Input 5.5938 and press R/S
CD =	Input 4 and press R/S
D =	Input 45.72 and press R/S
PT	Input 5 and press R/S
"ANGLE"	Input 85.1654 and press R/S
CD =	Input 1 and press R/S
D =	Input 275.85 and press R/S
PT	Input 6, SF 01 (set flag 01 by pressing shift 7, then 01),
	press R/S
CHORD = 275.85	Press R/S
RAD =	Input 400.00 and press R/S
DELTA = 40.2027	Press R/S
ARC = 281.63	
"ANGLE"	Press INVERSE key (third key on first row)
PT	Input 1 and press R/S
S 70.1439 E	Displays bearing. Press R/S
D = 278.83	Displays distance. Initiate AREA routine
	(press shift, then fourth key on fourth row)
SQ. FT. = 38,642.63	Press R/S
AC. = 0.8871	

POINT TO POINT AREA

Press shift, then first key on first row. The calculator will prompt "START". Input starting point number and press R/S. Calculator will prompt "PT". Input next point number and press R/S. Calculator will prompt "PT". Continue inputting point numbers, pressing R/S after each entry until you return to the beginning point. Re-enter the beginning point and the calculator will display SQ. FT. = . Press R/S and the calculator will display AC = . To include a curved side, follow the same routine using set flag 01 as just explained on the previous page for AREA.

RENUMBER

Press shift, then the third key on the first row. Calculator will prompt "OLD NO". Input old number or number to be duplicated and press R/S. Calculator will prompt "NEW NO". Input new point number and press R/S. Calculator will prompt 'OLD NO" to be input for continuation of process. Your old numbers will not be lost, only duplicated.

DOUBLE ANGLES

Input the first angle, then press shift, then press fourth key on first row. The calculator will display the doubled angle. Input the next angle to be doubled and press R/S. The calculator will display the doubled angle. Input angle and press R/S after each entry to continue. Also, see set flag 04 on page 9 for automatic double angle output during side shot entry.

METERS

Input the first distance in feet and press shift, then press fifth key on first row. The calculator will display the distance in meters. Input the next distance in feet and press R/S. The calculator will display the distance in meters. Input the distance in feet and press R/S after each entry to continue. Also see set flag 04 on page 9 for automatic meters output during sideshot entry.

OFFSETS FROM A LINE

Press shift, then press fifth key on the fourth row. Calculator will prompt "STA". Input station for base point on your base line, if you have stationing. If you do not have stationing, do not input any value. Press R/S and the calculator will prompt "OCC PT". Input occupied point or base point and press R/S. The calculator will prompt "BS PT". Input backsite point or base line reference point and press R/S. The calculator will prompt "PT". Input point number for which you desire base line distance or station and offset. Press R/S and the calculator will display the base line distance or station. Press R/S and the calculator will display the offset from the base line. A negative number represents a left offset and a positive number represents a right offset. Press R/S and the calculator prompts "PT" for continuation of routine.

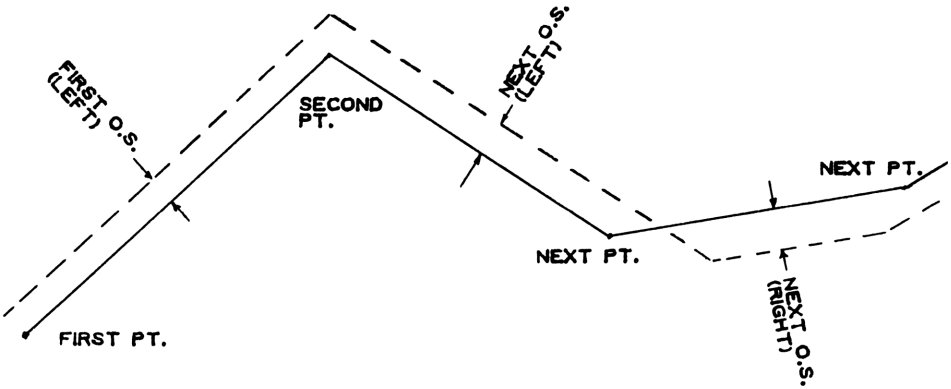
OFFSETS FROM A CURVE

Press shift, then press fifth key on fourth row. Calculator will prompt "STA". Input station for base point on your base line, if you have stationing. If you do not have stationing, do not input any value. Press shift, then press 7, then press 01 (set flag 01 abbreviated SF 01). Press R/S and the calculator will prompt for "RAD PT". Input the radius point of the curve and press R/S. Calculator will prompt "P.C. PT NO". Input the point number for the P.C. of the curve and press R/S. The calculator will prompt "P.T. PT NO". Input the point number for the P.T. of the curve and press R/S. Calculator will prompt "PT". Input the point number for which you desire base line curve distance or station and offset. The calculator will display the base line curve distance or station. Press R/S and the calculator will display the offset from the base line curve. A negative number represents left and a positive number represents a right offset. If the point is not within the P.C. and P.T. given, the program will recycle to a prompt for another PT. Press R/S and the calculator will prompt for the next point for continuation of routine.

