CO-OP 41

Surveying Module

REFERENCE MANUAL

Tripod Data Systems, Inc.

The CO-OP 41 Surveying Module and Data Collector

Reference Manual

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Introduction

The Data Collector Reference Manual is designed for users who are already familiar with the Data Collector's operation and use. If you are new to the data collector, you should first turn to the CO-OP 41 User's Manual to familiarize yourself with it's workings.

This manual provides a source of non-tutorial information concerning the functions in the CO-OP 41 Surveying Module, error messages, and other topics. The functions are listed in alphabetical order in Chapter 2 *Function Dictionary.*

Also included in this manual is a function summary and index (*Functions by Group,* page 139 - at the back of this manual).

The Function Dictionary covers function use, operation, and entry conditions. Before you begin referring to the dictionary, read through the information contained in Chapter 1 *General Information,* to familiarize yourself with the dictionary format, use, and key terms.

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Chapter 1
General Information

The User Interface

KEYING IN DATA

In most of the function descriptions there is a place that says to "key in" the data, or "after keying in the data." This means to type the data in and press the [R/S] key.

Example: Key in the number 754

754 [R/S]

KEYING IN BEARINGS

Entering bearing data into the CO-OP 41 takes two steps.

1. When a prompt asks for the bearing, as shown below, key in the bearing angle.

BRG?

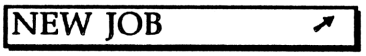
2. The CO-OP 41 then prompts for the quadrant in which the bearing angle lies.

QUAD?

   Key in 1 for the N-E quadrant, 2 for the S-E quadrant, 3 for the S-W quadrant, and 4 for the N-W quadrant.

SCROLL MENUS

Scroll menus allow you to instruct the CO-OP 41 to do one of several possible actions. A scroll menu is identified by an arrow in the far right hand position of the display. The following scroll menu appears when you press [ ] [JOBS].



To go to the next item in the scroll menu press [R/S], the next selection is then shown in the display.

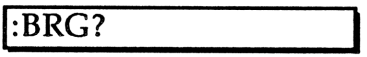
NEW JOB ↗ This currently shows in the display. Press [R/S] and the display will change to:

OLD JOB ↗ Press [R/S] again and the CO-OP 41 returns to the first option. Only two options are in this scroll menu. If you press [R/S] at the final option in a scroll menu, the first option re-appears in the display.

To choose an option in a scroll menu, press the [ENTER] key. The CO-OP 41 will execute your request.

SCROLLING PROMPTS

Scrolling prompts allow you to choose one of several ways to enter data into the CO-OP 41. Scrolling prompts are identified by a colon (:) in the far left of the display.



At this prompt, the CO-OP 41 is asking for a bearing. However, the colon at the left of the display indicates that you can enter the data in more than one form. To display the next prompt, press the [R/S] key.

:BRG? When this prompt shows in the display, press [R/S] and the display will change to:

:AZ? Press [R/S] again and the next prompt will be displayed. If you press [R/S] at the final prompt, then the first prompt will be displayed again.

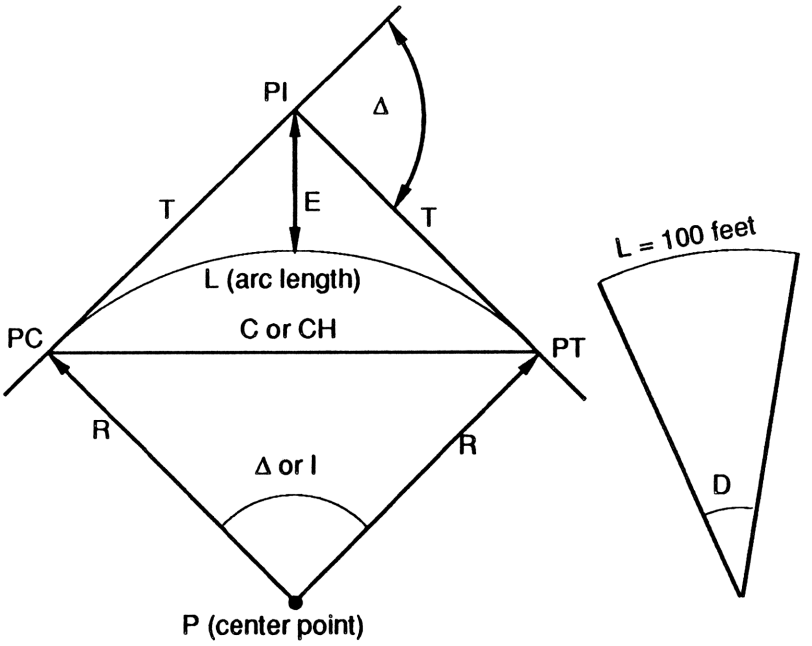
Once the prompt you want is displayed, key in your data and press [R/S]. The CO-OP 41 will use the supplied information in it's calculations.

