TOMSROM 1

A SURVEYING MODULE
FOR THE HP-41 WITH EXTENDED FUNCTIONS / MEMORY

MANUAL

By Thomas A. Bruns, L.S.

TOMSROM 1

A SURVEYING MODULE

FOR THE HP-41 WITH EXTENDED FUNCTIONS / MEMORY

MANUAL

By Thomas A. Bruns, L.S.
P. O. Box 3692
Santa Rosa, CA 95402

TABLE OF CONTENTS

A WORD ABOUT ...

This module requires extended functions/memory to operate properly.

CAUTION

Always turn the HP-41 off before inserting or removing any plug-in extentions or accessories. Failure to turn the HP-41 off could damage both the calculator and the accessory.

KEY NOTATION

KEYS	DESCRIPTION
[SHIFT]	The gold key on the calculator.
[CHS] [FIX]	A keyboard function. A shifted keyboard function.
[HMS+] or [INV]	A non-keyboard function. To execute it, press [XEQ] [ALPHA] HMS+ [ALPHA]. Optionally, you can assign functions to a User key. Shifted Alpha-keyboard characters are shown on the back of the calculator.
[A] [b]	A local Alpha label. Keys A-J. A shifted local Alpha label. Keys a-e.
[XEQ] CDM or CDM	A global label. To execute it, press [XEQ] [ALPHA] CDM [ALPHA]. Optionally, you can assign global labels to a User key. Shifted Alpha-keyboard characters are shown on the back of the calculator.

KEY ASSIGNMENTS

The module makes no key assignments. Do not assign programs and functions to the local Alpha labels, that is keys A-E, H-J, and a-e. I would advise assigning [X<>Y] to its own key, it will work faster.

SIZE

When necessary the programs in this module check for, and if necessary set, a minimum size of 19 registers.

STACK

When a program prompts for data input try not to disturb the stack as it may contain temporary data.

TONES

If you do not wish the calculator to emit any tones or beeps clear flag 26 at turn on.

CONFLICTS WITH OTHER ROMS AND PROGRAMS

This module uses the XROM number 06, this conficts with the HP circuits pac.
Functions and global labels used in this module:

```
TOMSROM 1
HMS*
HMS/
H∠
R*P
F-M
M-F
P*R
CLXM
ZN
'B-A
'A-B
INV
'P?
'FL?
'MG
'IZ
'Q?
'M1
'M3
'?Y
'ΣA
'↑
'%
'?
'$
'D?
'*CV
MZ
'P1
'P2
'EA
'>
'MFL
'CDM
'Sc
'Rc
'TCA
'CG
'ee
'Hd
'CRT
'CTC
'SSP
'RSO
'INTS
```

FUNCTIONS

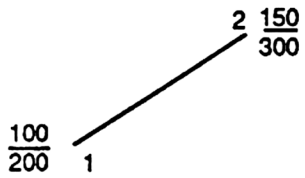
The new functions in this module are programmable and will consume two bytes of program memory when used in a program. You may wish to assign some functions to a User key.

[INV] INVerse

This function does an inverse from the coordinates contained in the stack. The function also sets the degree mode.

... from this ...		... to this.
T N1		T Δ departures
Z E1		Z Δ latitudes
Y N2		Y Az 1-2
X E2	[INV]	X Distance 1-2

Example:



T 100.0000		T 100.0000
Z 200.0000		Z 50.0000
Y 150.0000		Y 63.2606
X 300.0000	[INV]	X 111.8034

INPUT	KEYS	DISPLAY	COMMENTS
100	[ENTER]	100.0000	Begin
200	[ENTER]	200.0000	
150	[ENTER]	150.0000	
300	[INV]	111.8034	distance, review stack
	[RDN]	63.2606	azimuth
	[RDN]	50.0000	Δ latitudes
	[RDN]	100.0000	Δ departures, end of example.

[HMS*] Hours, Minutes, and Seconds multiply.
[HMS/] Hours, Minutes, and Seconds divide.

These functions are used to multiply and divide time and angles specified in the H.MS format by a number in the X-register. The function also sets the degree mode.

... from this ...		... to this.
T 0.0000		T 0.0000
Z 0.0000		Z 0.0000
Y angle (HMS)		Y 0.0000
X #	[HMS*] or [HMS/]	X angle x # (HMS)

Example: An angle was turned six times, the first angle was 236° 32' 20" and the last angle was 339° 14' 30", what is the mean.

INPUT	KEYS	DISPLAY	COMMENTS
236.322	[ENTER]	236.3220	Begin
6	[HMS*]	1,419.1400	
360	[HMS/]	3.5632	3 extra circles
	[LAST X]	360.0000	
3	[*]	1,080.0000	
339.143	[HMS+]	1419.1430	
6	[HMS/]	236.3225	mean, end of example.

[CLXM] CLear eXtended Memory

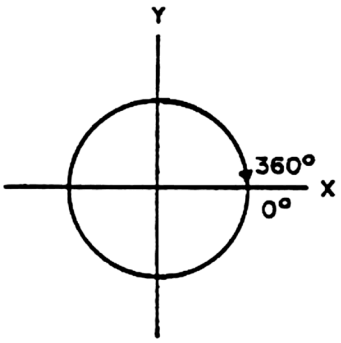
This function clears the extended memory. If the function is executed from the keyboard it will display "XM LOST".

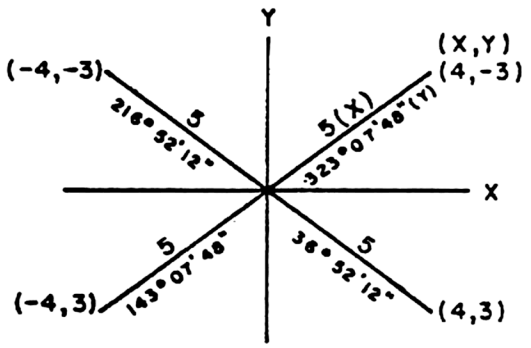
[M-F] Meters to Feet
[F-M] Feet to Meters

These functions are used to convert meters to feet, and feet to meters. The conversion factor is based on the US survey foot (1200/3937).

[P*R] Polar to Rectangular coordinate conversion
[R*P] Rectangular to Polar coordinate conversion

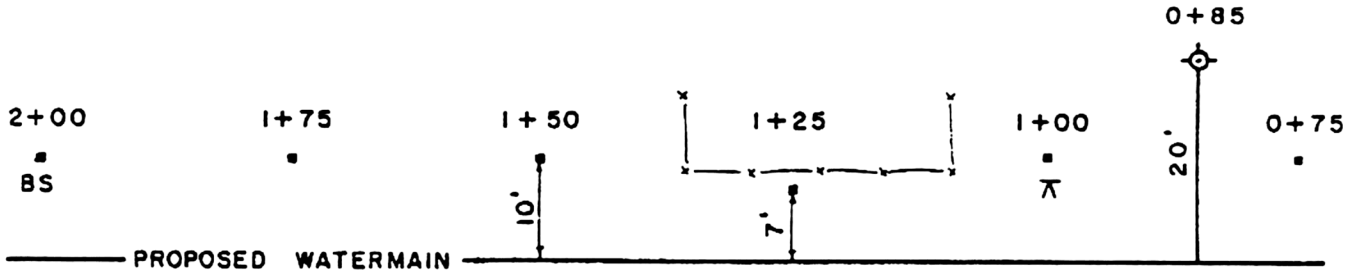
The polar/rectangular coordinate conversion functions have been enhanced to accept input and output in an H.MMSS format. the angle outputs are also based on a 360 ° circle as opposed to the ± 180°.
The X-and Y-register values are different than the HP -41 functions. This function also sets the degree mode.





Example: Use the [R*P] function to compute the distance and angle right for the different offset at station 1+25 and the fire hydrant. Transit is at station 1+00 backsighting station 2+00.

Note: Y-register input= positive for right, negative for left.
X-register input= positive for ahead, negative for back.



INPUT	KEYS	DISPLAY	COMMENTS
3	[CHS]	-3_	3' left, 25' ahead
	[ENTER]	-3.0000	
25	[R*P]	25.1794	distance
	[X<>Y]	353.0926	angle right (HMS)
10	[ENTER]	10.0000	10' right, 15' back
15	[CHS]	-15_	
	[R*P]	18.0278	distance
	[X<>Y]	146.1836	angle right (HMS)

[H∢] Horizontal angle

This function will divide the angle (HMS) in the X-register by two. If the angle in the X-register is a negative value 360° will be added to the angle before division by two. This function also sets the degree mode.

Example: What is the mean angle?
Direct angle= 261° 21' 50"
Reverse angle= 162° 43' 50"

INPUT	KEYS	DISPLAY	COMMENTS
162.435	[CHS] [H∢]	-162.435_ 261.2155	

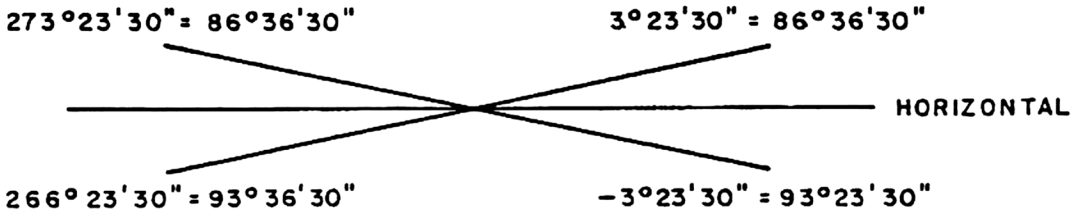
[MZ] Mean Zenith

This function means a zenith angle from the direct and reverse angles (HMS) in the Y- and X-registers. This function also sets the degree mode.

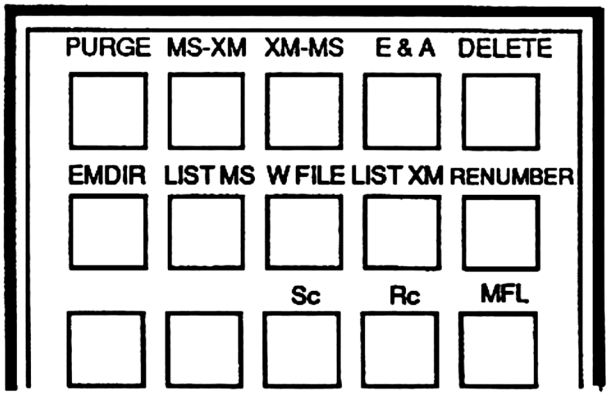
... from this ...			... to this.	
T	0.0000		T	0.0000
Z	0.0000		Z	0.0000
Y	Direct zenith (HMS)		Y	mean (HMS)
X	Reverse zenith (HMS)	[MZ]	X	sum (HMS)

[ZN] ZeNith

This function turns a vertical angle or a reverse zenith angle to a direct zenith angle. This function also sets the degree mode. Vertical and direct zenith angles must be less than 45° from the horizontal.



COORDINATE MANAGEMENT



This program is used to manage coordinates and files. The driver programs (CG, INTS, etc.) use the working file for coordinate access. File names are limited to six characters or less. Point numbering is unlimited, but you are limited to the capacity of the calculator. Extended memory files consist of consecutive blocks of point numbers. A mass storage device refers to the HP cassette drive (82161) or the HP disc drive (9114).

POINT NUMBER CAPACITIES

Basic extended memory = 61 points
One extended memory module = 180 points
Two extended memory modules = 299 points

NO CAN DO'S

Nonexistent files
Out of range point numbers
To point less than from point number

FILE STRUCTURE

EXTENDED MEMORY FILE

#	CONTENTS
00	File name <6 char.
01	Beginning pt #-1
02	N beg pt #
03	E beg pt #
04	N beg pt # +1
05	E beg pt # +1
06	N beg pt # +2
07	E beg pt # +2
08	etc.

MASS STORAGE FILE

#	CONTENTS
00	N1
01	E1
02	N2
03	E2
04	N3
05	E3
06	N4
07	E4
08	etc.

[J] MFL
Label **MFL** Make FiLe

This key and program are used to create files to store coordinates. File names must be six characters or less. This program may be executed from the coordinate management program or executed by its own global label.

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
1	Begin.		[XEQ] **CDM**	CDM*SLCT KEY:
	Select MFL key. **OR**		[J]	XM B MS
1a	Begin using the global label.		[XEQ] **MFL**	XM B MS
2	**Choose type of file to be created:**			
2a	To create a file in the extended memory. (This is also the default file created if [R/S] is pressed without prior data entry after step 1.)		[A]	FL NAME?
2b	To create a file in both the extended memory and in a mass storage device. (Both files will be created with the same name and begin with point number one.)		[B]	FL NAME?
2c	To create a file in a mass storage device.		[C]	FL NAME?
3	Input the desired file name. (The file name must be six characters or less.)	"ABC"	[R/S]	NO OF PTS?
4	Input the number of points you wish the file to hold. If you chose step 2b or 2c go to step 6.	#	[R/S]	
5	Input the point number you wish the extended memory file to begin with. (Defaults to point number one if [R/S] is pressed without prior data entry.)	#	[R/S]	XM BEG PT?
6	The calculator will beep if the file or files were successfully created. The extended memory file created will become the working file.			
7	If you began the program as in step 1 you will return to the coordinate management program.			CDM*SLCT KEY:
7a	If you began the program as in step 1a and flag 2 is clear you may restart the program with [R/S].		[R/S]	XM B MS

Example 1: Create a 25 point file, beginning with point 1, called "ABC" in the extended memory. This file is the working file for many of the examples in this manual.

INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] CDM	CDM*SLCT KEY:	Begin
	[J]	XM B MS	
	[A]	FL NAME?	
"ABC"	[R/S]	NO OF PTS?	
25	[R/S]	XM BEG PT?	
	[R/S]	CDM*SLCT KEY:	end of example.

Example 2: Create a 25 point file, beginning with point 101, called "86-2" in the extended memory. Look on the back of the calculator for [SHIFT] ALPHA characters.

INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] MFL	XM B MS	Begin, use global label.
	[A]	FL NAME?	
"86-2"	[R/S]	NO OF PTS?	
25	[R/S]	XM BEG PT?	
101	[R/S]	"86-2"	
	[R/S]	XM B MS	end of example.

The next examples require a mass storage device.

Example 3: Create a 50 point file called "86-3" in both the extended memory and in a mass storage device. (Cassette drive or disc drive.)

INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] CDM	CDM*SLCT KEY:	Begin
	[J]	XM B MS	
	[B]	FL NAME?	
"86-3"	[R/S]	NO OF PTS?	
50	[R/S]	CDM*SLCT KEY:	end of example.

Example 4: Create a 1000 point file called "86-4" in a mass storage device.

INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] CDM	CDM*SLCT KEY:	Begin
	[J]	XM B MS	
	[C]	FL NAME?	
"86-4"	[R/S]	NO OF PTS?	
1000	[R/S]	CDM*SLCT KEY:	end of example.

[A] EMDIR

This key merely executes the extended function [EMDIR] the extended memory file directory. It can be used to select a working file. The HP-41CX [EMDIR] works differently than the extended functions [EMDIR], refer to your HP-41 manual for more information on [EMDIR].

[a] PURGE

This key is used when you wish to purge the working file from the extended memory. Any file in the extended memory may be selected as the working file by using [EMDIR].

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
1	Begin.		[XEQ] CDM	CDM*SLCT KEY:
2	Select the purge key.		[a]	PURGE: "FILE"?Y
3	The program will ask if you wish to purge the working file. You have ten seconds to answer this question, the program will default to a no answer if ten seconds passes. If the answer is yes press the "Y" key and the file will be purged, if the answer is no press any key except the "Y" key and the file will not be purged.			
4	The program will then execute a [EMDIR] to establish a new working file. The program will return to the coordinate management program if the [EMDIR] is allowed to run to completion.			CDM*SLCT KEY:

[C] W FILE

This key will put into the ALPHA register and display the beginning point, the last point, and the name of the working file. Press [R/S] to return to the coordinate management prompt.

ALPHA: "101-125*ABC" This indicates the working file is called "ABC" and contains points 101 to 125.

[d] E&A (Enter and Assign)

This key will store coordinates , by point number, in the working file of the extended memory. This key is also available in all the driver programs.