OFFSET INTERSECTIONS

Press shift, then press third key on seventh row. This routine generates coordinates for an intersect point a specified offset distance from each of two lines which intersect. The calculator will flash "FIRST" and prompt "PT". Input the first point on the first line and press R/S. The calculator will prompt "FIRST O.S.". Input the first offset (negative for left, positive for right) with left and right as looking up the line from the first point to the intersect point of the two lines. Press R/S and the calculator will flash "SECOND" and prompt "PT". Input the second point or intersect point of the two lines and press R/S. The calculator will flash "NEXT" and prompt "PT". Input the next point or points on the second line. Press R/S and the calculator will prompt "NEXT O.S.". Input the offset from the second line (negative for left, positive for right) as looking up the line from the intersect point to the next point. Press R/S and the calculator will prompt "INT. PT". Input the point number for the intersect point to be computed and press R/S.

The offset intersect point is now computed and is your COP (currently occupied point). The calculator will flash "NEXT" and prompt "PT". If you have a continuous P.I. line and you need offset intersection points generated along this line, the next prompts allow you to continue calculating without re-entry of rear points and offsets. Input the next point along your P.I. line and press R/S. The calculator will prompt "NEXT O.S.". Input the next offset from your P.I. line as looking up the line and press R/S. The calculator will prompt "INT. PT.". Input the intersect point and press R/S. The calculator will compute the intersect point and flash "NEXT" and prompt "PT" allowing you to continue.



COORDINATE VIEW

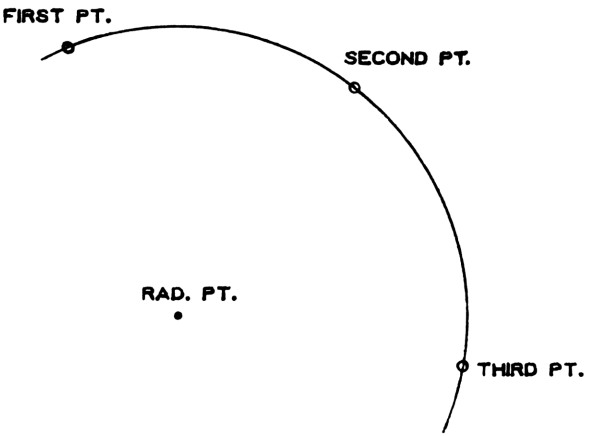
Press shift, then press second key on first row. This routine works when you do not have a printer attached. The calculator will prompt "PT". Input the point number you wish to view the coordinates for and press R/S. If no coordinates have been generated for that point, the calculator will prompt for N?. Input the northing and press R/S. The calculator will prompt for E?. Input the easting and press R/S. The calculator will flash the point number just entered and display N = 1000.00. Press R/S and the calculator will display E = 1000.00. Press R/S and the calculator will prompt "PT" ready to continue. An important hint to remember concerning the calculator's storage registers is that you can recall 10 or recall J for your COP (currently occupied point number). Also, you can recall 07 or recall G for your current northing. You can recall 08 or recall H for your current easting.

COORDINATE LIST

Press shift, then press second key on first row. This routine works only with a printer hooked up. The calculator will prompt "FRM PT". Input the first point number you want and press R/S. The calculator will prompt "THRU PT". Input the last point number you want and press R/S. The printer will print the coordinate list including all unused points having 0.00 for northing and easting values. The calculator will return to a prompt for "FRM PT" allowing you to continue. If you would like a larger printout, you can set flag 12 and it will double the size. You may have to fix the decimal places to two places to accomodate this double width or in the case of very large coordinates, you may not be able to use double width.

3 POINTS ON A CIRCLE

Press shift, then press fourth key on bottom row. Calculator will prompt for "1ST PT." Input first point on curve and press R/S. Calculator will prompt for "2ND PT". Input second point on curve and press R/S. Calculator will prompt for "3RD PT". Input third point on curve and press R/S. Calculator will display the radius that will pass through all three points. Press R/S and the calculator recycles for the next three point circle solution.