DEFLECTION ANGLES

A general note on the DEF-LT and DEF-RT functions: to use one of these functions when entering a traverse or side shot, select the :AZIMUTH? prompt. Next, key in the deflection right or left (whichever applies) and then execute the deflection function (either ☐ [DEF-LT] or ☐ [DEF-RT]). The correct azimuth is now in the display, so hit [R/S] and the CO-OP 41 will continue with the traverse or side shot.

CURVE FUNCTIONS

All of the curve computation functions (IC, ID, IE, IP, IR, IT, LP, LR, RC) are very similar. Each of these functions needs two inputs to determine the other information about the curve and to make a traverse along the perimeter of the defined curve. The first prompt in each function will be for an angle, a radius, or an arc length, the second prompt will be for a radius, tangent distance, chord length or some other value.



In the above diagram and in the curve function names, the abbreviations are:

PI Point of intersection

I Delta angle

T Tangent length

E External

PC Point of curvature

PT Point of tangency

R Radius

D Degree of curvature

C Chord length

When using the curve functions in a traverse, if the number you enter for the second prompt is a negative number, the curve will be concave (inward). A positive number entered for the second prompt will make the curve convex (outward). The points of tangency of the curve are not affected by whether the curve is concave or convex.

When the information for the second prompt is keyed in, the CO-OP 41 will put up a scroll menu to select a right or left turn.

After you select the direction to turn, the CO-OP 41 displays the current forward tangent azimuth.

The forward tangent displayed is in the direction of the traverse. If the displayed forward tangent is correct (as it usually is) then simply press [R/S]. If this value is not correct, then key in the correct forward tangent azimuth and press [R/S]. You need to enter the proper tangent azimuth of the curve if it is not tangent to the direction of the traverse at the point of curvature (P.C.).

When the forward tangent azimuth has been entered, the CO-OP 41 will bring up a scroll menu to choose between viewing the data, and storing the calculated end point of the curve to a new point.

VIEW DATA ↗
STORE PT ↗

VIEW DATA ↗ This shows the following information and then goes back to the VIEW DATA/STORE PT scroll menu (press R/S to go to the next item).

I= #.####	(Delta angle in degrees)
R= #.####	Radius in feet
T= #.####	Tangent distance in feet
L= #.####	Arc length in feet
CH= #.####	Chord in feet
D= #.####	Degree of curve in degrees
E= #.####	External in feet

STORE PT ↗ The CO-OP 41 will store the calculated end point of the arc to the next point number and display the stored point number.

STO PT: #.####

This will be shown in the display for a second, then the CO-OP 41 will prompt if you want to repeat a similar curve calculation (helpful for staking curves).

R/S REPEAT

Pressing R/S causes the CO-OP 41 to advance on the same curve for the same delta angle. When it stops the CO-OP 41 will be back at the VIEW DATA/STORE PT menu.

Example: You have traversed along a property line until it comes to a road boundary. You must now traverse along the curved road boundary. You know the delta of the curve to be 10 degrees, and the chord to be 30 feet. The curve is also concave (inward), and turns right with a forward tangent of 10.

XEQ ALPHA IC ALPHA	DELTA∠?
10 R/S	CH?
30 R/S	TURN RIGHT ↗
ENTER	F TAN?#.####
10 R/S	VIEW DATA ↗
ENTER	I= 10.0000
R/S	R= 172.1057
R/S	T= 15.0573
R/S	L= 30.0381
R/S	CH= 30.0000
R/S	D= 33.1728
R/S	E= 0.6574
R/S	VIEW DATA ↗
R/S	STORE PT ↗

[ENTER] [STO PT: #.####]

DEFINING A LINE

To define a line you must have entered one point that will serve as a control point. The control point is simply a known point that is on the line. With the control point an azimuth or bearing can be entered or calculated to define the line. In functions where a line needs to be defined, the first prompt will be for the control point.

[1ST PT?]

After you key in the first control point, the CO-OP 41 prompts for the bearing of the line from the control point. You can either key in the bearing or press [R/S] and scroll through the choices on how to enter the line (See the section titled: *Scrolling Menus*).

[:BRG?]
[:AZ?]
[:POL?]
[:PP PT1?]

BRG? This prompt is asking for the bearing of the line from the first control point (See the section titled:*Keying in Bearings,* above.)

AZ? This prompt is asking for the azimuth of the line from the first control point.