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
1	Begin.		[XEQ] CDM	CDM*SLCT KEY
2	Select the enter and assign key.		[d]	NEW PT NO?
3	Input desired point number.	Pt #	[R/S]	N?
4	Input northing of point.	N	[R/S]	E?
5	Input easting of point.	E	[R/S]	NEW PT NO?
6	If you have more coordinates to store go to step 3; if you are finished storing coordinates press [R/S] without prior data entry after any prompt to return to the coordinate management program.		[R/S]	CDM*SLCT KEY
7	If the point number has already been used you will hear a tone and see:			#. USED
	You can either input a new point number,	Pt #	[R/S]	NEW PT NO?
	or press [R/S] without prior data entry to use the point number again.		[R/S]	NEW PT NO?
8	If you hear a tone and see:			Pt #-Pt #*Pt #
	This means the point number does not fall within the point range of the working file. Input a point number that does.	Pt #	[R/S]	NEW PT NO?

[e] Delete

This key is used when a coordinates are to be deleted from the working file of the extended memory.

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
1	Begin.		[XEQ] CDM	CDM*SLCT KEY:
2	Select the delete key.		[e]	XM BEG PT?
3	Input the beginning point to be deleted.	Pt #	[R/S]	TO PT NO?
4	Input the last point to be deleted. (If you wish only one point to be deleted press [R/S] without prior data entry.)	Pt #	[R/S]	CDM*SLCT KEY:
5	If the last point number is less than the beginning point number a tone will sound and "NO CAN DO" will be displayed and no coordinates will be deleted.			NO CAN DO CDM*SLCT KEY:

[E] Renumber

This key is used to change the point number of coordinates within the working file of the extended memory. The old point number is not deleted.

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
1	Begin		[XEQ] CDM	CDM*SLCT KEY:
2	Select the renumber key.		[E]	OLD PT NO?
3	Input the point number you wish to renumber.	Pt #	[R/S]	NEW PT NO?
4	Input the new point number.	Pt #	[R/S]	OLD PT NO?
5	If you have more points to renumber go to step 3. If you are finished renumbering press [R/S] without prior data entry after any prompt to return to coordinate management program.		[R/S]	CDM*SLCT KEY:

[D] LIST XM

This key is used to list the coordinates of certain points or all the points in the working file of the extended memory. If the printer is on line they will be printed.

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
1	Begin.		[XEQ] CDM	CDM*SLCT KEY:
2	Select the list extended memory key. The working file's name will be displayed for one second and will be printed if a printer is on line.		[D]	FILE: ABC XM BEG PT?
3	Input the beginning point of the coordinates you wish to view or have printed. (If you wish to list the entire file press [R/S] without prior data entry.)	Pt #	[R/S]	TO PT NO?
4	Input the last point you wish to list. If you wish only one point to be listed press [R/S] without prior data entry. (If the last point number is smaller than the beginning point number you will exit the program via "NO CAN DO".)	Pt #	[R/S] [R/S]* [R/S]*	N#= # E#= # etc.
5	The program will return to the coordinate management prompt when finished.			CDM*SLCT KEY:

* This [R/S] not necessary when printer is on line.

This key requires a mass storage device on line.

[B] LIST MS

This key is used to list coordinates of certain points or all the points in a mass storage file. If the printer is on line they will be printed.

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
1	Begin.		[XEQ] CDM	CDM*SLCT KEY:
2	Select the list mass storage key.		[B]	MS FL?
3	Input name of mass storage file. (If you wish to use the name of the working file in the extended memory press [R/S] without prior alpha entry.) The file name will be displayed for one second and will be printed if a printer is on line.	"ABC"	[R/S]	FILE: ABC MS BEG PT?
4	Input the beginning point of the coordinates you wish to view or have printed. (If you wish to view or print the entire file press [R/S] without prior data entry.)	Pt #	[R/S]	TO PT NO?
5	Input the last point you wish to view or print. If you wish only one point to be listed press [R/S] without prior data entry. (If the last point number is smaller than the beginning point number you will exit via "NO CAN DO".)	Pt #	[R/S] [R/S]* [R/S]*	N#= # E#= # etc
6	This program will not return to the coordinate management program if an entire file was listed. The program will return to the coordinate management program if only a block of points were listed.			CDM*SLCT KEY:

* This [R/S] not necessary when printer is on line.

The following routines require a mass storage device on line.

The routines provide transfer of coordinates from the extended memory to mass storage and visa versa. The routines will use all available data registers for transfer, but will check for a minimum size of 19 registers. The extended memory file last used will become the working file.

NO CAN DO'S

Nonexistent files
Out of range point numbers
To point number less than from point number

[c] XM-MS

This key transfers coordinates in extended memory files to mass storage files.

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
1	Begin.		[XEQ] CDM	CDM*SLCT KEY:
2	Select extended memory to mass storage key.		[c]	XM FL?
3	Input name of extended memory file. (Defaults to the working file if [R/S] is pressed without prior alpha entry.)	"ABC"	[R/S]	XM BEG PT?
4	Input the extended memory beginning point you wish the transfer to start from. (Defaults to the starting point of the extended memory file if [R/S] is pressed without prior data entry.)	Pt #	[R/S]	TO PT NO?
5	Input the last point you wish to transfer. (If [R/S] is pressed without prior data entry only one point will be transfered.)	Pt #	[R/S]	MS FL?
6	Input name of mass storage file. (Defaults to the working file's name if [R/S] is pressed without prior alpha entry.)	"DEF"	[R/S]	MS BEG PT?
7	Input the beginning point in the mass storage file. (Defaults to the same point number as in step 4 if [R/S] is pressed without prior data entry.)	Pt #	[R/S]	STANDBY
8	When finished the calculator will beep.			CDM*SLCT KEY:

[b] MS-XM

This key transfers coordinates in mass storage files to extended memory files.

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
1	Begin.		[XEQ] CDM	CDM*SLCT KEY:
2	Select mass storage to extended memory key.		[b]	MS FL?
3	Input name of mass storage file. (Defaults to the extended memory working file if [R/S] is pressed without prior alpha entry.)	"ABC"	[R/S]	MS BEG PT?
4	Input the beginning point in mass storage you wish transfer to start from. (Defaults to point number one if [R/S] is pressed without data entry.)	Pt #	[R/S]	TO PT NO?
5	Input the last point number you wish to transfer. (If [R/S] is pressed without prior data entry only the beginning point is transferred.)	Pt #	[R/S]	XM FL?
6	Input name of extended memory file. (Defaults to the working file if [R/S] is pressed without prior alpha entry.)	"DEF"	[R/S]	XM BEG PT?
7	Input the beginning point in the extended memory file. (Defaults to the same point number as in step 4 if [R/S] is pressed without prior data entry.)	Pt #	[R/S]	STANDBY
8	When finished the calculator will beep.			CDM*SLCT KEY:

Available files.

Extended Memory		Mass Storage	
ABC	1-25	86-4	1-1000
86-2	101-125		

Example 1: Transfer points 1-5 in the XM file "ABC" to points 601-605 in the MS file "86-4".

INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] CDM	CDM*SLCT KEY:	Begin
	[c]	XM FL?	
ABC	[R/S]	XM BEG PT?	
1	[R/S]	TO PT NO?	
5	[R/S]	MS FL?	
86-4	[R/S]	MS BEG PT?	
601	[R/S]	STANDBY	
		CDM*SLCT KEY:	end of example.

Example 2: Transfer points 101-110 in the MS file "86-4" to points 101-110 in the XM file "86-2".

INPUT	KEYS	DISPLAY	COMMENTS
		CDM*SLCT KEY:	Begin, should still be in CDM
	[b]	MS FL?	
86-4	[R/S]	MS BEG PT?	
101	[R/S]	TO PT NO?	
110	[R/S]	XM FL?	
86-2	[R/S]	XM BEG PT?	
	[R/S]	STANDBY	
		CDM*SLCT KEY:	end of example.

[H] Sc
Label Sc (Store coordinates)

This program can be used from the coordinate management program or by its own global label. The program transfers coordinates from the working file to a file in the mass storage with the same name and point numbers.

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
1	Begin.		[XEQ] CDM	CDM*SLCT KEY?
2	Select store coordinates key.		[H]	STANDBY
3	When finished the calculator will beep.			CDM*SLCT KEY:
	OR			
1	Begin. (Can be used as a subroutine.)		[XEQ] Sc	STANDBY
2	When finished the calculator will beep and stop, or if used as a subroutine will return to the calling program.			

Available Files

Extended Memory	Mass Storage
86-4 1-50	86-4 1-1000

Example : Store points 1-50 in the XM file "86-4" to its mass storage file.

INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] CDM	CDM*SLCT KEY:	Begin
	[H]	STANDBY	
		CDM*SLCT KEY:	end of example.

[I] Rc
Label **Rc** (Recall coordinates)

This program can be used from the coordinate management program or by its own global label. The program transfers coordinates from mass storage to the working file. File names must be the same.

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
1	Begin.		[XEQ] **CDM**	CDM*SLCT KEY:
2	Select recall coordinates key.		[I]	XM BEG PT?
3	Input the point number you wish to become the new beginning point of the working file. (Defaults to point number one if [R/S] is pressed without prior data entry.)	Pt #	[R/S]	STANDBY
4	When finished the calculator will beep.			CDM*SLCT KEY:
	OR			
1	Begin. (Can be used as a subroutine.)		[XEQ] **Rc**	XM BEG PT?
2	Input the point number you wish to become the new beginning point of the working file. (Defaults to point number one if [R/S] is pressed without prior data entry.)	Pt #	[R/S]	STANDBY
3	When finished the calculator will beep and stop, or if used as a subroutine will return to the calling program.			

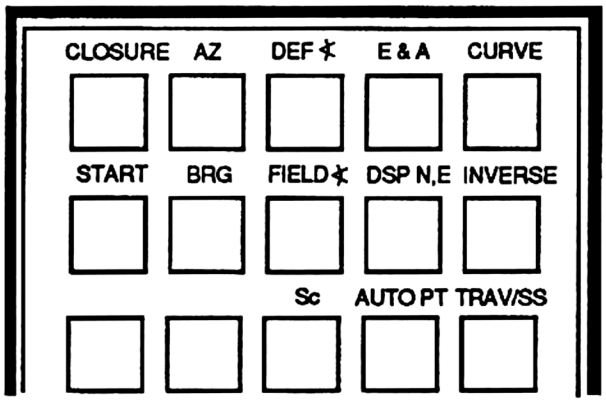
Available files.

Extended Memory		Mass Storage	
86-4	1-50	86-4	1-1000

Example: Recall MS file "86-4" points 601-650 to the 50 point XM file.

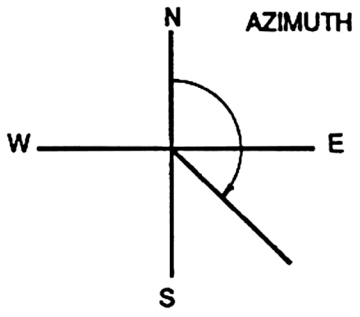
INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] **CDM**	CDM*SLCT KEY:	Begin, should still be in **CDM**
	[I]	XM BEG PT?	
601	[R/S]	STANDBY	
		CDM*SLCT KEY:	end of example.

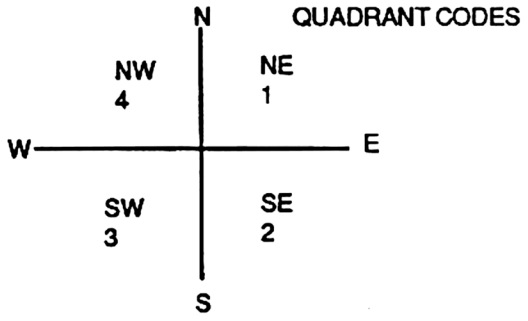
COORDINATE GEOMETRY

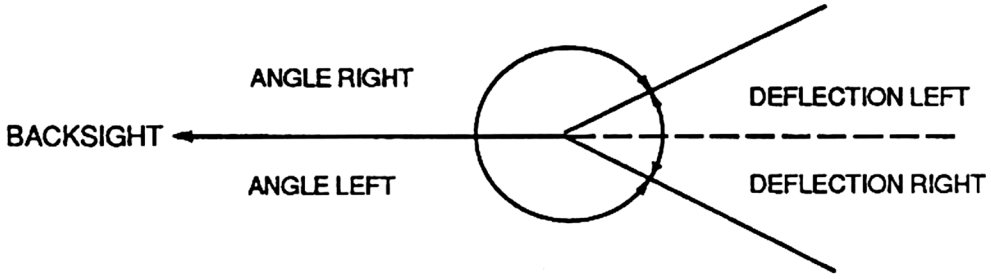


This program is useful for general coordinate geometry problems; traversing, inversing, curved sides, and sideshots.

DIRECTION INPUTS







DISTANCE INPUT

Along with a variety of distance reductions / conversions, described in the user instructions, the program provides for a user routine for distance input. Your user routine can be used for a scale factor or perhaps a personal EDMI reduction. The user routine must be called Label "UHD" and return with the horizontal distance in the X-register. If your user routine uses local Alpha labels, (the subroutine return stack is cleared when a local Alpha label key is pressed), you can return to CG or TCA by ending your routine with [GTO] **Hd**.

CURVED SIDES

Along with a variety of ways to traverse or inverse a curved side, described in the users instructions, the program provides for a user routine for curve input or a general escape and return to the CG program. The user routine must be called Label "UCV". If your user routine uses local Alpha labels, (the subroutine return stack is cleared when a local Alpha label key is pressed), you can return to CG by ending your routine with [GTO] **ee**.

AREA

The program accumulates area by the equation:

$$\text{Area} = \sum_{k=1}^{n} \text{Lat}_k \, (1/2 \, \text{Dep}_k + \sum_{j=1}^{k-1} \text{Dep}_j)$$

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
1	Begin. The working file's name is displayed for one second and printed if printer is on line.		[XEQ] CG	FILE: ABC POB?
2	Input beginning point number.	Pt #	[R/S]	BS PT NO?
3	Input a point number you wish to backsight. If you have no backsight go to step 4. OR if you wish to input a bearing or azimuth as a backsight press [R/S] without prior data entry to the "BS PT NO?" prompt.	Pt #	[R/S]	TRAV BK BRG?
	Input bearing or azimuth of backsight.	Brg or Az	[R/S]	QD?
	Input quadrant code. If you input an azimuth press [R/S] without prior data entry to the "QD?" prompt.	Qd	[R/S]	TRAV
4	Input direction of course.			
	Input Azimuth;	Az	[b]	HD?
	or Bearing	Brg	[B]	QD?
	and Quadrant code;	Qd	[R/S]	HD?
	or Field angle right;	Angle(HMS)	[C]	HD?
	or Field angle left;	Angle(HMS)	[CHS][C]	HD?
	or Deflection angle right;	Angle(HMS)	[c]	HD?
	or Deflection angle left.	Angle(HMS)	[CHS][c]	HD?
5	Input horizontal distance.	HD	[R/S]	NEW PT NO?
	OR press [R/S] without prior data entry to the prompt.		[R/S]	SD M CH U
	Input slope distance, (Default input.)	SD	[A] or [R/S]	∠?
	and zenith or vertical angle;	Angle(HMS)	[R/S]	NEW PT NO?
	or Feet to Meters conversion;	Feet	[b]	NEW PT NO?
	or Meters to Feet conversion;	Meters	[B]	NEW PT NO?
	or Feet to Chains conversion;	Feet	[c]	NEW PT NO?
	or Chains to Feet conversion;	Chains	[C]	NEW PT NO?
	or User key. (See text.)	???	[D]	NEW PT NO?
	If printer is on line the bearing, azimuth, and the horizontial distance of the course will be printed.			
6	Input new point number;	Pt #	[R/S]	TRAV
	or if you do not wish to assign a point number input a zero or press [R/S] without prior data entry. If the printer is on line the coordinates will be printed.			
7	Repeat steps 4,5,and 6 for successive courses.			
8	Initiate closure. The word "CLOSURE" is displayed for one second and printed if printer is on line.		[a]	CLOSURE CLOSE PT NO?