SLOPE DISTANCE (STAKE SET)

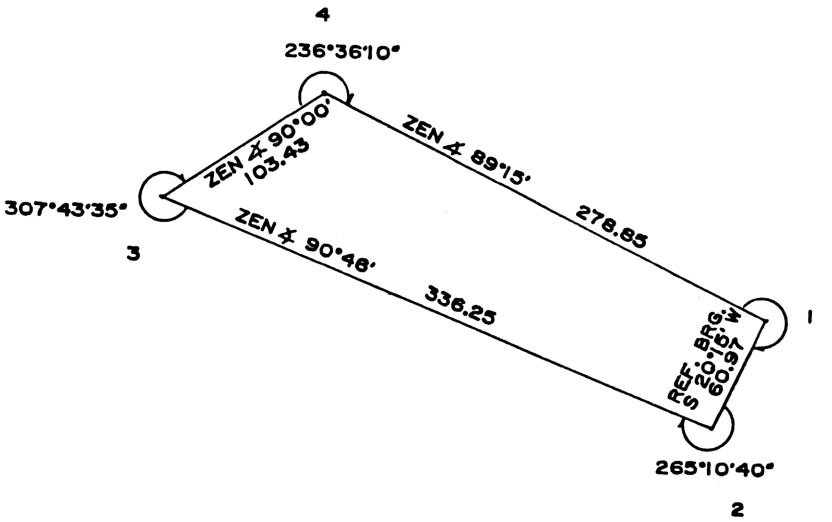
Press shift, then press fifth key on second row. Calculator will prompt for "ZEN∠". Input zenith angle and press R/S. Calculator will prompt for CALL D. Input call distance or horizontal distance and press R/S. Calculator will display slope distance (S.D.) for setting stake. Press R/S and the program will recycle. After program is cycled once if it is run again, bypassing the prompts with no entry will result in the use of the same values previously keyed in for those prompts. Also note that "ZEN∠" and CALL D. can be preloaded in register 01 (A) and register 02 (B) respectively. Slope distance can be recalled from register 03 after cycling the program through once.

HORIZONTAL DISTANCE

Press shift, then press fourth key on second row. Calculator will prompt for "ZEN∠". Input zenith angle and press R/S. Calculator will prompt for SLOPE D. Input slope distance and press R/S. Calculator will display horizontal distance (H.D. =). Input next zenith angle and press R/S. The calculator will prompt for SLOPE D. Input slope distance and press R/S. Calculator will display horizontal distance. Program will continue to recycle in this manner.

COMPASS ADJUSTMENT

This routine will give the ratio of error and adjust a traverse by the compass rule. If you wish to balance angles, this must be done before you run the traverse. To balance a traverse, start at your beginning point and then continue the traverse around and back to the point of beginning giving it a different point number. Next, INVERSE to the point of beginning and after the calculator gives you the bearing and distance on what is your "closing line", press SHIFT 4 which is the compass routine key and the program will give the the ratio of error. Next, the program will prompt for each point to be adjusted. Your traverse points need not be sequential because this routine will let you adjust your points either one at a time or in sets.



COMPASS ADJUSTMENT EXAMPLE

DISPLAY	USER INSTRUCTION
	Press first key on first row
"START"	Input 1 and press R/S
N = ?	Input 5000 and press R/S
E = ?	press R/S (5000 will be used again)
"ANGLE"	Input 20.15 and press R/S
"CD = "	Input 3 (angle code for S.W. Brg.) and press R/S
D =	Input 60.97 and press R/S
PT	Input 2 and press R/S
"ANGLE"	Input 265.1040 and press R/S
CD =	Input 7 (angle code for angle right) press R/S
D =	Input 336.25, press CHS , press R/S
	(Input dist. as negative for ZEN < prompt)
"ZEN.. ∢ "	Input 90.46 and press R/S
"PT"	Press R/S (automatic point increment to 3)
"ANGLE"	Input 307.4335
"CD = "	Press R/S (automatic recall last angle code)
D =	Input 103.43
ZEN ∢	Press R/S (automatic 90.00 zen. angle)
PT	Input 4 and press R/S
"ANGLE"	Input 236.36 10 and press R/S
CD =	Input 7 and press R/S
D =	Input 278.85 and press R/S
ZEN ∢	Input 89.15 and press R/S
PT	Input 5 and press R/S
"ANGLE"	Press INVERSE (third key, first row)
PT	Input 1 and press R/S
S 63.1558 E	Displays bearing of closing line. Press R/S
D = 0.0273	Displays distance of closing line. Press R/S
PT	Press shift, then press 4
HD = 779.446	Displays total traverse distance
Ratio 1 to 28, 520.48	Display ratio of error
PT	Input 1.0004 (points one thru four), press R/S
PT	Continue to input any points to balance and press R/S