POL? This prompt is asking for a second known point that will define the line. When entered, the CO-OP 41

computes the bearing of the line by inversing between the point you just entered and the first control point (the point number you entered for the 1ST PT? prompt).

PP PT1? This prompt is asking for two points that will define a line parallel to the line you want. Enter the first of the two points that define the parallel line and press [R/S]. The CO-OP 41 prompts for the second point that defines the parallel line.

```
PT2?
```

After keying in the second point the CO-OP 41 calculates the line from the first control point based on the input information.

THE RANDOM POINT FILE

The random point file is used in many of the plotting and coordinate geometry functions. See the RDMPTS function for information on the entry of random points into the Random Point File.

In random point files that are used by plotter functions or by the AUTO function:

- Positive numbers represent traverse points (the plotter will draw a line to that point).
- Negative, whole numbers represent side shot points (the plotter will go to that point with the pen in the up position).
- Negative numbers with fractions represent curves. The format for entering a curve is – PTOC.PTOT where PTOC is the point of curvature and PTOT is the point of tangency. The point of tangency must take four decimal places to the

right of the decimal point. The points defining traverses that include curves should be entered in clockwise order.

Thus to enter a curve from point 12 to point 15 key in -12.0015. The CO-OP 41 prompts for the radius of the circle.

```
RADIUS?
```

The sign of the radius indicates whether it is convex or concave. Enter a positive radius for a convex (outward) circle, and a negative radius for a concave (inward) circle.

Note : In plotting a curve, you first need to move the pen to the beginning point of the curve. This can be done by drawing a line to the P.C. or lifting the pen to the P.C. (P.C. refers to point of curvature).

Note: Curve information may be used only for AUTO, and the plotting functions. Functions such as AA, CRIS, and OFFSET don't handle curve information.

The random point file is originally set up to use 120 registers. To have the largest possible random point file, execute the SIZE function (see the HP-41 Owner's Manual) and enter 290 at the SIZE prompt. A SIZE of 290 registers allows you to input 210 points for the random point file.

Format For Function Entries

Name: Gives the name of the function.

Purpose: Describes what the function does.

Keystrokes: Shows what keys need to be pressed in what order to execute the function

Entry Conditions: Describes what needs to be done, or set up before executing the function.

Operation: Explains how the function works, and what information to enter. Also explains any information that the function calculates.

Remarks: Special things to keep in mind when using the function.

See Also: Identifies other functions that are similar to, or effect the function.

Examples: Illustrates some of the different ways you can use the function.

Chapter 2
Function Dictionary

3P

Name: Three Points

Purpose: This function is used when you have already stored three points on a curve, and need to know the radius of the curve (possibly for use with the curve computation programs).

Keystrokes: [XEQ] [ALPHA] 3P [ALPHA]

Entry Conditions: Must have already stored the three points on the curve.

Operation: When executed the function prompts for the first point number.

```
1ST PT?
```

Key in the point number of the first known point number on the curve you have stored in the current job file. The CO-OP 41 then prompts for the second and third points.

```
2ND PT?
```

```
3RD PT?
```

Key in the appropriate point numbers for each of these prompts. After keying in the 3rd point number, the CO-OP 41 displays the radius of the curve:

R= #.##

See Also: IR, LR, RC

Example: You have already determined the coordinates of three points around a curve, and have stored them in the current job file (points 6, 7, and 8 as shown below).

POINT	NORTH	EAST
6	5,100	5,100
7	5,150	5,150
8	5,100	5,200

Find the radius of the curve defined by these three points.

XEQ ALPHA 3P ALPHA	1ST PT?
6 R/S	2ND PT?
7 R/S	3RD PT?
8 R/S	R=50.00

∠LT

Name: Angle Left

Purpose: This function is used when you have measured an angle left and need to convert it into an azimuth.

Keystrokes: ☐ ∠LT

Entry Conditions: The function is entered with the angle left (in degree, minute, second format) in the X-register.

Operation: There are no prompts or displays, the function simply returns the converted azimuth (in degree, minute, second format) to the X-register.

Remarks: To give the correct answer the back sight must be properly set (see BACKS function).

See Also: ∠RT, BACKS

Example: Your back sight is set at 180 degrees, and you have measured an angle left of 45 degrees 30 minutes 15 seconds. What is the azimuth of the target point?

45.3015 [ ] [<LT]

134.2945

∠RT

Name: Angle Right

Purpose: This function is used when you have measured an angle right and need to convert it into an azimuth.

Keystrokes: [ ] [<RT]

Entry Conditions: The function is entered with the angle right (in degree, minute, second format) in the X-register.

Operation: There are no prompts or displays, the function simply returns the converted azimuth (in the degree, minute, second format) to the X-register.