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
9	Input closing point number. Press [R/S] without prior data entry if there is no closing point number.	Pt #	[R/S]	"BEARING"
	Output closing bearing and azimuth;		[R/S]*	AZ=
	and error distance;		[R/S]*	HD=
	and total distance traversed;		[R/S]*	ΣHD=
	and precision ratio;		[R/S]*	PR=1/
	and area, including error course, in square units.		[R/S]*	AREA=
10	For a new problem.		[R/S]*	FILE: ABC POB?
	OR			
	Anytime.		[A]	POB?
	Inverse:			
1	Begin.		[A]	POB?
2	Input beginning point number. (Steps 1 and 2 may not always be necessary.)	Pt #	[R/S]	BS PT NO?
3	Input point number to inverse to.	Pt #	[E]	"BEARING"
	Output bearing and azimuth;		[R/S]*	AZ=
	and distance of new course.		[R/S]*	HD=
	If the printer is on line the coordinates will also be printed.		[R/S]*	TRAV or SS
4	Repeat step 3 for successive courses.			
5	To initiate inverse closure.		[a]	CLOSURE CLOSE PT NO?
6	For area press [R/S] without prior data entry to the prompt.		[R/S]	AREA=
			[R/S]*	FILE: ABC POB?
	Traverse and Sideshots:			
	The user may switch between the			TRAV
	travese mode and sideshot mode, after a		[J]	SS
	beginning point has been established, at will.		[J]	TRAV
	In the traverse mode flag 1 will be set.			
	In the sideshot mode flag 1 will be cleared.			
	Automatic point numbering:			
	The user may switch between a prompting request for a point number and automatic point numbering, after a beginning point has been established.			

* This [R/S] not necessary if printer is on line.

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
1	To initiate auto-point numbering input the point number you wish numbering to start with. Flag 0 will be set.	Pt#	[I]	TRAV or SS
2	The new point numbers will be displayed as you use them.			
3	To stop using auto-point numbering. Flag 0 will be cleared.		[I]	TRAV or SS
4	For a new auto-point starting number step 3 must be performed first, then go to step 1.			
5	When you start a new traverse the auto-point will be cleared (stopped).			
	Curved sides:			
1	Traverse or inverse to the point where the curve begins.			TRAV
2	Initiate curve routine.		[e]	IN BT DT U
3	For a non-tangent inverse go to step 4. For a tangent inverse go to step 5. For a tangent bearing traverse go to step 6. For a tangent delta traverse go to step 7. For a users routine go to step 8.			
4	Non-tangent inverse: Input point number to inverse to; and go to step 9. (The back azimuth is along the chord).	Pt#	[a]	IN BT DT U R?+/-
5	Tangent inverse: Input point number to inverse to; and go to step 9.	Pt#	[A]	IN BT DT U R?+/-
6	Tangent bearing traverse: Input bearing or azimuth of tangent course out of the curve; and quadrant code (if you input an azimuth press [R/S] without prior data entry in response to the "QD?" prompt); and go to step 9.	 BRG or AZ Qd	 [B] [R/S]	IN BT DT U QD? R?+/-
7	Tangent delta traverse: Input central angle of the curve, positive if curve is to the right or negative if curve is to the left; and go to step 9.	 +or- Angle(HMS)	 [C]	IN BT DT U R?+/-

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
8	User routine (see text).	???	[D]	
9	Input radius of curve, positive if the segment area is to be added to the traverse or negative if the segment area is to be subtracted from the traverse.	+ or - R	[R/S]	R=
10	Output radius and delta; and length of curve; and tangent; and chord; the segment area is also output if the printer is on line.		[R/S]* [R/S]* [R/S]* [R/S]* [R/S]*	DELTA= L= T= C= TRAV
11	You have returned to the CG program, input the next course.			
	Storing coordinates:			
1	Select the enter and assign key.		[d]	NEW PT NO?
2	Input desired point number.	Pt #	[R/S]	N?
3	Input northing of point.	N	[R/S]	E?
4	Input easting of point.	E	[R/S]	NEW PT NO?
5	If you have more coordinates to store go to step 2; if you are finished storing coordinates press [R/S] without prior data entry after any prompt to return to the CG program.		[R/S]	TRAV or SS
6	If the point number has already been used you will hear a tone and see: You can either input a new point number, or press [R/S] without prior data entry to use the point number again.	 Pt #	 [R/S] [R/S]	#. USED NEW PT NO? NEW PT NO?
7	If you hear a tone and see: This means the point number does not fall within the point range of the working file. Input a point number that does.	 Pt #	 [R/S]	Pt #-Pt #*Pt # NEW PT NO?
	Displaying coordinates:			
1	Input the point number of the coordinates you wish to display.	Pt #	[D]	N#=
2	Display easting. This step must be performed to return to the calling program.		[R/S]*	E#=
3	You have returned to the CG program.		[R/S]	TRAV or SS

* This [R/S] not necessary if the printer is on line.

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
1	**Storing coordinates in mass storage:** If a mass storage device is on line you may store the working file's coordinates. The files must have the same name and point numbers.		[H]	STANDBY
2	When finished the calculator will beep and restart the CG program.			FILE:ABC POB?

DATA REGISTERS:

#	CG/TCA	#	TCA Adj
00	az trav (HMS)	00	close N/ next N
01	HD	01	close E/ next E
02	N beg	02	N beg
03	E beg	03	E beg
04	ΣHD	04	ΣHD/dist
05	Σlat	05	adj N
06	Σdep	06	adj E
07	area	07	ΔN/ΣHD
08	Σseg area	08	ΔE/ΣHD
09	|Σdep|	09	
10	az ss (HMS)	10	
11		11	close pt #
12		12	beg pt #
13		13	counter pt #
14	auto pt #	14	end pt #
15	pt # pointer	15	pt # pointer
16	delta		
17	radius		
18	seg area		

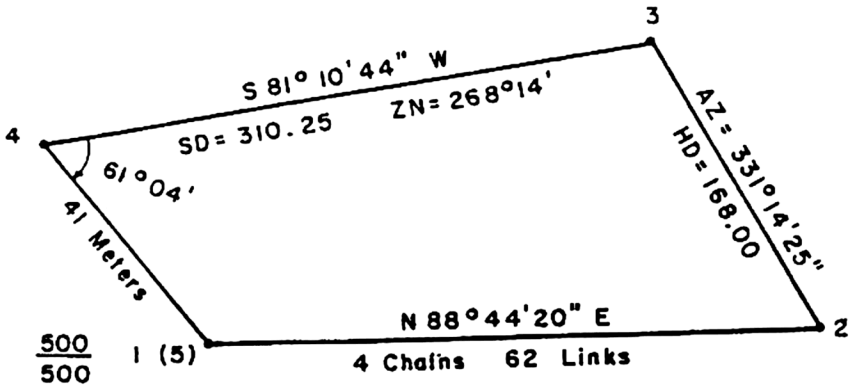
FLAGS:

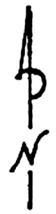
#	SET INDICATES	CLEAR INDICATES
00	auto point	no auto point
01	TRAV	SS
02		
03		
04	closure	no closure
05	"open"	closed loop
06	curve left	curve right
07	subtract seg area	add seg area
08	TCA	CG

STATUS:

SIZE 019, FIX 4, DEG, USER.

Example 1: A Traverse.

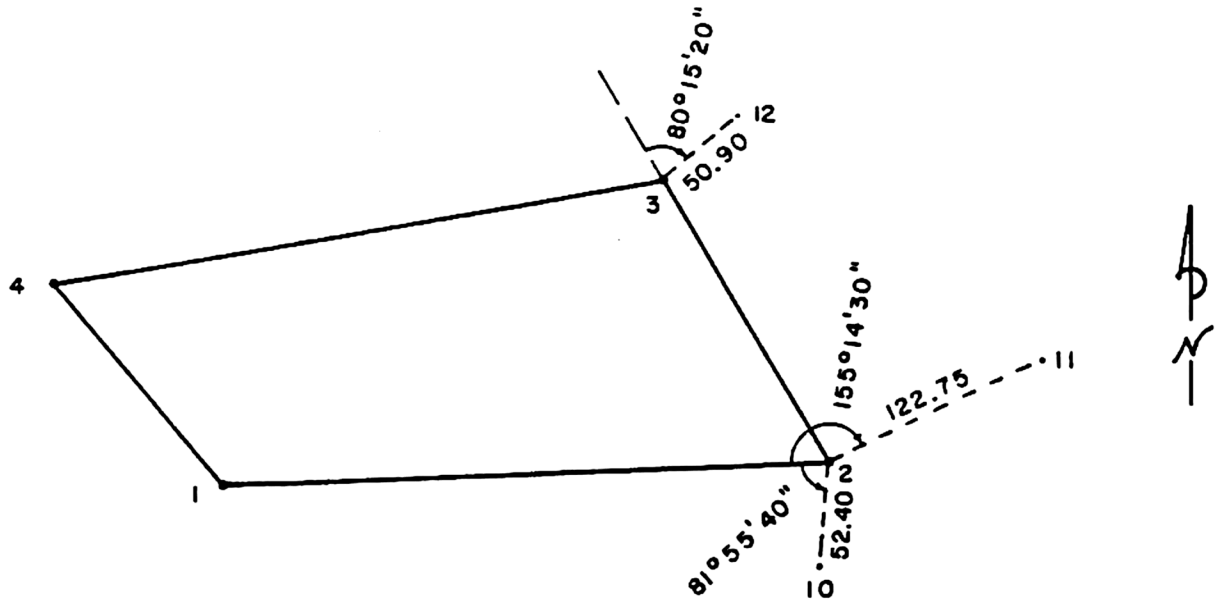




INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] CG	FILE: ABC	Begin
		POB?	
	[d]	NEW PT NO?	store pt # 1
1	[R/S]	N?	
500	[R/S]	E?	
500	[R/S]	NEW PT NO?	
	[R/S]	TRAV or SS	depends on status of flag 1
	[A]	POB?	restart
1	[R/S]	BS PT NO?	no backsight
88.442	[B]	QD?	same as azimuth
	[R/S]	HD?	distance is in chains
	[R/S]	SD M CH U	
4.62	[C]	NEW PT NO?	
2	[R/S]	TRAV	next course
331.1425	[b]	HD?	
168	[R/S]	NEW PT NO?	
3	[R/S]	TRAV	next course
81.1044	[B]	QD?	
3	[R/S]	HD?	
	[R/S]	SD M CH U	
310.25	[A]or[R/S]	⋆?	
268.14	[R/S]	NEW PT NO?	
4	[R/S]	TRAV	next course
61.04	[C]	HD?	angle right
	[R/S]	SD M CH U	
41	[B]	NEW PT NO?	
5	[R/S]	TRAV	initiate closure
	[a]	CLOSURE	
		CLOSE PT NO?	
1	[R/S]	S 36.2547 E	closing bearing
	[R/S]*	AZ=143.3413	closing azimuth
	[R/S]*	HD=0.1001	error distance
	[R/S]*	ΣHD=917.5367	total distance traversed
	[R/S]*	PR=1/9168.	precision ratio
	[R/S]*	AREA=40,986.4780	area in square units
			end of example.

* This [R/S] not necessary if the printer is on line.

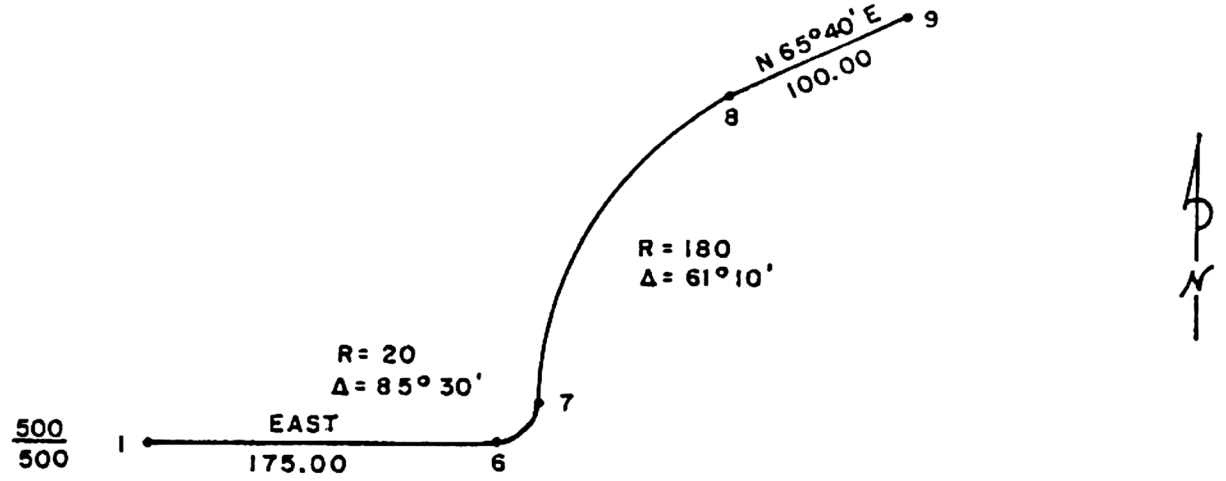
Example 2: Using Example 1 as control coordinates generate coordinates for the given sideshots. Use auto-point numbering for points 10,11, and 12.



INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] CG	FILE: ABC POB?	Begin
2	[R/S]	BS PT NO?	
1	[R/S]	TRAV	
	[J]	SS	switch to sideshot mode
10	[I]	SS	initiate auto point
81.554	[CHS][C]	HD?	angle left
52.4	[R/S]	10.0000 SS	next side shot
155.143	[C]	HD?	
122.75	[R/S]	11.0000 SS	
	[J]	TRAV	switch to traverse mode
3	[E]	N 28.4535 W	inverse to pt # 3
	[R/S]*	AZ= 331.1425	
	[R/S]*	HD=168.00	
	[R/S]*	TRAV	
	[J]	SS	switch to sideshot mode
80.152	[c]	HD?	deflection right
50.9	[R/S]	12.0000 SS	
4	[E]	S 81.1044 W	sideshot inverse to pt # 4
	[R/S]*	AZ=261.1044	
	[R/S]*	HD=310.1025	
	[R/S]*	SS	
	[I]	SS	stop auto point numbering end of example.

* This [R/S] not necessary if printer is on line.

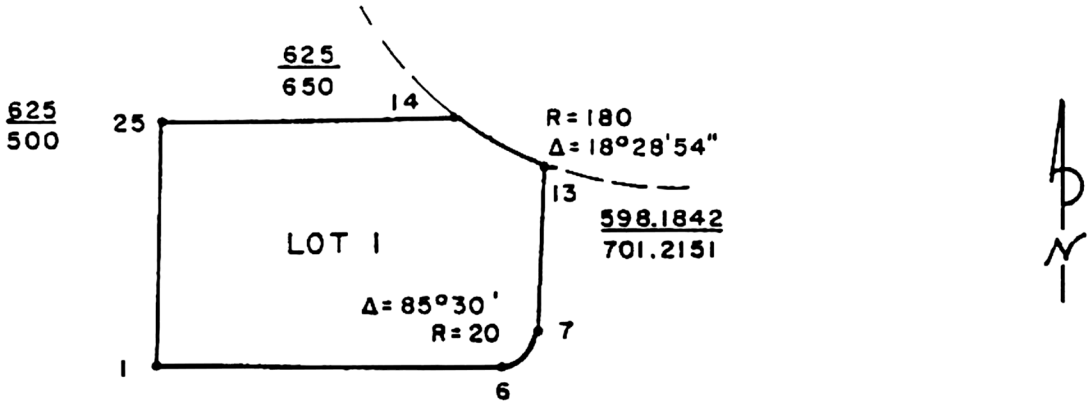
Example 3: Generate the coordinates for points 6-9 using auto point numbering.



INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] CG	FILE: ABC POB?	Begin
1	[R/S]	BS PT NO?	no backsight
6	[I]	TRAV	start auto point
90	[b]	HD?	
175	[R/S]	6.0000 TRAV	next course
	[e]	IN BT DT U	initiate curve
85.3	[CHS][C]	R?+/-	delta traverse to left
20	[R/S]	7.0000 R=20.0000	curve output
	[R/S]*	DELTA=85.3000	
	[R/S]*	L=29.8451	
	[R/S]*	T=18.4878	
	[R/S]*	C=27.1520	
	[R/S]*	TRAV	next course
	[e]	IN BT DT U	initiate curve
65.4	[B]	QD?	bearing out of curve
	[R/S]	R?+/-	same as azimuth
180	[CHS][R/S]	8.0000 R=180.0000	subtract segment area curve output
	[R/S]*	DELTA=61.1000	
	[R/S]*	L=192.1608	
	[R/S]*	T=106.3810	
	[R/S]*	C=183.1648	
	[R/S]*	TRAV	next course
0	[c]	HD?	tangent course, deflection 0°
100	[R/S]	9.0000 TRAV	
	[I]	TRAV	stop auto point numbering end of example.