ADVANCED COMPASS

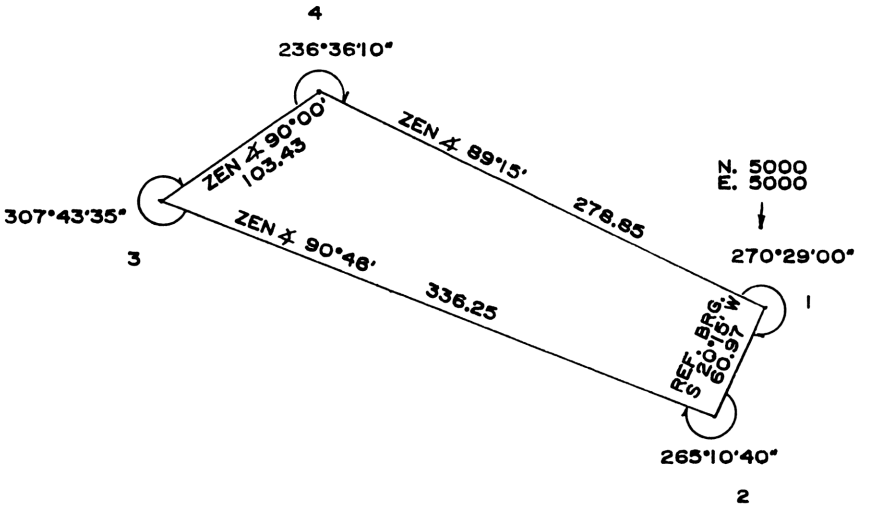
This routine provides a superior alternative to balancing angles with compass adjustment. A closing angle is needed to use this routine. Although occasionally you may obtain a slightly lower precision ratio with this adjustment than with compass adjustment with angles balanced, you will on the average double your precision ratio. The process this adjustment routine uses is to continue the field traverse around twice providing a point of beginning and point of ending for each point on the traverse. Then the traverse point with the least distance between the point of beginning and point of ending is selected and displayed as B.P.O.B. or "Best Point of Beginning." The program will then display the total traverse distance and the closing line and balance this error into the traverse by the standard compass adjustment. The result of this adjustment is that the worst traverse angle is eliminated rather that changing all the traverse angles by balancing and then performing the compass adjustment on the traverse. Since the field data is altered by adjusting angles before the data is considered to calculate the precision ratio when using compass adjustment with balanced angles, I believe this advanced compass adjustment is superior in the case of equivalent precision ratios because no field data is altered, only the worst traverse angle is excluded. Taking random sample of 12 traverses the average precision ratio improved from 1:72,000 using compass adjustment with balanced angles to 1:168,000 using advanced compass adjustment.

In case of a bad angular closure the feature whereby the worst angle is located is beneficial in locating a bust.

To use this routine, "START" at the first point on your traverse and continue traversing around using consecutive point numbers until you are back to your beginning point which is to be numbered consecutively from your last traverse number. Now you press the Adv. Comp. (Advanced Compass) key and the program will prompt for "CLOSING ANGLE" to be keyed in and press R/S. The program will prompt for CD = (angle code) to be keyed in and press R/S. Next the angular error wil be given as "∢ out", then each closing line will be shown beginning at the starting point. This gives you a chance to check the variations in the closures at each point on the traverse. Press R/S again and the B.P.O.B. is displayed. Press R/S again for the closing line bearing and distance. Press R/S again and the ΣHD (Total Travese Distance) is displayed. Press R/S again and the traverse is balanced. After this you will have to rotate the traverse to the reference bearing of your choice or you may choose to do so after entering sideshots.

CORRECT

While traversing if an angle or distance is entered incorrectly, and you are numbering your points consecutively, after the point number is keyed in press R/S and then press the "CORRECT" key and it will allow you to back up 1 traverse leg and re-enter the data correctly. This routine cannot be used after traversing through a curve or if point numbers are not consecutive. The area is corrected also when this routine is used while traversing a figure.

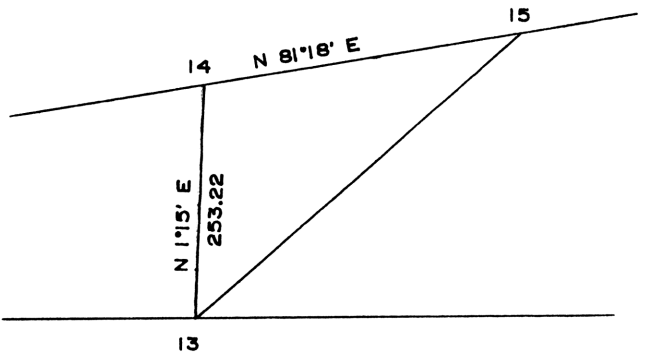


ADVANCED COMPASS EXAMPLE

DISPLAY	USER INSTRUCTION
	Press first key on first row
"START"	Input 1 and press R/S
N = ?	Input 5000 and press R/S
E = ?	Press R/S (5000 will be used again)
"ANGLE"	Input 20.15 and press R/S
"CD = "	Input 3 (angle code for S.W. Brq.) and press R/S
D =	Input 60.97 and press R/S
PT	Input 2 and press R/S
"ANGLE"	Input 265.1040 and press R/S
CD =	Input 7 (angle code for angle right) press R/S
D =	Input 336.25, press CHS , press R/S
	(Input dist. as negative for ZEN <. prompt)
"ZEN.. ∢ "	Input 90.46 and press R/S
"PT"	Press R/S (automatic point increment to 3)
"ANGLE"	Input 307.4335
"CD = "	Press R/S (automatic recall last angle code)
D =	Input 103.43
ZEN ∢	Press R/S (automatic 90.00 zen. angle)
PT	Input 4 and press R/S
"ANGLE"	Input 236.36 10 and press R/S
CD =	Input 7 and press R/S
D =	Input 278.85 and press R/S
ZEN ∢	Input 89.15 and press R/S
PT	Input 5 and press R/S
"ANGLE"	Press shift, then press 3 (Advance Compass)
"CLOSING ANGLE"	Input 270.2900 and press R/S
CD =	Input 7 and press R/S
∢ OUT - 0.0035	Displays angular error
CLOS. 0.0273	Displays closure at first traverse point
CLOS. 0.0171	Displays closure at next traverse point
CLOS. 0.0551	Displays closure at next traverse point
CLOS. 0.0517	Displays closure at next traverse point
BPOB = 2	Displays the best point of beginning
S59.2033 E	Displays closing line bearing
D. = 0.0171	Displays closing line distance
ΣHD = 779.4460	Displays total traverse distance
Ratio 1 to 45,695	Displays closure

SWING AREA

This is a pre-determined area cut-off routine for swinging a line to form a triangle between two fixed base lines to enclose the desired area. Press shift, then press the second key on the fourth row. The calculator will prompt for "FIRST PT" to be input, then press R/S. The calculator will prompt for "SECOND PT" to be input, then press R/S. The calculator will flash "SECOND" and prompt for "ANGLE" to be input, then press R/S. The calculator will prompt for CD = (angle code) to be input, then press R/S. The calculator will prompt for "AREA" (in square feet) to be input, then press R/S. The calculator will prompt for "THIRD PT" to be input, then press R/S. The calculator then solves for the area and occupies the second point. It then goes into the "INVERSE" routine automatically and is ready to inverse to the point of your choice.



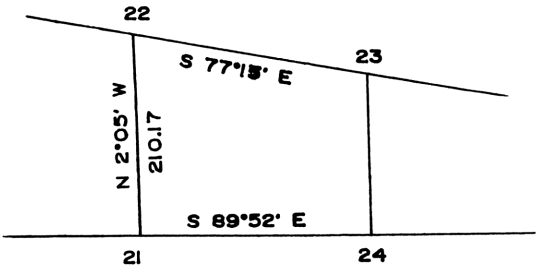
SWING AREA EXAMPLE

DISPLAY	USER INSTRUCTIONS
	Press shift, then press second key on first row.
PT.	Input first point (13) and press R/S
PT.	Input second point (14) and press R/S
"ANGLE"	Input second angle (81.18) and press R/S
CD	Input angle code (1) and press R/S
AREA	Input area in sq. ft. (43,560) and press R/S
THIRD PT.	Input third point (15) and press R/S

SLIDE AREA

This is a pre - determined area cut-off routine for sliding a line parallel to a base line with the other two sides of the trapazoid figure fixed.

Press shift, then press the third key on the fourth row. The calculator will prompt "FIRST PT" to be input, then press R/S. The calculator will prompt for "SECOND PT" to be input, then press R/S. The calculator will prompt for "FIRST ANGLE" to be input, then press R/S. The calculator will prompt for CD = (angle code) to be input, then press R/S. The calculator will prompt for "SECOND ANGLE" to be input, then press R/S. The calculator will prompt for CD = (angle code) to be input, then press R/S. The calculator will prompt for "AREA" (in square feet) to be input, then press R/S. The calculator solves for the area, occupies the second point and goes into the INVERSE routine.



SLIDE AREA EXAMPLE

DISPLAY	USER INSTRUCTIONS
	Press shift, then press third key on fourth row.
PT.	Input first point (21) and press R/S
PT.	Input second point (22) and press R/S
"ANGLE"	Input first angle (89.52) and press R/S
CD =	Input Z and press R/S
"ANGLE"	Input second angle (77.15) and press R/S
CD =	Input 1 and press R/S
AREA	Input sq. ft. (43,560) and press R/S
THIRD PT	Input third point (23) and press R/S
FOURTH PT	Input fourth point (24) and press R/S

SUNSHOTS (For Solar or Polaris observations)
Calculator will prompt "LAT?"Key in observer's latitude (north positive; south negative) in D.MS and press R/S .