* This [R/S] not necessary if printer is on line.

Example 4: Calculate the area of lot 1. Points 1, 6, and 7 are from example 3; store the missing coordinates.



INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] CG	FILE: ABC POB?	Begin
1	[R/S]	BS PT NO?	no backsight, inverse
6	[E]	S 90.0000 E	output
	[R/S]*	AZ=90.0000	
	[R/S]*	HD=175.0000	
	[R/S]*	TRAV	next course
	[e]	IN BT DT U	initiate curve
7	[A]	R?+/-	tangent inverse
20	[R/S]	R=20.0000	add segment area
	[R/S]*	DELTA=85.3000	curve output
	[R/S]*	L=29.8451	
	[R/S]*	T=18.4878	
	[R/S]*	C=27.1520	
	[R/S]*	TRAV	next course
13	[E]	N 4.3000 E	
	[R/S]*	AZ=4.3000	
	[R/S]*	HD=80.0000	
	[R/S]*	TRAV	next course
	[e]	IN BT DT U	initiate curve
14	[a]	R?+/-	non tangent inverse
180	[CHS][R/S]	R=180.0000	subtract segment area
	[R/S]*	DELTA=18.2854	curve output
	[R/S]*	L=58.0621	
	[R/S]*	T=29.2854	
	[R/S]*	C=57.8107	
	[R/S]*	TRAV	next course
25	[E]	N 90.0000 W	
	[R/S]*	AZ=270.0000	
	[R/S]*	HD=150.0000	
	[R/S]*	TRAV	next course
1	[E]	S 0.0000 W	
	[R/S]*	AZ=180.0000	

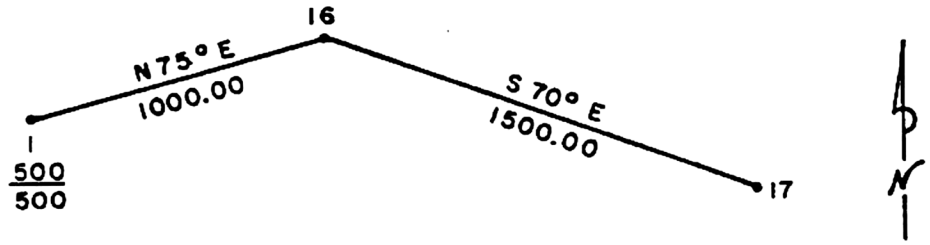
*This [R/S] not necessary if printer is on line.

INPUT	KEYS	DISPLAY	COMMENTS
	[R/S]*	HD=125.0000	
	[R/S]*	TRAV	initiate closure
	[a]	CLOSURE	
		CLOSE PT NO?	I did already
	[R/S]	AREA=23,924.3969	
	[R/S]*	FILE: ABC	
		POB?	end of example.

* This [R/S] not necessary if printer is on line.

Example 5: This example demonstrates the use of the User distance input. Input the program into the RAM of your calculator. The program multiplies the input distance by a scale factor of 0.9998.

```
01♦LBL "UHB"
02 .9998
03 *
04 END
```



INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] CG	FILE: ABC	Begin
		POB?	
1	[R/S]	BS PT NO?	
75	[b]	HD?	
	[R/S]	SD M CH U	
1,000	[D]	NEW PT NO?	
16	[R/S]	TRAV	
70	[B]	QD?	
2	[R/S]	HD?	
	[R/S]	SD M CH U	
1,500	[D]	NEW PT NO?	
17	[R/S]	TRAV	end of example.

```
EXAMPLE 5:

FILE: ABC

POB
N1=500.0000
E1=500.0000

N 75.0000 E
AZ=75.0000
HD=999.8000

N16=758.7673
E16=1,465.7326

S 70.0000 E
AZ=110.0000
HD=1,499.7000

N17=245.8397
E17=2,874.9897
```

PRINTOUTS

EXAMPLE 1:

```
FILE: ABC

POB
N1=500.0000
E1=500.0000

N 88.4420 E
AZ=88.4420
HD=304.9200

N2=506.7109
E2=804.8461

N 28.4535 W
AZ=331.1425
HD=168.0000

N3=653.9873
E3=724.0150

S 81.1044 W
AZ=261.1044
HD=310.1025

N4=606.4331
E4=417.5804

S 37.4516 E
AZ=142.1444
HD=134.5142

N5=500.0805
E5=499.9406

CLOSURE

S 36.2547 E
AZ=143.3413
HD=0.1001
ΣHD=917.5367
PR=1/9,168.

AREA=40,986.4780


FILE: ABC
```

EXAMPLE 2:

```
FILE: ABC

POB
N2=506.7109
E2=804.8461

S 6.4840 W
AZ=186.4840
HD=52.4000

N10=454.6807
E10=798.6317

N 63.5850 E
AZ=63.5850
HD=122.7500

N11=560.5584
E11=915.1548

N 28.4535 W
AZ=331.1425
HD=168.0000

N3=653.9873
E3=724.0150

N 51.2945 E
AZ=51.2945
HD=50.9000

N12=685.6762
E12=763.8475

S 81.1044 W
AZ=261.1044
HD=310.1025

N4=606.4331
E4=417.5804
```

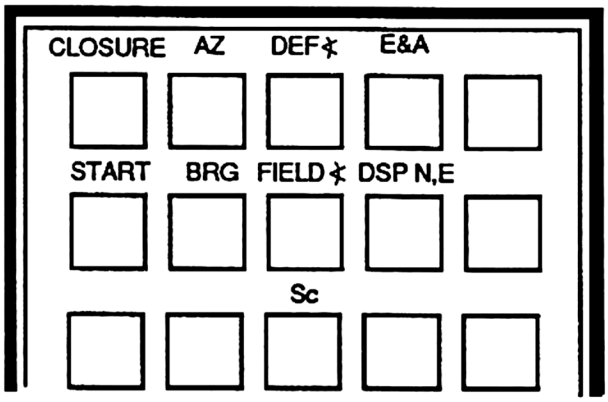
EXAMPLE 3:

```
FILE: ABC

POB
N1=500.0000
E1=500.0000

S 90.0000 E
AZ=90.0000
HD=175.0000

N6=500.0000
E6=675.0000

R=20.0000
DELTA=85.3000
L=29.8451
T=18.4878
C=27.1520
SEG=99.0678

N7=518.4308
E7=694.9383

R=180.0000
DELTA=61.1000
L=192.1608
T=106.3810
C=183.1648
SEG=-3,102.8422

N8=668.3176
E8=800.2155

N 65.4000 E
AZ=65.4000
HD=100.0000

N9=709.5221
E9=891.3318
```

EXAMPLE 4:

```
FILE: ABC

POB
N1=500.0000
E1=500.0000

S 90.0000 E
AZ=90.0000
HD=175.0000

N6=500.0000
E6=675.0000

R=20.0000
DELTA=85.3000
L=29.8451
T=18.4878
C=27.1520
SEG=99.0678

N7=518.4308
E7=694.9383

N 4.3000 E
AZ=4.3000
HD=80.0000

N13=598.1842
E13=701.2151

R=180.0000
DELTA=18.2854
L=58.0621
T=29.2854
C=57.8107
SEG=-90.1496

N14=625.0000
E14=650.0000

N 90.0000 W
AZ=270.0000
HD=150.0000

N25=625.0000
E25=500.0000

S 0.0000 W
AZ=180.0000
HD=125.0000

N1=500.0000
E1=500.0000

CLOSURE

AREA=23,924.3969
```

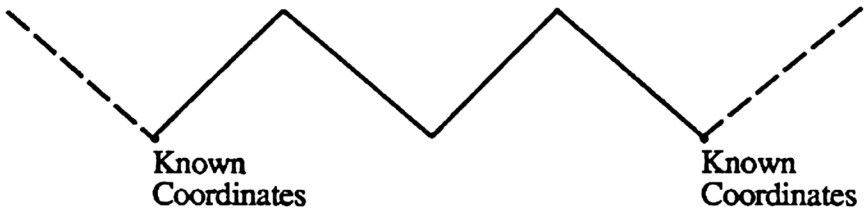
TRAVERSE WITH COMPASS RULE ADJUST



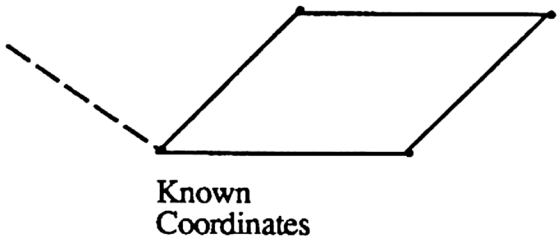
This program is used to generate and adjust a traverse by the compass or Bowditch rule. Point numbers for the traverse legs are consecutive starting from the given beginning point number, prestored in the working file. Adjust angles prior to input.

Directional and distance inputs are the same as in the CG program.

"OPEN" (CONNECTING TRAVERSE)



CLOSED LOOP TRAVERSE



STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
1	Begin. The working file's name is displayed for one second and printed if printer is on line.		[XEQ] **TCA**	FILE: ABC POB?
2	Input beginning point number.	Pt #	[R/S]	BS PT NO?
3	Input the point number you wish to backsight. **OR** if you wish to input a bearing or azimuth as a backsight press [R/S] without prior data entry to the "BS PT NO?" prompt. Input bearing or azimuth of backsight. Input quadrant code. If you input an azimuth press [R/S] without prior data entry to the "QD?" prompt.	Pt # Brg or Az Qd	[R/S] [R/S] [R/S] [R/S]	TRAV BK BRG? QD? TRAV
4	Input direction of next course. Input Azimuth; **or** Bearing and quadrant code; **or** Field angle right; **or** Field angle left; **or** Deflection angle right; **or** Deflection angle left.	 Az(HMS) Brg(HMS) Qd Angle(HMS) Angle(HMS) Angle(HMS) Angle(HMS)	 [b] [B] [R/S] [C] [CHS][C] [c] [CHS][c]	 HD? QD? HD? HD? HD? HD? HD?
5	Input horizontal distance. **OR** press [R/S] without prior data entry to the prompt. Input slope distance, (default input) and zenith or vertical angle; **or** Feet to Meters conversion; **or** Meters to Feet conversion; **or** Feet to Chains conversion; **or** Chains to Feet conversion; **or** User key. (See text.)	HD SD Angle(HMS) Feet Meters Feet Chains ???	[R/S] [R/S] [A] **or** [R/S] [R/S] [b] [B] [c] [C] [D]	# SD M CH U x? # # # # # #
6	The next point number will be temporarily viewed, and if the printer is on line the bearing, azimuth, horizontal distance, and the new coordinates will be printed.			TRAV
7	Repeat steps 4, 5, and 6 for successive courses.			
8	To initiate closure. The word "CLOSURE" is displayed for one second and printed if the printer is on line.		[a]	CLOSURE OPEN?Y
9	You have ten seconds to answer this question. If you do not answer within ten seconds the answer is assumed to be no. If the traverse is open (connecting) press "Y".	 "Y"		 CLOSE PT NO?

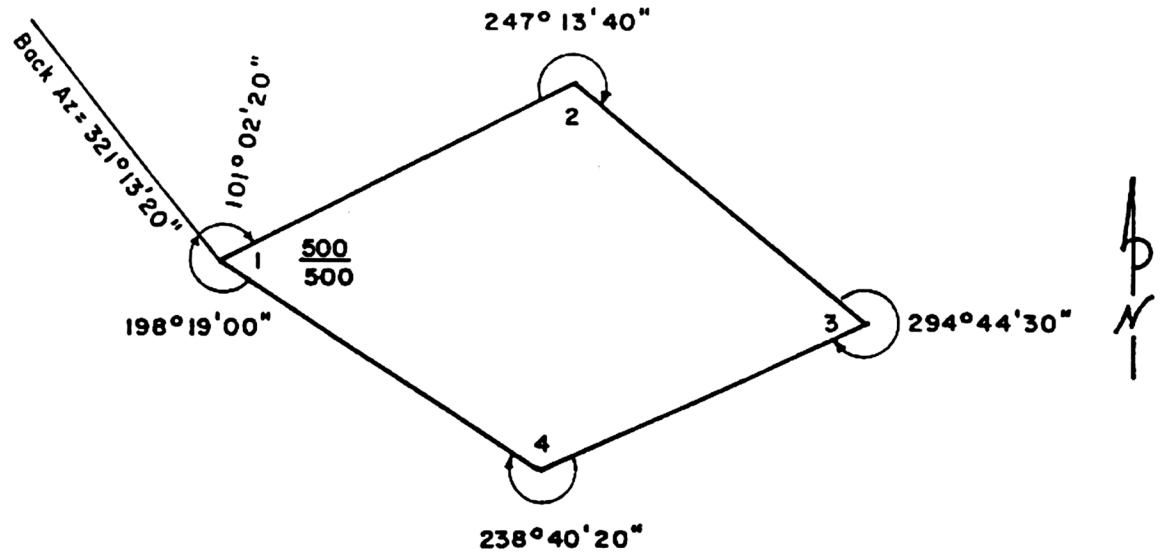
STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
	Input closing point number.	Pt #	[R/S]	"BEARING"
	OR if the traverse is a closed loop press any button except the "Y" key.		[R/S]	"BEARING"
10	Output closing bearing and azimuth;		[R/S]*	AZ=
	and error distance;		[R/S]*	HD=
	and total distance traversed;		[R/S]*	ΣHD=
	and precision ratio.		[R/S]*	PR=1/
11	The program will now adjust the traverse, standby until tone sounds.		[R/S]*	COMPASS ADJUST
12	Output. The program will now inverse			"BEARING"
	through the traverse. For a final look or		[R/S]*	AZ=
	printout of the adjusted traverse. If the		[R/S]*	HD=
	traverse is a closed loop the area is also		[R/S]*	N#=
	output.		[R/S]*	E#=
			[R/S]*	etc
			...	...
13	For a new problem.		[R/S]*	FILE: ABC
	OR			POB?
	Anytime.		[A]	POB?

* This [R/S] not necessary if printer is on line.

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
	Storing coordinates:			
1	Select the enter and assign key.		[d]	NEW PT NO?
2	Input desired point number.	Pt #	[R/S]	N?
3	Input northing of point.	N	[R/S]	E?
4	Input easting of point.	E	[R/S]	NEW PT NO?
5	If you have more coordinates to store go to step 2; if you are finished storing coordinates press [R/S] without prior data entry after any prompt to return to the TCA program.		[R/S]	TRAV or SS
6	If the point number has already been used you will hear a tone and see:			#. USED
	You can either input a new point number,	Pt #	[R/S]	NEW PT NO?
	or press [R/S] without prior data entry to use the point number again.		[R/S]	NEW PT NO?
7	If you hear a tone and see:			Pt #-Pt #*Pt #
	This means the point number does not fall within the point range of the working file. Input a point number that does.	Pt #	[R/S]	NEW PT NO?
	Displaying coordinates:			
1	Input the point number of the coordinates you wish to display.	Pt #	[D]	N#=
2	Display easting. This step must be performed to return to the calling program.		[R/S]*	E#=
3	You have returned to the TCA program.		[R/S]	TRAV or SS
	Storing coordinates in mass storage:			
1	If a mass storage device is on line you may store the working file's coordinates. The files must have the same name and point numbers.		[H]	STANDBY
2	When finished the calculator will beep and restart the CG program.			FILE: ABC POB?