Calculator will prompt "LONG?"
Key in observer's longitude (west positive; east negative) in D.MS and press R/S .

Calculator will prompt "GHA 0?"
From the ephemeris table, key in the Greenwich hour angle (GHA) in D.MS at 0 hr. for the Greenwich date of observation and press R/S .

Calculator will prompt "GHA 24?"
From the ephemeris table, key in GHA in D.MS at 0 hr. for the next Greewich day and press R/S .

Calculator will prompt "DECL 0?"
From the ephemeris table, key in the declination in D.MS at 0 hr. for the Greenwich date of observation and press R/S .

Calculator will prompt "DECL 24?"
From the ephemeris table, key in the declination in D.MS at 0 hr. for the next Greenwich day and press R/S .

Calculator will prompt "SEMI DIA?"
From the ephemeris table, key in the semidiameter in D.MS at 0 hr. for the Greenwich date of observation.

For observation on sun's left edge only (facing the sun), the semidiameter is positive.
For observation on both left and right edge (not recommended) or center of sun, the semidiameter is zero. Press R/S .

Calculator will prompt ANGLE.
Key in the clockwise angle reading in D.MS from the backsite and press R/S .

Calculator will prompt GMT (Greenwich mean time). Key in GMT and press R/S . The azimuth will be displayed in D.M.S.

To compute another azimuth for the same observation press R/S .

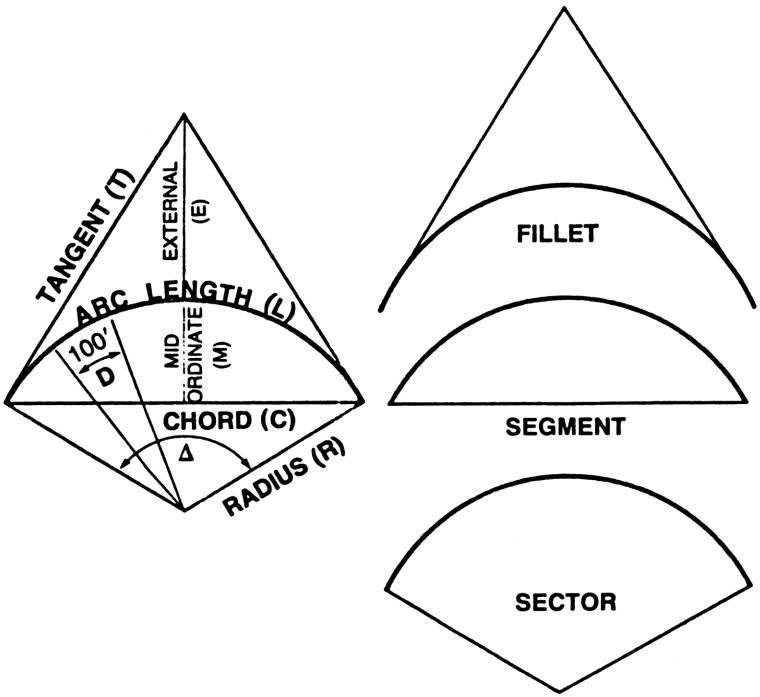
TIME
This is a calculator function. I recommend you assign this to the SHIFT ENTER key if you are using an HP 41CX and you intend to use the sunshot routine. To do this press SHIFT XEQ ALPHA T I M E ALPHA SHIFT ENTER . This function captures and holds the time off of the clock at the instant the key is pressed. This will help in synchronizing to GMT (Greenwich Mean Time) and in recording time at the instant of sighting on the sun.

Greenwich mean time or Universal time is available by calling WWD at (303) 499-7111.

Note: This is a modified version of the program AZO11 as listed in the 1988 Lietz ephemeris and is used with permission from Elgin, Knowles, and Seanne, Inc.

HORIZONTAL CURVE SOLUTIONS

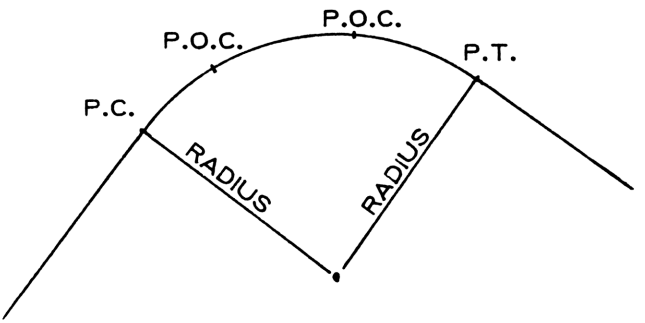
Press shift, then press the third key on the bottom row. As the prompts appear, if you can provide the answer, key it in and press R/S. If not, just bypass the prompt by inputting no data and pressing R/S. After two curve elements have been entered, all curve data will be given.



HORIZONTAL CURVE STAKEOUT

Press shift, then press the third key on the bottom row.

When prompt for DELTA appears, bypass it by pressing R/S. When prompt for RADIUS appears, key it in as a positive value if the curve is to the right looking from the P.C. toward the P.T. and as a negative value if the curve is to the left looking from the P.C. toward the P.T. After keying in the radius, press S.F. 01 (set flag 01), then press R/S. The next prompt is for P.C. STA (or could be the P.T. STA if you are backing in a curve) to be keyed in then press R/S. The next prompt is for P.O.C. STA. to be keyed in then press R/S. After this, when the next prompt for P.O.C. appears if it is the next station, just press R/S without any input and 100 feet will be added to the previous P.O.C. station. For each P.O.C., the program will give the AR (angle right) from the back tangent (or angle right from the forward tangent if you are backing in a curve). Then the program will give the L.C. (long chord) and S.C. (short chord).



CONTOURS

Press shift, then the fourth key on the third row.The routine requires a contour interval of 1, 2, or 5 to be stored in register 01. If you don't do this before you initiate the routine, it will prompt for 1, 2, or 5 store 01. The routine will prompt for upper elev., lower elev., & scaled distance between elev. points. After those are input it will give the distances to be scaled from the upper elev. point to each contour. After the last distance is given, it will go back to the beginning of the routine.

ERROR MESSAGES:

END OF FL

Used Point number that was too large for your file

DUP.FL

When creating a file this message appears to indicate a dupicate file already exists.

FL NOT FOUND

The data file specified does not exist. You will need to create a file.

NONEXISTANT

Storage registers have been re-partitioned to a number smaller than 100. To remedy this, XEQ ALPHA S I Z E ALPHA, then 1 0 0

STORAGE REGISTERS

07 or G - - - - - - - - - - - - - - - - - Current northing
08 or H - - - - - - - - - - - - - - - - - Current easting
10 or J - - - - - - - - - - - - - - - - - -Current point number
14 -- Last distance inversed
19 - Current file name

IF TROUBLE PERSISTS

Remove module and start at page one following instructions for a fresh start.

TRAVERSE WITH ADVANCED COMPASS ADJ.

```
FILE NAME?
12567
FIRST PT 1.0000
LAST PT 150.0000
START  1.0000
ANGLE 20.1500
CD= 3.0000
D.=60.9950

CALCULATOR
FILE 12567
PTS 1.0000
TO 150.0000
CLR-R/S

FILE NAME?
12567
FIRST PT 1.0000
LAST PT 150.0000
START  1.0000
ANGLE 20.1500
CD= 3.0000
D.=-60.9950
ZEN ∠ 91.4042
PT 2.0000

ANGLE 265.1048
CD= 7.0000
D.=87.3231
ZEN ∠ 336.5470
PT 3.0000

CORRECTED
ANGLE 265.1048
CD= 7.0000
D.=336.5470
ZEN ∠ 87.3231
PT 3.0000

ANGLE 162.4048
CD= 7.0000
D.=187.4610
ZEN ∠ 89.4327
PT 4.0000

ANGLE 265.5336
CD= 7.0000
D.=45.7220
ZEN ∠ 90.0000
PT 5.0000

ANGLE 271.1636
CD= 7.0000
D.=275.9020
ZEN ∠ 91.1011
PT 6.0000

ANGLE 204.2855
CD= 7.0000
D.=278.9360
ZEN ∠ 91.3658
PT 7.0000

CLOSING
ANGLE 270.2941
CD= 7.0000
∠ OUT 0.0024
CLOS. 0.0495
CLOS. 0.0539
CLOS. 0.0393
CLOS. 0.0512
CLOS. 0.0478
CLOS. 0.0382
B.P.O.B.=6.0000
CLOSING LINE
S 84.3120 E
D=0.0362
ZHD=1,185.0566
RATIO 1 TO 39,222.1499
```

ROTATION

```
OCC PT. 1.0000
BS PT. 6.0000
N 70.1416 W
D=278.8319
ROTATE TO-
ANGLE 70.1437
CD= 4.0000
SCL. 1.0000
TRANS TO
N= 5,000.0000
E= 5,000.0000

PT. 1.0000
N=5,000.0000
E=5,000.0000

PT. 2.0000
N=4,942.8000
E=4,978.8377

PT. 3.0000
N=5,032.2671
E=4,654.7905

PT. 4.0000
N=5,026.6639
E=4,467.4362

PT. 5.0000
N=5,071.5607
E=4,462.6640

PT. 6.0000
N=5,094.2512
E=4,737.5806
```