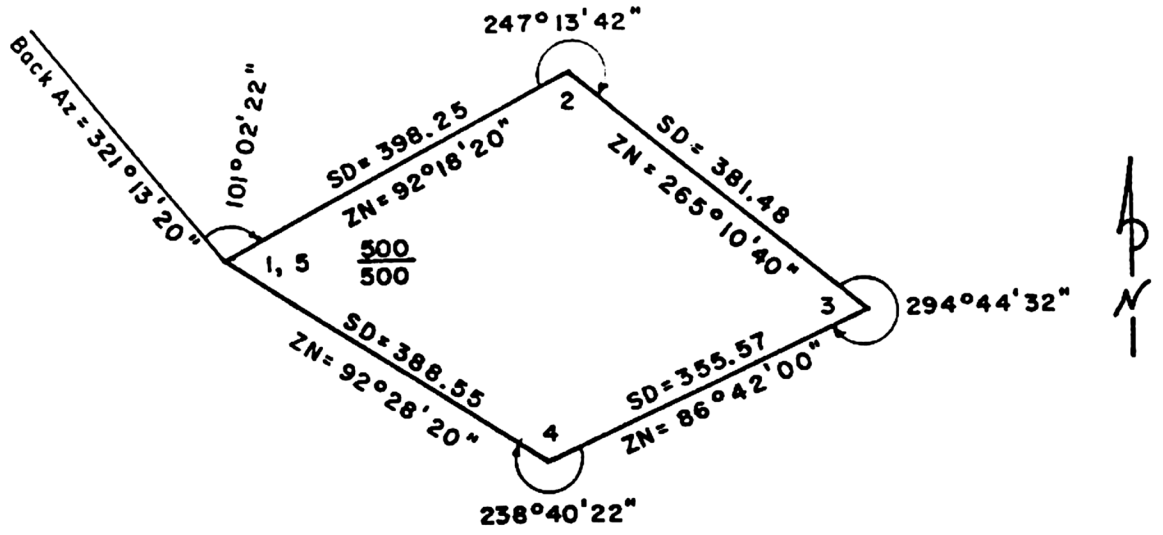
*This [R/S] not necessary if printer is on line.

Example 1: Adjust angles.



INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] CG or TCA	FILE: ABC POB?	Begin input any point
1	[R/S]	BS PT NO?	
	[R/S]	BK BRG?	
321.132	[R/S]	QD?	azimuth
	[R/S]	TRAV	
101.022	[C]	HD?	ignore prompt
247.134	[C]	HD?	
294.443	[C]	HD?	
238.402	[C]	HD?	
198.19	[C]	HD?	
	[RCL] 00 or	321.1310	recall azimuth
	[VIEW] 00	321.1310	10" short, add 2" per angle end of example.

Example 2: Compute and compass rule adjust traverse.

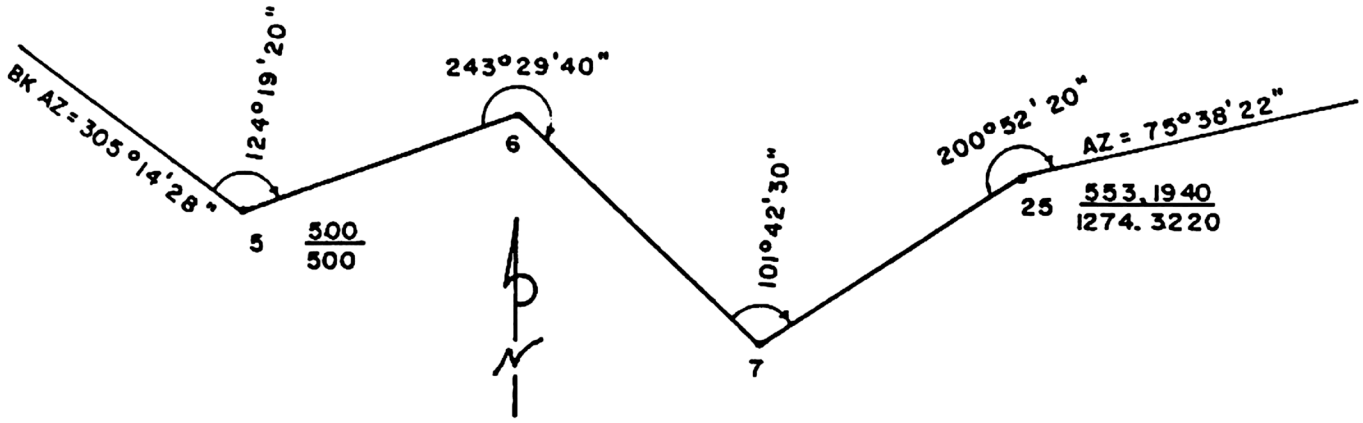


INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] TCA	FILE: ABC	Begin
		POB?	
1	[R/S]	BS PT NO?	
	[R/S]	BK BRG?	
321.132	[R/S]	QD?	
	[R/S]	TRAV	1st course
101.0222	[C]	HD?	
	[R/S]	SD M CH U	
398.25	[R/S]	∠?	default condition
92.182	[R/S]	2.0000	
		TRAV	next course
247.1342	[C]	HD?	
	[R/S]	SD M CH U	
381.48	[R/S]	∠?	
265.104	[R/S]	3.0000	
		TRAV	next course
294.4432	[C]	HD?	
	[R/S]	SD M CH U	
355.57	[R/S]	∠?	
86.42	[R/S]	4.0000	
		TRAV	last course
238.4022	[C]	HD?	
	[R/S]	SD M CH U	

INPUT	KEYS	DISPLAY	COMMENTS
388.55	[R/S]	∠?	
92.282	[R/S]	5.0000	
		TRAV	initiate closure
	[a]	CLOSURE	
		OPEN?Y	no
	[R/S]	S 48.4260 E	closure output
	[R/S]*	AZ=131.1700	
	[R/S]*	HD=0.0483	
	[R/S]*	ΣHD=1,521.2261	
	[R/S]*	PR=1/31,526.	
	[R/S]*	COMPASS ADJUST	adjusting traverse, standby until tone sounds
		N 62.1548 E	adjusted traverse output
	[R/S]*	AZ=62.1548	
	[R/S]*	HD=397.9321	
	[R/S]*	N2=685.2008	
	[R/S[*	E2=852.2082	
	[R/S]*	S 50.3036 E	
	[R/S]*	AZ=129.2924	
	[R/S]*	HD=380.1417	
	[R/S]*	N3=443.4519	
	[R/S]*	E3=1,145.5769	
	[R/S]*	S 64.1350 W	
	[R/S]*	AZ=244.1350	
	[R/S]*	HD=354.9760	
	[R/S]*	N4=289.1257	
	[R/S]*	E4=825.9030	
	[R/S]*	N 57.0543 W	
	[R/S]*	AZ=302.5417	
	[R/S]*	HD=388.1762	
	[R/S]*	N1=500.0000	
	[R/S]*	E1=500.0000	
	[R/S]*	AREA=128,592.2389	
	[R/S]*	FILE: ABC	
		POB?	end of example.

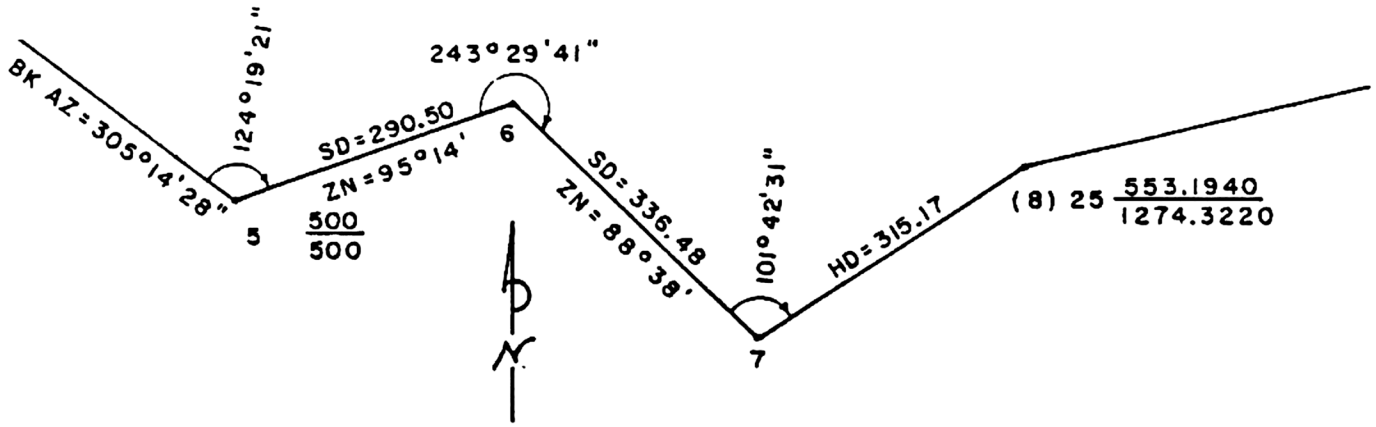
* This [R/S] not necessary if printer is on line.

Example 3: Adjust angles and store coordinates for points 5 and 25.



INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] CG or TCA	FILE: ABC	Begin
		POB?	input any point
1	[R/S]	BS PT NO?	
	[R/S]	BK BRG?	
305.1428	[R/S]	QD?	azimuth
	[R/S]	TRAV	
124.192	[C]	HD?	ignore prompt
243.294	[C]	HD?	
101.423	[C]	HD?	
200.522	[C]	HD?	
	[RCL] 00 or	75.3818	recall azimuth
	[VIEW] 00	75.3818	4" short, add 1" per angle
	[d]	NEW PT NO?	store points
5	[R/S]	N?	
500	[R/S]	E?	
500	[R/S]	5. USED	use again
	[R/S]	NEW PT NO?	
25	[R/S]	N?	
553.194	[R/S]	E?	
1274.322	[R/S]	NEW PT NO?	return to CG or TCA
	[R/S]	TRAV	end of example.

Example 4: Compute and compass rule adjust the open (connecting) traverse.



INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] TCA	FILE: ABC	Begin
		POB?	
5	[R/S]	BS PT NO?	
	[R/S]	BK BRG?	
305.1428	[R/S]	QD?	azimuth
	[R/S]	TRAV	1st course
124.1921	[C]	HD?	
	[R/S]	SD M CH U	
290.5	[R/S]	∠?	
95.14	[R/S]	6.0000	
		TRAV	next course
243.2941	[C]	HD?	
	[R/S]	SD M CH U	
336.48	[R/S]	∠?	
88.38	[R/S]	7.0000	
		TRAV	last course
101.4231	[C]	HD?	
315.17	[R/S]	8.0000	
		TRAV	
	[a]	CLOSURE	initiate closure
		OPEN?Y	yes
"Y"		CLOSE PT NO?	
25	[R/S]	N 43.4134 E	closure output
	[R/S]*	AZ=43.4134	
	[R/S]*	HD=0.0344	
	[R/S]*	ΣHD=940.8433	
	[R/S]*	PR=1/27,327.	
	[R/S]*	COMPASS ADJUST	adjusting traverse, standby until tone sounds
		N 69.3346 E	adjusted traverse output
	[R/S]*	AZ=69.3346	
	[R/S]*	HD=289.2986	
	[R/S]*	N6=601.0179	

* This [R/S] not necessary if printer is on line.

INPUT	KEYS	DISPLAY	COMMENTS
	[R/S]*	E6=771.0886	
	[R/S]*	S 46.5638 E	
	[R/S]*	AZ=133.0322	
	[R/S]*	HD=336.3844	
	[R/S]*	N7=371.3629	
	[R/S]*	E7=1,016.8793	
	[R/S]*	N 54.4560 E	
	[R/S]*	AZ=54.4560	
	[R/S]*	HD=315.1813	
	[R/S]*	N25=553.1940	
	[R/S]*	E25=1,274.3220	
	[R/S]*	FILE: ABC	
		POB?	end of example.

* This [R/S] not necessary if printer is on line.

PRINTOUTS

EXAMPLE 2:

FILE: ABC

POB
N1=500.0000
E1=500.0000

N 62.1542 E
AZ=62.1542
HD=397.9276

N2=685.2092
E2=852.1987

S 50.3036 E
AZ=129.2924
HD=380.1297

N3=443.4681
E3=1,145.5583

S 64.1356 W
AZ=244.1356
HD=354.9804

N4=289.1494
E4=825.8760

N 57.0542 W
AZ=302.5418
HD=388.1884

N5=500.0318
E5=499.9637

CLOSURE

S 48.4260 E
AZ=131.1700
HD=0.0483
ΣHD=1,521.2261
PR=1/31,526.

COMPASS ADJUST

POB
N1=500.0000
E1=500.0000

N 62.1548 E
AZ=62.1548
HD=397.9321

N2=685.2088
E2=852.2082

S 50.3036 E
AZ=129.2924
HD=380.1417

N3=443.4519
E3=1,145.5769

S 64.1350 W
AZ=244.1350
HD=354.9760

N4=289.1257
E4=825.9030

N 57.0543 W
AZ=302.5417
HD=388.1762

N1=500.0000
E1=500.0000

AREA=128,592.2389

FILE: ABC

EXAMPLE 4:

FILE: ABC

POB
N5=500.0000
E5=500.0000

N 69.3349 E
AZ=69.3349
HD=289.2891

N6=601.0103
E6=771.0813

S 46.5630 E
AZ=133.0330
HD=336.3843

N7=371.3464
E7=1,016.8635

N 54.4601 E
AZ=54.4601
HD=315.1700

N8=553.1691
E8=1,274.2982

CLOSURE

N 43.4134 E
AZ=43.4134
HD=0.0344
ΣHD=940.8433
PR=1/27,327.

COMPASS ADJUST

POB
N5=500.0000
E5=500.0000

N 69.3346 E
AZ=69.3346
HD=289.2986

N6=601.0179
E6=771.0886

S 46.5638 E
AZ=133.0322
HD=336.3844

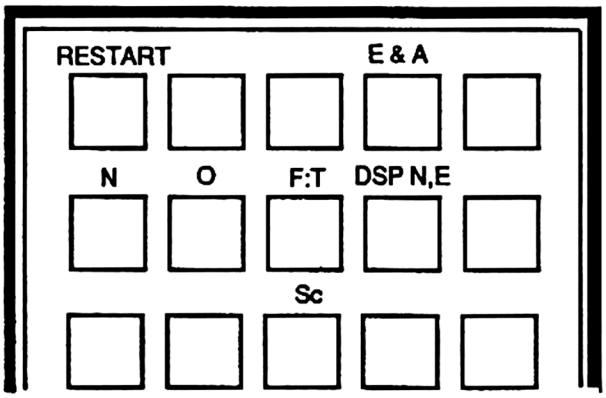
N7=371.3629
E7=1,016.8793

N 54.4560 E
AZ=54.4560
HD=315.1813

N25=553.1940
E25=1,274.3220

FILE: ABC

COORDINATE TRANSFORMATION



This program rotates, translates, and rescales coordinates stored in the working file. The program **CTC** transforms coordinates if two points in both the old and new system are known. The program **CRT** transforms coordinates by inputing the necessary data; old bearing, new bearing, scale factor, and the new coordinates of pivot point.

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
	Coordinate Rotation and Transformation:			
1	Begin. The working file's name is displayed for one second and printed if the printer is on line.		[XEQ] **CRT**	FILE: ABC OLD PIV PT?
2	Input pivot point number of old system.	Pt #	[R/S]	OLD 2ND PT?
3	Input a second point number in old system to be used for azimuth.	Pt #	[R/S]	NEW BRG?
	OR Press [R/S] without prior data entry and input old system bearing or azimuth. (If you		[R/S]	OLD BRG?
	Input an azimuth press [R/S] without prior	Brg or Az	[R/S]	QD?
	data entry to the "QD?" prompt.)	Qd	[R/S]	NEW BRG?
4	Input new system bearing or azimuth for the line input in step 3. (If you input an	Brg or Az	[R/S]	QD?
	azimuth press [R/S] without prior data entry to the "QD?" prompt.)	Qd	[R/S]	S.F.?
5	Input scale factor. If the scale factor is one press [R/S] without prior data entry.	S.F.	[R/S]	TRANS?Y
6	You have ten seconds to answer this question. If you do not answer within ten seconds the answer is assumed to be no. If you wish to translate the coordinates press "Y";	"Y"		NEW PIV PT?
	OR if you do not wish to translate the coordinates press any key other than the "Y" key, and go the step 8.		[R/S]	FROM PT NO? NEW PIV PT?
7	Input the new pivot point number.	Pt #	[R/S]	FROM PT NO?
	OR Press [R/S] without prior data entry to input coordinates.		[R/S]	N?
	Input northing;	N	[R/S]	E?
	and easting.	E	[R/S]	FROM PT NO?
	Go to step 8.			
	Coordinate Transformation by Coordinates:			
1	Begin. The working file's name is displayed for one second and printed if printer is on line.		[XEQ] **CTC**	FILE: ABC OLD PIV PT?
2	Input pivot point number in the old system.	Pt #	[R/S]	OLD 2ND PT?
3	Input second point number in the old system.	Pt #	[R/S]	NEW PIV PT?
4	Input pivot point number in the new system.	Pt #	[R/S]	NEW 2ND PT?
	OR Press [R/S] without prior data entry to input coordinates.		[R/S]	N?
	Input northing;	N	[R/S]	E?
	and easting.	E	[R/S]	NEW 2ND PT?

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
5	Input second point number in the new system. OR Press [R/S] without prior data entry to input coordinates. Input northing; and easting. Go to step 8.	Pt # N E	[R/S] [R/S] [R/S] [R/S]	FROM PT NO? N? E? FROM PT NO?
8	Input starting point number in the old system to be transformed. OR press [R/S] without prior data entry if you do not have a consecutive block of points to transform and go to step 10.	Pt #	[R/S]	TO PT NO?
9	Input last point number in the old system to be transformed. If the printer is on line the "OLD" and "NEW" coordinates will be printed.	Pt #	[R/S]	N O F:T
10 10a	**Select key:** To transform coordinates from the old system to the new system, input point number in old system.	Pt #	[A]	N O F:T
10b	To transform coordinates from the new system to the old system, input point number in new system.	Pt #	[B]	N O F:T
10c	To transform a consecutive block of points from the old system to the new system. Input starting point; and last point.	 Pt# Pt#	[C] [R/S] [R/S]	FROM PT NO? TO PT NO? N O F:T
11	Repeat step 10 as needed.			
12	For a new case; and go to step 2.		[a]	FILE: ABC OLD PIV PT?

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
	Storing coordinates:			
1	Select the enter and assign key.		[d]	NEW PT NO?
2	Input desired point number.	Pt #	[R/S]	N?
3	Input northing of point.	N	[R/S]	E?
4	Input easting of point.	E	[R/S]	NEW PT NO?
5	If you have more coordinates to store go to step 2; if you are finished storing coordinates press [R/S] without prior data entry after any prompt to return to the CRT program.		[R/S]	OLD PIV PT?
6	If the point number has already been used you will hear a tone and see: You can either input a new point number, or press [R/S] without prior data entry to use the point number again.	Pt#	[R/S] [R/S]	#.USED NEW PT NO? NEW PT NO?
7	If you hear a tone and see: This means the point number does not fall within the point range of the working file. Input a point nmber that does.	Pt#	[R/S]	PT#-PT#*PT# NEW PT NO?
	Displaying coordinates:			
1	Input the point number of the coordinates you wish to display. Display nothing.	Pt #	[D]	N#=
2	Display easting. This step must be performed to return to the calling program.		[R/S]*	E#=
3	You have returned to the CRT program.		[R/S]	OLD PIV PT?
	Storing coordinates in mass storage:			
1	If a mass storage device is on line you may store the working file's coordinates. The files must have the same name and point numbers.		[H]	STANDBY
2	When finished the calculator will beep and restart the CRT program.			FILE: ABC OLD PIV PT?

*This [R/S] not necessary if printer is on line.

DATA REGISTERS:

#	CRT/CTC
00	rotation ∠ (HMS)
01	scale factor
02	N old piv pt
03	E old piv pt
04	N new piv pt
05	E new piv pt
....	
13	from point
14	to point
15	pt # pointer

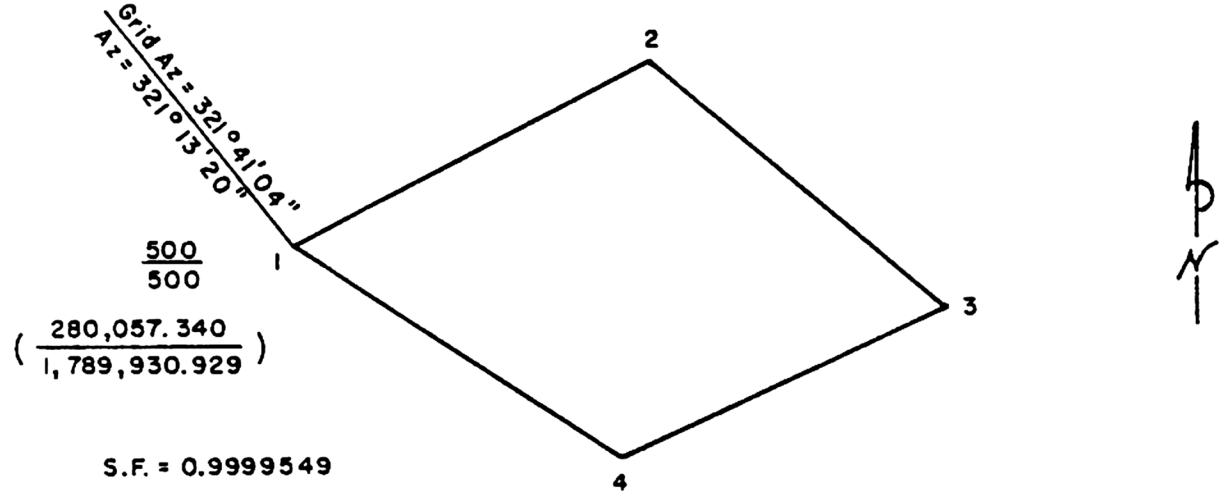
FLAGS:

#	SET INDICATES	CLEAR INDICATES
01	CTC	CRT
....		
08	RTN	prompt
09	"OLD"	"NEW"
10	store coord. no √	

STATUS:

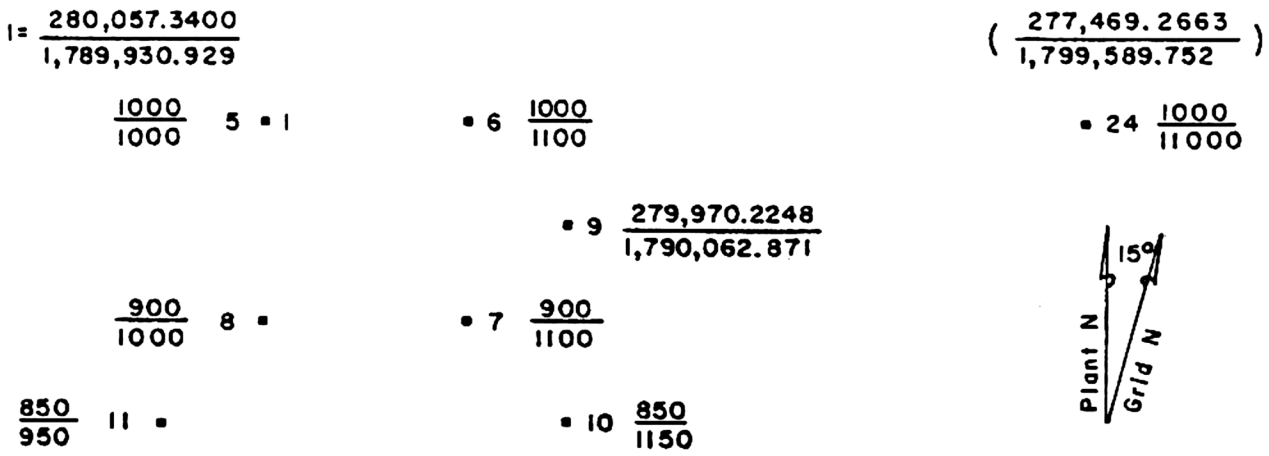
SIZE 016, FIX 4, DEG, USER.

Example 1: Transform coordinates of the closed traverse in example 1 of TCA.



INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] CRT	FILE: ABC	Begin
		OLD PIV PT?	
1	[R/S]	OLD 2ND PT?	have azimuth
	[R/S]	OLD BRG?	
321.132	[R/S]	QD?	
	[R/S]	NEW BRG?	
321.4104	[R/S]	QD?	
	[R/S]	S.F.?	scale factor
.9999549	[R/S]	TRANS?Y	translate? yes"Y"
"Y"		NEW PIV PT?	
	[R/S]	N?	
280,057.34	[R/S]	E?	
1,789,930.929	[R/S]	FROM PT NO?	
1	[R/S]	TO PT NO?	
4	[R/S]	N O F:T	end of example.

Example 2: Transform the coordinates below. Store necessary coordinates.



INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] CTC	FILE: ABC OLD PIV PT?	Begin
5	[R/S]	OLD 2ND PT?	
24	[R/S]	NEW PIV PT?	
1	[R/S]	NEW 2ND PT?	only have coordinates
	[R/S]	N?	
277,469.2663	[R/S]	E?	
1,799,589.752	[R/S]	FROM PT NO?	
5	[R/S]	TO PT NO?	
8	[R/S]	N O F:T	
	[C]	FROM PT NO?	
10	[R/S]	TO PT NO?	
11	[R/S]	N O F:T	
9	[B]	N O F:T	new system to old system
24	[A]	N O F:T	old system to new system end of example.

PRINTOUTS

EXAMPLE 1:

FILE: ABC

OLD
N1=500.0000
E1=500.0000

NEW
N1=280,057.3400
E1=1,789,930.929

OLD
N2=685.2008
E2=852.2082

NEW
N2=280,239.6852
E2=1,790,284.604

OLD
N3=443.4519
E3=1,145.5769

NEW
N3=279,995.5885
E3=1,790,576.008

OLD
N4=289.1257
E4=825.9030

NEW
N4=279,843.8530
E4=1,790,255.106

EXAMPLE 2:

FILE: ABC

OLD
N5=1,000.0000
E5=1,000.0000

NEW
N5=280,057.3400
E5=1,789,930.929

OLD
N6=1,000.0000
E6=1,100.0000

NEW
N6=280,031.4593
E6=1,790,027.517

OLD
N7=900.0000
E7=1,100.0000

NEW
N7=279,934.8710
E7=1,790,001.636

OLD
N8=900.0000
E8=1,000.0000

NEW
N8=279,960.7518
E8=1,789,905.048

OLD
N10=850.0000
E10=1,150.0000

NEW
N10=279,873.6365
E10=1,790,036.990

OLD
N11=850.0000
E11=950.0000

NEW
N11=279,925.3980
E11=1,789,843.814

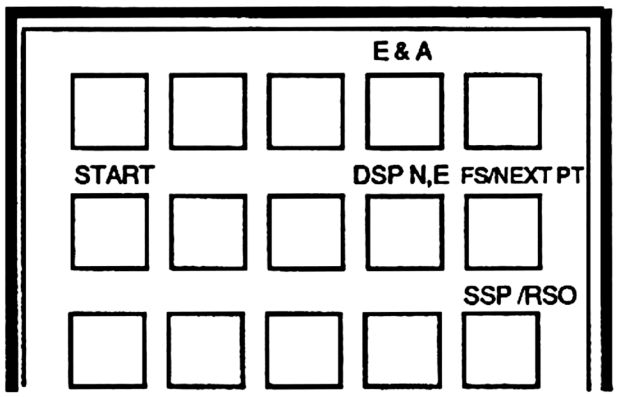
NEW
N9=279,970.2248
E9=1,790,062.871

OLD
N9=950.0000
E9=1,150.0000

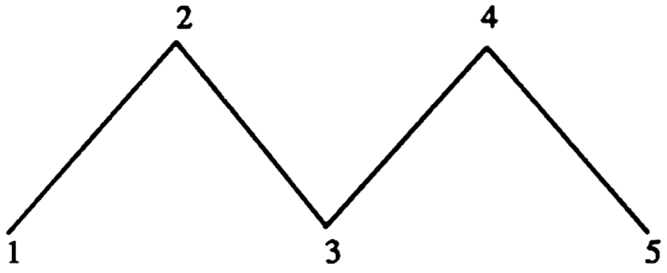
OLD
N24=1,000.0000
E24=11,000.0000

NEW
N24=277,469.2663
E24=1,799,589.752

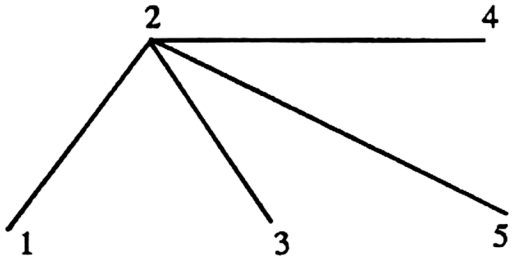
SUCCESSIVE POINTS AND RADIAL STAKEOUT



These programs calculate the horizontal distance, the field angle right, the field angle right doubled, the bearing, and azimuth of either successive points or from a fixed point.



SUCCESSIVE POINTS



RADIAL POINTS

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
1	Begin Successive Points. **OR**		[XEQ] **SSP**	FILE: ABC
1a	Begin Radial Stakeout.		[XEQ] **RSO**	FILE: ABC
	The working file's name is displayed for one second and printed if printer is on line.			POB?
2	Input the point that will be occupied first.	Pt #	[R/S]	BS PT NO?
3	Input the point you wish to backsight.	Pt #	[R/S]	NEXT PT NO?
	OR if you wish to input a back bearing or azimuth press [R/S] without prior data entry to the prompt. (If you input an azimuth press [R/S] without prior data entry to the "QD?" prompt.)			**or** FS PT NO?
			[R/S]	BK BRG?
		Brg or Az	[R/S]	QD?
		Quadrant	[R/S]	NEXT PT NO?
				or FS PT NO?
4	Input the next successive point number, **or** the radial point you wish to foresight.	Pt #	[R/S]	HD=
5	Output. Horizontal distance; and the angle		[R/S]*	∢1=
	right; and angle right doubled;		[R/S]*	∢2=
	and bearing;		[R/S]*	"BEARING"
	and azimuth.		[R/S]*	AZ=
			[R/S]*	NEXT PT NO?
				or FS PT NO?
6	Go to step 4.			
	OR If you do not need all of the output supplied you may input the next point when you wish.	Pt #	[E]	HD=
			[R/S]*	etc.
7	You may switch between **SSP** and **RSO** at will. The backsight will be the same as the			NEXT PT NO?
	previous solution. **SSP** sets flag 1, **RSO** clears flag 1.		[J]	FS PT NO?
			[J]	NEXT PT NO?
8	For a new case. Go to step 2.		[A]	POB?

*This [R/S] not necessary is printer is on line.

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
	Storing coordinates:			
1	Select the enter and assign key.		[d]	NEW PT NO?
2	Input desired point number.	Pt #	[R/S]	N?
3	Input northing of point.	N	[R/S]	E?
4	Input easting of point.	E	[R/S]	NEW PT NO?
5	If you have more coordinates to store go to step 2; if you are finished storing coordinates press [R/S] without prior data entry after any prompt to return to the SSP/RSO program.		[R/S]	POB?
6	If the point number has already been used you will hear a tone and see:			#.USED
	You can either input a new point number,	Pt#	[R/S]	NEW PT NO?
	or press [R/S] without prior data entry to use the point number again.		[R/S]	NEW PT NO?
7	If you hear a tone and see:			Pt#-Pt#*Pt#
	This means the point number does not fall within the point range of the working file.			
	Input a point number that does.	Pt#	[R/S]	NEW PT NO?
	Displaying coordinates:			
1	Input the point number of the coordinates you wish to display. Display nothing.	Pt #	[D]	N#=
2	Display easting. This step must be performed to return to the calling program.		[R/S]*	E#=
3	You have returned to the SSP/RSO program.		[R/S]	POB?

* This [R/S] not necessary if printer is on line.

DATA REGISTERS:

#	SSP/RSO
00	back az (HMS)
01	HD
02	∢ between
03	occupied pt #
04	N old
05	E old
06	new pt #
07	N new
08	E new
09	BS pt #
10	new az
....	
15	pt # pointer

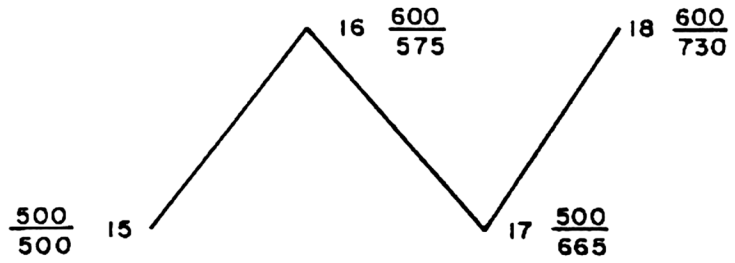
FLAGS:

#	SET INDICATES	CLEAR INDICATES
01	SSP	RSO

STATUS:

SIZE 016, FIX 4, DEG, USER.