TRAVERSE WITH AREA

```
START  1.0000

S 20.1500 W
D=60.9684

TO PT 2.0000

N 74.3406 W
D=336.2289

TO PT 3.0000

S 88.0641 W
D=187.4541

TO PT 4.0000

N 5.5938 W
D=45.7218

TO PT 5.0000


CURVE DATA
CHORD=275.8514
RAD.=400.0000
DELTA=40.2027
ARC=281.6327

N 85.1654 E
D=275.8514

TO PT 6.0000

S 70.1437 E
D=278.8319

TO PT 1.0000

SQ. FT.=30,643.0556
AC.=0.6871
```

SLIDE A LINE

```
TRAPZ
FIRST
PT 1.0000
SECOND
PT 2.0000
FIRST
ANGLE 1.0000
CD= 5.0000
SECOND
ANGLE 2.0003
CD= 5.0000
AREA 10,890.0000
THIRD PT 7.0000
FOURTH PT 8.0000

N 74.3406 W
D=162.8495

TO PT 7.0000

N 20.1500 E
D=73.2496
```

SWING A LINE

```
TRIANGLE
FIRST
PT 5.0000
SECOND
PT 4.0000
SECOND
ANGLE 4.0003
CD= 5.0000
AREA 5,445.0000
THIRD PT 9.0000

N 88.0641 E
D=238.7924

TO PT 9.0000

N 81.1316 W
D=246.3238

TO PT 5.0000
```

OFFSET INTERSECT.

```
OFFSET INT.
FIRST
PT 2.0000
FIRST O.S. 10.0000
SECOND
PT 3.0000
NEXT
PT 4.0000
NEXT O.S. 12.0000
INT. PT. 10.0000
```

HORIZ. CURVE SOLV.

```
DLTA=40.2027
1/2 DLTA=20.1014

RAD=400.0000
ARC=281.6321
CHD=275.8509
TAN=146.9369
EXT=26.1343
M.O.=24.5315

SEC=56,326.4292
SEG=4,529.7772
FIL=2,448.3307
```

RADIAL STAKEOUT

```
RAD ST
OCC PT. 3.0000
BS PT. 4.0000

PT 5.0000
AR=13.2651
D=196.1035

PT 6.0000
AR=145.0401
D=103.4226

PT 1.0000
AR=187.1343
D=346.7143

PT 2.0000
AR=197.1914
D=336.2289
```

SIDESHOTS WITH DOUBLE ANGLES, METERS, AND ZEN. ANGLES

```
S.S.
OCC PT. 3.0000
BS PT. 4.0000

ANGLE 282.3620
DBL 205.1240
CD= 7.0000
D.=153.2000
MTRS 46.6959
ZEN ∠ 91.0500
PT 13.0000

ANGLE 291.5236
DBL 223.4512
CD= 7.0000
D.=152.5000
MTRS 46.4826
ZEN ∠ 90.5200
PT 14.0000
```

SIDESHOTS

```
S.S.
OCC PT. 2.0000
BS PT. 3.0000

ANGLE 275.3620
CD= 7.0000
D.=250.3200
PT 11.0000

ANGLE 283.2556
CD= 7.0000
D.=300.0000
PT 12.0000
```

SIDESHOTS WITH
TRIG. LEVELS
VERSION II

```
H.I. ELEV 105.2600
H. ROD 4.7000

S.S.
OCC PT. 5.0000
BS PT. 6.0000

ANGLE 32.5100
DBL 65.4200
CD= 7.0000
D.=140.7800
MTRS 42.9103
ZEN ∠ 90.4800
ELEV=98.5944
PT 17.0000

ANGLE 41.2500
DBL 82.5000
CD= 7.0000
D.=321.5400
MTRS 98.0066
ZEN ∠ 91.3900
ELEV=91.3016
PT 18.0000
```

SIDESHOTS WITH
TRIG. LEVELS
VERSION I

```
REF ELEV 100.0000
REF ZEN ∠ 92.5300
REF SLP DST 256.3200

S.S.
OCC PT. 4.0000
BS PT. 3.0000

ANGLE 95.2536
DBL 190.5112
CD= 7.0000
D.=145.5600
MTRS 44.3672
ZEN ∠ 92.5200
ELEV=105.6138
PT 15.0000

ANGLE 100.2538
DBL 200.5116
CD= 7.0000
D.=251.4100
MTRS 76.6307
ZEN ∠ 91.4600
ELEV=105.1427
PT 16.0000
```

NOTES