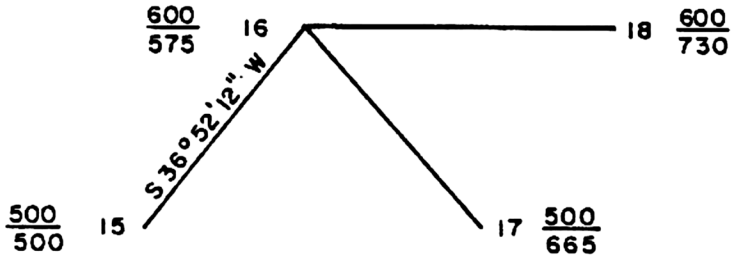
Example 1: A successive point problem. Store necessary coordinates first.



INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] SSP	FILE: ABC	Begin
		POB?	input occupied Pt#
16	[R/S]	BS PT NO?	
15	[R/S]	NEXT PT NO?	
17	[R/S]	HD=134.5362	output
	[R/S]*	∢1=281.0834	
	[R/S]*	∢2=202.1709	
	[R/S]*	S 41.5914 E	
	[R/S]*	AZ=138.0046	
	[R/S]*	NEXT PT NO?	
18	[R/S]	HD=119.2686	output
	[R/S]*	∢1=75.0040	
	[R/S]*	∢2=150.0120	
	[R/S]*	N 33.0126 E	
	[R/S]*	AZ=33.0126	
	[R/S]*	NEXT PT NO?	end of example.

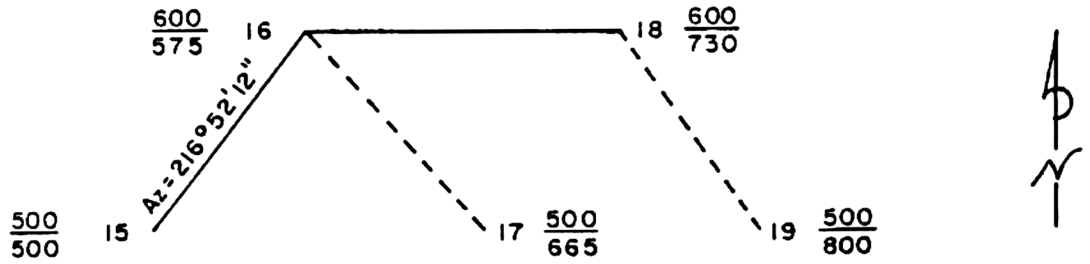
*This [R/S] not necessary if printer is on line.

Example 2: A radial stakeout problem. Store necessary coordinates first. No printer.



INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] RSO	FILE: ABC	Begin
		POB?	
16	[R/S]	BS PT NO?	use back bearing
	[R/S]	BK BRG?	
36.5212	[R/S]	QD?	
3	[R/S]	FS PT NO?	
17	[R/S]	HD=134.5362	output
	[R/S]	∢1=281.0834	all I want
18	[E]	HD=155.0000	
	[R/S]	∢1=233.0748	
	[R/S]	∢2=106.1536	
	[R/S]	S 90.0000 E	
	[R/S]	AZ=90.0000	
	[R/S]	FS PT NO?	end of example.

Example 3: A combination problem. Store necessary coordiates first. No printer.



INPUT	KEYS	DISPLAY	COMMENTS
	[A]	POB?	Begin, program should still be in the RSO program
16	[R/S]	BS PT NO?	use back azimuth
	[R/S]	BK BRG?	
216.5212	[R/S]	QD?	
	[R/S]	FS PT NO?	
17	[R/S]	HD=134.5362	
	[R/S]	∠1=281.0834	
	[J]	NEXT PT NO?	switch to SSP
18	[R/S]	HD=155.0000	
	[R/S]	∠1=233.0748	
	[J]	FS PT NO?	switch to RSO
19	[R/S]	HD=122.0656	
	[R/S]	∠1=235.0029	end of example.

PRINTOUTS

EXAMPLE 1:

```
FILE: ABC

16 BS 15 FS 17

HD=134.5362
∠1=281.0834
∠2=202.1709
S 41.5914 E
AZ=138.0046

17 BS 16 FS 18

HD=119.2686
∠1=75.0040
∠2=150.0120
N 33.0126 E
AZ=33.0126
```

EXAMPLE 2:

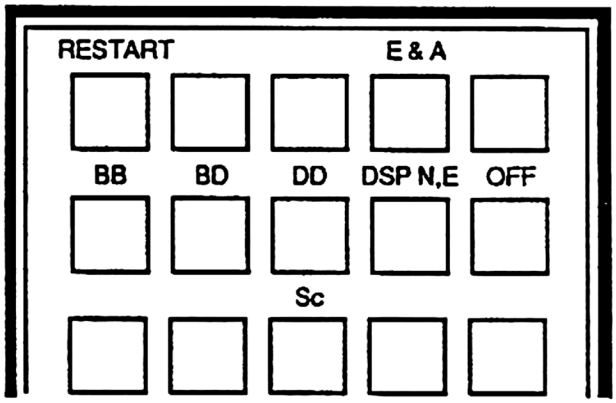
```
FILE: ABC

AZ=216.5212

16 BS AZ FS 17

HD=134.5362
∠1=281.0834
∠2=202.1708
S 41.5914 E
AZ=138.0046

16 BS AZ FS 18

HD=155.0000
∠1=233.0748
∠2=106.1536
S 90.0000 E
AZ=90.0000
```

EXAMPLE 3:

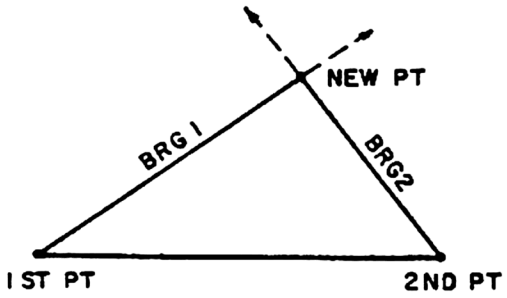
```
AZ=216.5212

16 BS AZ FS 17

HD=134.5362
∠1=281.0834
∠2=202.1708
S 41.5914 E
AZ=138.0046

16 BS AZ FS 18

HD=155.0000
∠1=233.0748
∠2=106.1536
S 90.0000 E
AZ=90.0000
```

```
18 BS 16 FS 19

HD=122.0656
∠1=235.0029
∠2=110.0057
S 34.5931 E
AZ=145.0029
```

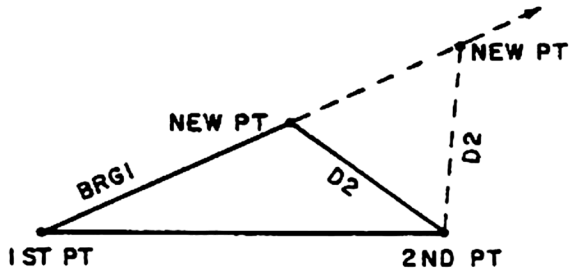
INTERSECTIONS



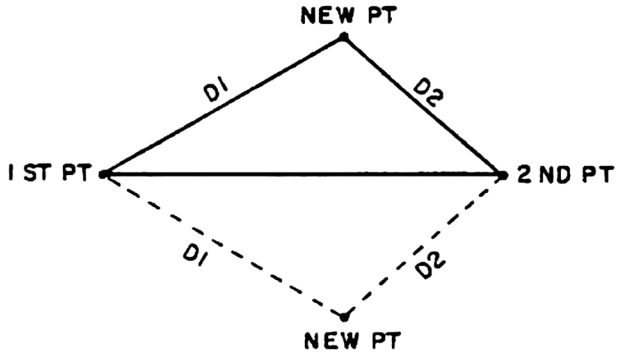
This program calculates the missing data of various intersections between two lines. The coordinates generated may then be stored in the working file.



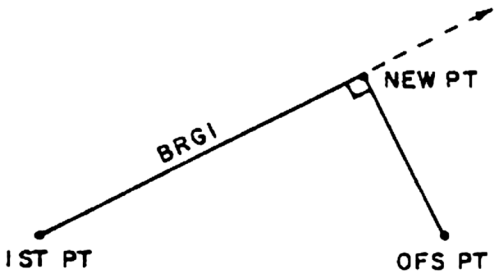
BEARING - BEARING



BEARING - DISTANCE
(TWO SOLUTIONS)



DISTANCE - DISTANCE
(TWO SOLUTIONS)



OFFSET

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
1	Begin. The working file's name is displayed for one second and printed if printer is on line.		[XEQ] **INTS**	FILE: ABC BB BD DD C O
2	**Select type of intersection:** Bearing-Bearing; **or** Bearing-Distance; **or** Distance-Distance; **or** Store coordinates; **or** View coordinates; **or** Offset from a point to a line.		 [A] [B] [C] [d] [D] [E]	 1ST PT NO? 1ST PT NO? 1ST PT NO? NEW PT NO? N#= 1ST PT NO?
3	Input first point number. For Bearing-Bearing go to step 4; For Bearing-Distance go to step 5; For Distance-Distance go to step 6; For Offset go to step 7.	Pt #	[R/S]	
4	Bearing-Bearing intersection: Input second point number; and input bearing or azimuth from first point, and quadrant code, (if you input an azimuth press [R/S] without prior data entry in response to the "QD?" prompt); **OR** if you wish to input a line point press [R/S] without prior data entry to the "BRG 1?" prompt, and input line point number; and input bearing or azimuth from second point, and quadrant code, (if you input an azimuth press [R/S] without prior data entry in response to the "QD?" prompt); **OR** if you wish to input a line point press [R/S] without prior data entry to the "BRG 2?" prompt, and input line point number. Go to step 8.	 Pt # Brg or Az Qd Pt # Brg or Az Qd Pt #	 [R/S] [R/S] [R/S] [R/S] [R/S] [R/S] [R/S] [R/S]	2ND PT NO? BRG 1? QD? BRG 2? BRG 1? LINE PT NO? BRG 2? QD? "BRG 1-3" (output) BRG 2? LINE PT NO? "BRG 1-3" (output)
5	Bearing-Distance intersection: Input second point number; and input bearing or azimuth from first point, and quadrant code, (if you input an azimuth press [R/S] without prior data entry in response to the "QD?" prompt); **OR** if you wish to input a line point press [R/S] without prior data entry to the "BRG 2?" prompt, and input line point number; and input distance from point 2. Go to step 8.	 Pt # Brg or Az Qd Pt # Distance	 [R/S] [R/S] [R/S] [R/S] [R/S] [R/S]	2ND PT NO? BRG 1? QD? D2? BRG 1? LINE PT NO? D2? "BRG 1-3" (output)

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
6	Distance-Distance intersection:			2ND PT NO?
	Input second point number;	Pt #	[R/S]	D1?
	and input distance from first point;	Distance	[R/S]	D2?
	and input distance from second point.	Distance	[R/S]	"BRG 1-3"
	Go to step 8.			(output)
7	Offset from a point to a line intersection:			BRG 1?
	Input bearing or azimuth from first point,	Brg or Az	[R/S]	QD?
	and quadrant code, (if you input an azimuth	Qd	[R/S]	OFS PT NO?
	press [R/S] without prior data entry in response to the "QD?" prompt);			
	OR if you wish to input a line point press			
	[R/S] without prior data entry to the "BRG 1?"			BRG 1?
	prompt,		[R/S]	LINE PT NO?
	and input line point number;	Pt #	[R/S]	OFS PT NO?
	and input offset point number.	Pt #	[R/S]	"BRG 1-3"
8	Output. Bearing and distance from point 1,		[R/S]*	D1=
	and bearing from point 2,		[R/S]*	"BRG 2-3"
	and distance from point 2.		[R/S]*	D2=
			[R/S]*	NEW PT NO?
9	If you wish to store the coordinates of the			
	intersection point, input new point number.	Pt #	[R/S]	N#=
	OR if you do not wish to store the new coordinates either press [R/S] without prior			NEW PT NO?
	data entry or input a zero as your point number.		[R/S]	N0=
	The northing will be output.			
10	Output easting. This step must be performed to return to **INTS** program.		[R/S]*	E#= or E0=
11	If a second solution exists press [R/S]. The results			
	are output as in steps 8-10. If a second solution		[R/S]	"BRG 1-3"
	does not exist the program will stop, press [R/S] again and go to step 2. **OR**			(output)
11a	If you are executing an offset intersection you will			
	be prompted for a new offset point.		[R/S]	OFS PT NO?
12	For a new intersection problem you may press the appropriate local Alpha label			
	OR press.		[a]	BB BD DD C O

* This [R/S] not necessary if printer is on line.

STEP	INSTRUCTIONS	INPUT	KEYS	DISPLAY
	Storing coordinates:			
1	Select the enter and assign key.		[d]	NEW PT NO?
2	Input desired point number.	Pt #	[R/S]	N?
3	Input northing of point.	N	[R/S]	E?
4	Input easting of point.	E	[R/S]	NEW PT NO?
5	If you have more coordinates to store go to step 2; if you are finished storing coordinates press [R/S] without prior data entry after any prompt to return to the **INTS** program.		[R/S]	BB BD DD C O
6	If the point number has already been used you will hear a tone and see:			#. USED
	You can either input a new point number,	Pt #	[R/S]	NEW PT NO?
	or press [R/S] without prior data entry to use the point number again.		[R/S]	NEW PT NO?
7	If you hear a tone and see:			Pt #-Pt #*Pt #
	This means the point number does not fall within the point range of the working file. Input a point number that does.	Pt #	[R/S]	NEW PT NO?
	Displaying coordinates:			
1	Input the point number of the coordinates you wish to display. Display nothing.	Pt #	[D]	N#=
2	Display easting. This step must be performed to return to the calling program.		[R/S]*	E#=
3	You have returned to the **INTS** program.		[R/S]	BB BD DD C O
	Storing coordinates in mass storage:			
1	If a mass storage device is on line you may store the working file's coordinates. The files must have the same name and point numbers.		[H]	STANDBY
2	When finished the calculator will beep and restart the **INTS** program.			FILE: ABC BB BD DD C O

* This [R/S] not necessary if printer is on line.

DATA REGISTERS:

#	INTS		
00	N1	08	az 2-3 (HR)
01	E1	09	HD 2-3
02	az 1-2 (HR)	10	N3
03	HD 1-2	11	E3
04	N2	12	scratch
05	E2	....	
06	az 1-3 (HR)	15	pt # pointer
07	HD 1-3		

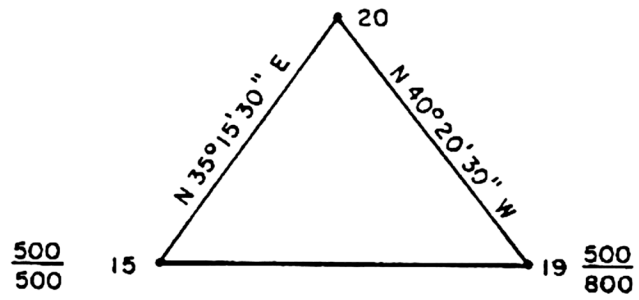
FLAGS:

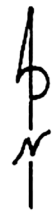
#	SET INDICATES	CLEAR INDICATES
05	offset/BRG1	no offset/BRG2

STATUS:

SIZE 016, FIX 4, DEG, USER.

Example 1: A Bearing-Bearing intersection problem. Store necessary coordinates first.

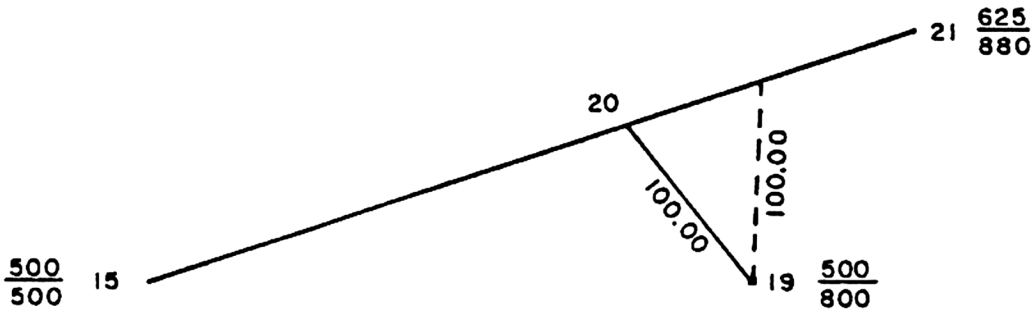


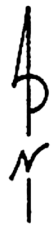


INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] INTS	FILE: ABC	Begin
		BB BD DD C O	select BB
	[A]	1ST PT NO?	
15	[R/S]	2ND PT NO	
19	[R/S]	BRG1?	
35.153	[R/S]	QD?	NE bearing same as azimuth
	[R/S]	BRG2?	
40.203	[R/S]	QD?	
4	[R/S]	N 35.1530 E	output
	[R/S]*	D1=236.0761	
	[R/S]*	N 40.2030 W	
	[R/S]*	D2=252.9130	
	[R/S]*	NEW PT NO?	use 20
20	[R/S]	N20=692.7697	
	[R/S]*	E20=636.2782	
	[R/S]*	636.2782	
	[R/S]	BB BD DD C O	end of example.

* This [R/S] not necessary if printer is on line.

Example 2: A Bearing-Distance intersection problem. Store necessary coordinates first.



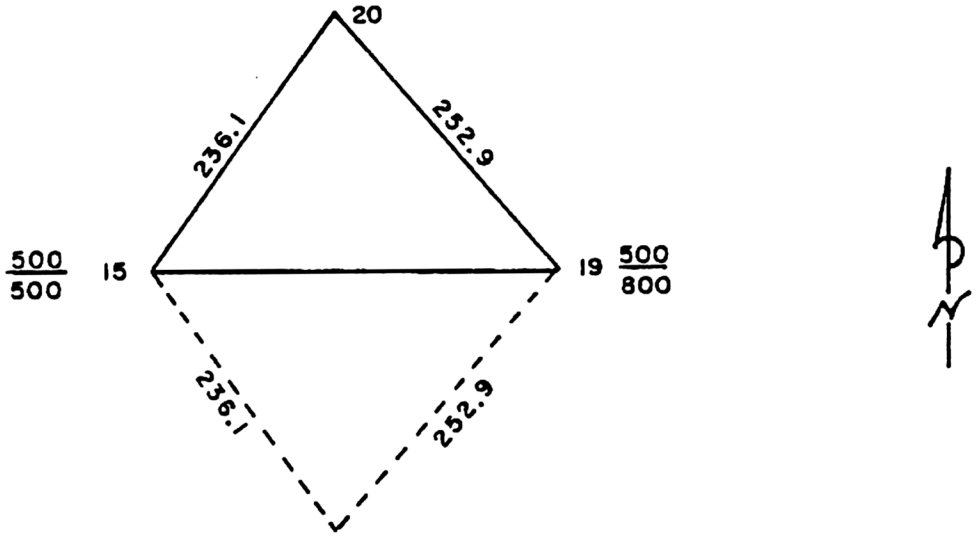


INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] INTS	FILE: ABC	Begin
		BB BD DD C O	select BD
	[B]	1ST PT NO?	
15	[R/S]	2ND PT NO?	
19	[R/S]	BRG1?	use line point
	[R/S]	LINE PT NO?	
21	[R/S]	D2?	
100	[R/S]	N 71.4729 E	first solution output

INPUT	KEYS	DISPLAY	COMMENTS
	[R/S]*	D1=319.7960	
	[R/S]*	N 2.1004 E	
	[R/S]*	D2=100.0000	
	[R/S]*	NEW PT NO?	none, want second solution
	[R/S]	N0=599.9284	
	[R/S]*	E0=803.7825	
	[R/S]*	N 71.4729 E	second solution output
	[R/S]*	D1=250.1595	
	[R/S]*	N 38.3505 W	
	[R/S]*	D2=100.0000	
	[R/S]*	NEW PT NO?	use 20
20	[R/S]	20. USED	use again
	[R/S]	N20=578.1687	
	[R/S]*	E20=737.6329	
	[R/S]*	737.6329	
	[R/S]	BB BD DD C O	end of example.

* This [R/S] not necessary if printer is on line.

Example 3: A Distance-Distance intersection problem.

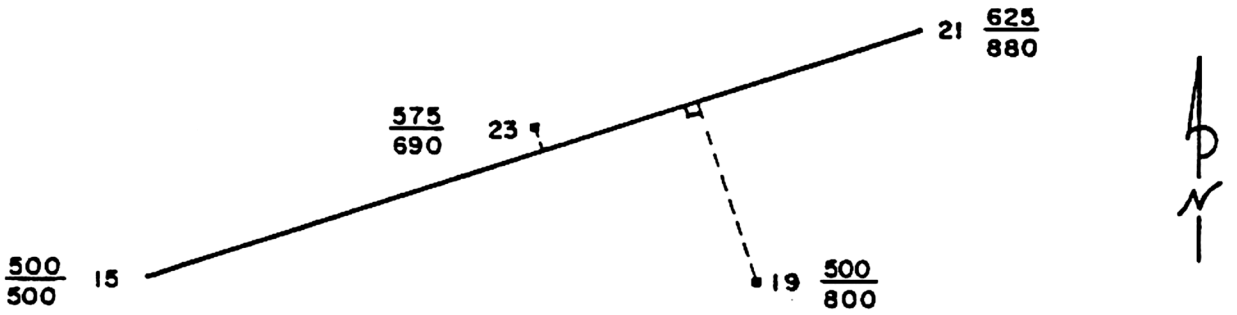


INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] INTS	FILE: ABC	Begin
		BB BD DD C O	select DD
	[C]	1ST PT NO?	
15	[R/S]	2ND PT NO?	
19	[R/S]	D1?	
236.1	[R/S]	D2?	
252.9	[R/S]	S 35.1547 E	first solution output
	[R/S]*	D1=236.1000	
	[R/S]*	S 40.2007 W	
	[R/S]*	D2=252.9000	
	[R/S]*	NEW PT NO?	none, want second solution
	[R/S]	N0=307.2220	
	[R/S]*	E0=636.3080	

INPUT	KEYS	DISPLAY	COMMENTS
	[R/S]*	N 35.1547 E	second solution output
	[R/S]*	D1=236.1000	
	[R/S]*	N 40.2007 W	
	[R/S]*	D2=252.9000	
	[R/S]*	NEW PT NO?	use 20
20	[R/S]	20. USED	I know
	[R/S]	N20=692.7780	
	[R/S]*	E20=636.3080	
	[R/S]*	636.3080	
	[R/S]	BB BD DD C O	end of example.

* This [R/S] not necessary if printer is on line.

Example 4: An Offset from a point to a line problem. Store necessary coordinates first.



INPUT	KEYS	DISPLAY	COMMENTS
	[XEQ] INTS	FILE: ABC	Begin
		BB BD DD C O	select O
	[E]	1ST PT NO?	
15	[R/S]	BRG1?	use line point
	[R/S]	LINE PT NO?	use 21
21	[R/S]	OFS PT NO?	
19	[R/S]	N 71.4729 E	first offset output
	[R/S]*	D1=284.9777	
	[R/S]*	N 18.1231 W	
	[R/S]*	D2=93.7427	
	[R/S]*	NEW PT NO?	none
	[R/S]	N0=589.0486	
	[R/S]*	E0=770.7077	
	[R/S]*	OFS PT NO?	
23	[R/S]	N 71.4729 E	second offset output
	[R/S]*	D1=203.9216	
	[R/S]*	S 18.1231 E	
	[R/S]*	D2=11.8741	
	[R/S]*	NEW PT NO?	none
	[R/S]	N0=563.7205	
	[R/S]*	E0=693.7104	
	[R/S]*	OFS PT NO?	end of example.

* This [R/S] not necessary if printer is on line.

PRINTOUTS

EXAMPLE 1:

```
FILE: ABC

N 35.1530 E
D1=236.0761

N 40.2030 W
D2=252.9130

N20=692.7697
E20=636.2782
```

EXAMPLE 2:

```
FILE: ABC

N 71.4729 E
D1=319.7960

N 2.1004 E
D2=100.0000

N0=599.9284
E0=803.7825

N 71.4729 E
D1=250.1595

N 38.3505 W
D2=100.0000

N20=578.1687
E20=737.6329
```

EXAMPLE 3:

```
FILE: ABC

S 35.1547 E
D1=236.1000

S 40.2007 W
D2=252.9000

N0=307.2220
E0=636.3080

N 35.1547 E
D1=236.1000

N 40.2007 W
D2=252.9000

N20=692.7780
E20=636.3080
```

EXAMPLE 4:

```
FILE: ABC

N 71.4729 E
D1=284.9777

N 18.1231 W
D2=93.7427

N0=589.0486
E0=770.7077

N 71.4729 E
D1=203.9216

S 18.1231 E
D2=11.8741

N0=563.7205
E0=693.7104
```

SUBROUTINES

These subroutines will consume two bytes each when used in a program. They may also be assigned to a User key.

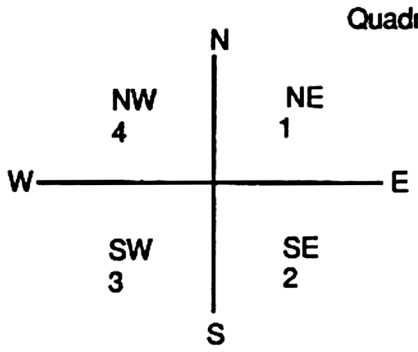
Label **A-B**

This subroutine converts an azimuth to a bearing.

... from this ...			... to this.
T	T		**T** T
Z	Z		**Z** Z
Y	Y		**Y** Y
X	Azimuth (HMS)	[XEQ] **A-B**	**X** bearing (HMS)
			ALPHA "BEARING"

Label **B-A**

This subroutine converts a bearing to an azimuth.



... from this ...			... to this.
T	T		**T** T
Z	Z		**Z** T
Y	Bearing (HMS)		**Y** Z
X	Quadrant code	[XEQ] **B-A**	**X** azimuth (HMS)

Label **P?**

This subroutine puts into the Alpha register the point number limits of the working file and the current point number stored in register 15. It is up to the calling program to display.

ALPHA: "1-50*34" (This means the working file is from point 1 to 50 and the current point number is 34.)

Label **MG**

This subroutine will pause and display the Alpha register, and if the printer is on line, it will be printed.

Label **FL?**

This subroutine will pause and display the working file's name, and if the printer is on line, it will be printed.

Label **Q?**

This subroutine prompts for a quadrant code input, if none is input (i.e. [R/S] is pressed without prior data entry) the routine will assume an azimuth in the X-register and return, if a quadrant code was input it will be converted to an azimuth and return.

Label **P1**

This subroutine clears flag 22 and appends to the Alpha register " PT NO?" and returns. It is up to the calling program to prompt or display.

Label **P2**

This subroutine clears flag 22 and appends to the Alpha register " BEG NO?" and returns. It is up to the calling program to prompt or display.

Label **M1**

This subroutine adds 180° to the angle (HMS) in the X-register and then does a modulo 360°.

Label **M3**

This subroutine does a modulo 360° to the angle (HMS) in the X-register.

Label **IZ**

This subroutine is used to initialize a program. Besides setting various flags it also checks for a minimum size of 19 registers. It partially disturbs the stack, the X- and Y-registers are maintained.

```
43*LBL "IZ"          50 SIZE?
44 FIX 4             51 19
45 DEG               52 X>Y?
46 SF 21             53 PSIZE
47 SF 27             54 R↑
48 SF 28             55 R↑
49 SF 29             56 RTN
```

Label **?Y**

This is a yes/no question routine. The subroutine appends "?Y" to the message in the Alpha register then displays the message and waits ten seconds for a key to be pressed. If the answer is yes press the "Y" key, flag 10 will be set and return to the calling program. If any other key is pressed or if ten seconds pass the answer is assumed to be no, flag 10 will be cleared and return to the calling program. The subroutine partially disturbs the stack, the X- and Y-registers are maintained.

Label **Sc**
Label **Rc** See coordinate management.

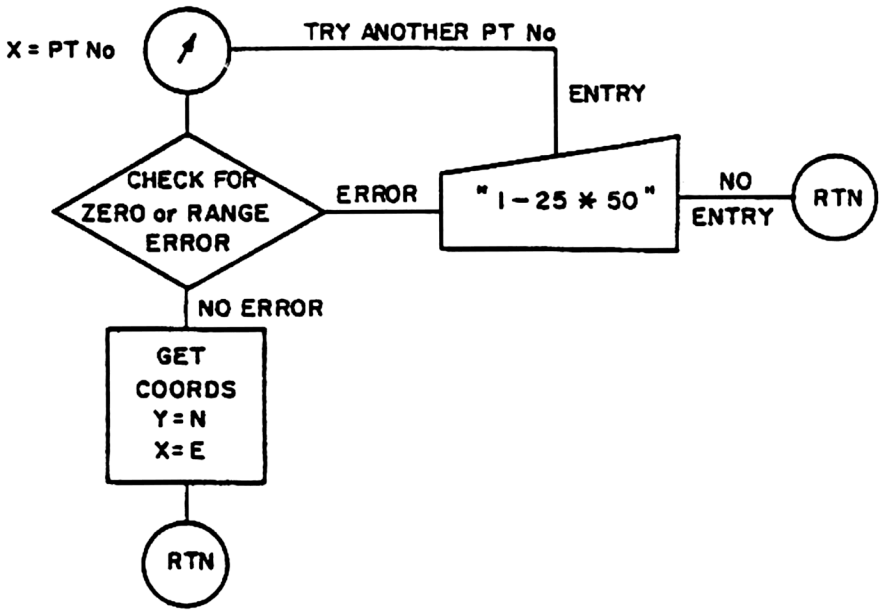
Label EA

This is an " Enter and Assign " coordinates subroutine. The program will prompt for a "NEW PT NO?", "N?" (northing), and "E?" (easting), then check if the point number is already used, if not store the coordinates in the working file of the extended memory. To return to the calling program press [R/S] without prior data entry after any prompt.

Label /

This subroutine returns, from the working file, the coordinates assigned to the point number in the X-register to the Y- and X-registers.

... from this ...		... to this.
T T		T Z
Z Z		Z Y
Y Y		Y Northing
X Point number	[XEQ] /	X Easting



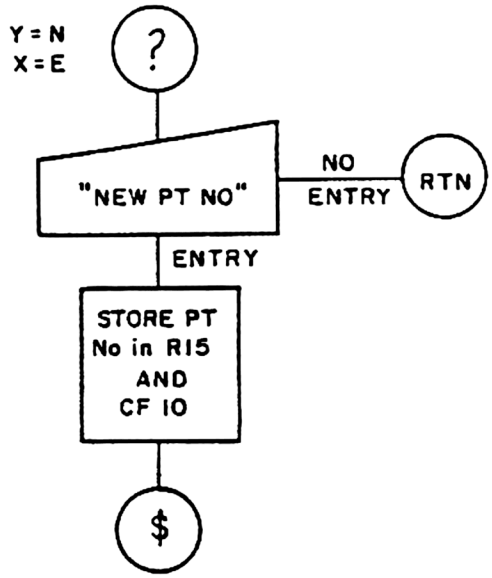
Label %

This subroutine is used to aview or print coordinates. The northing and easting must be in the Y- and X-register and the point number stored in register 15. Both coordinates must be aviewed before the subroutine returns to the calling program.

Label ?

This subroutine is used to store new coordinates. The northing and easting to be stored must be in the Y- and X-register upon entry to ?. The program will prompt for a "NEW PT NO?", (if [R/S] is pressed without prior data entry, the subroutine will return to the calling program) the new point number (zero is not a point number) will be stored in register 15, flag 10 will be cleared indicating to

check if the new point number has already been used, and then the subroutine will execute Label $ before returning to the calling program.



Label $

This subroutine is used to store coordinates into the working file. Upon entry the northing and easting must be in the Y- and X-registers, the point number to be used must be stored in register 15 (zero is not a point number), also flag 10 is used, if flag 10 is clear $ will check if the point number has already been used, if flag 10 is set $ will not check if the point number has been previously used. If the point number has been used you have the opportunity to input another point number or use the point number again. Also the subroutine makes a check to see if the point number is within the point number range of the working file, if not the subroutine will stop for a new point number input. When the subroutine returns to the calling program the northing and easting are in the Y- and X-registers.