Remarks: To give the correct answer, the back sight must be properly set (see BACKS function).

See Also: ∠LT, BACKS

Example: Your back sight is set at 180 degrees, and you have measured an angle right of 45 degrees 30 minutes 15 seconds. What is the azimuth of the target point?

45.3015 [ ] [<RT]

```
225.3015
```

AA

Name: Angle Adjust

Purpose: This function is used to adjust the angles of a traverse after the points have been stored, and the angle error has been computed.

Keystrokes: [XEQ] [ALPHA] AA [ALPHA]

Entry Conditions: To use this function you must already have completed a traverse and found the angle error. Then you can enter all the points along the traverse to be adjusted in the random point file.

Operation: This function adjusts each angle that is specified in the random point file by the average angle error. The sign of the angle error should be properly entered to indicate the direction of the adjustment. Positive angle error means the average angle error is added to each angle.

When AA is executed, the CO-OP 41 prompts for the angle error.

```
∠ERR?
```

See the remarks and example below for how to calculate the angle error. After the angle error is keyed in, the CO-OP 41 prompts for the number of angles to adjust.

ANGLES?

When you have keyed in the number of angles to adjust, the CO-OP 41 starts adjusting the angles. When it is completed, the HP-41 will beep.

Remarks: There are at least three ways to compute the total error of angle:

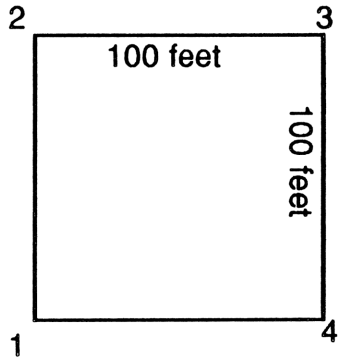
1) Sum the interior angles of a closed traverse and subtract from this (n–2) x 180, where n is the number of interior angles ((n–2) x 180 is the sum of the interior angles in any polygon).

2) If you are using deflection angles, then sum the deflection angles and subtract the sum from 360 degrees (the sum of the deflection angles of any polygon should be 360).

3) When the traverse is completed, take an extra shot from the last point to the second point. Then, subtract the azimuth of the line between the first and second point from the azimuth of the line between the last and second point.

See Also: CX

Example: You traverse a square area as shown below, however in your traverse you introduce an error of 1 minute on each leg of the traverse (except the first leg - AA assumes that the first traverse is correct).



☐ JOBS	NEW JOB ↗
ENTER	JOB NAME?
AAEX R/S	N/E ONLY ↗
ENTER	PTS?
10 R/S	RAWDAT OFF ↗
ENTER	N=E=5000 ↗
ENTER	0.0000

You have now set up the job file. The next step is to enter in the traverses.

☐ TRAVRS	:AZIMUTH?
0 R/S	:H DIST?
100 R/S	TRAVRS

	:AZIMUTH?
90.01 ▢ DEF-RT	90.0100
R/S	:H DIST?
100 R/S	3.0000
	TRAVRS
	:AZIMUTH?

Notice that we made a one minute error above (normally you would not know this, of course).

90.01 ▢ DEF-RT	180.0200
R/S	:H DIST?
100 R/S	4.0000
	TRAVRS
	:AZIMUTH
90.01 ▢ DEF-RT	270.0300
R/S	:H DIST?
100 R/S	

We are now done with traversing the square, and we should be back at the original starting point. But, we find, by recalling the coordinate information, that we aren't.

[RCL] [N]	5,000.0582
[RCL] [E]	4,999.9419

To find angle error, we shoot another traverse to the second point (this should contain the same error as our other traverse).

[ ] [TRAVRS]	:AZIMUTH?
90.01 [ ] [DEF-RT]	0.0400
[R/S]	:H DIST?
100 [R/S]	

Now we have to find the angle difference between the line 1-2, and the line 5-6. If our traverse is without errors, these should be the same.

[ ] [P-TO-P]	FROM PT?
1 [R/S]	TO PT?
2 [R/S]	AZ=0 00' 00"
[ ] [P-TO-P]	FROM PT?
5 [R/S]	T0 PT?
6 [R/S]	AZ=0 04' 00"

Subtracting these two gives -4 minutes of error. Now we have to enter the points in the random point file.

[ ] [RDM-PTS]	PT?

1.0006 [R/S]	PT?
0 [R/S]	

Now, using the AA function:

[XEQ] [ALPHA] AA [ALPHA]	∠ERR?
.04 [CHS] [R/S]	ANGLES?

Not counting the first leg of the square we have traversed 4 angles (2 to 3, 3 to 4, 4 to 5, and 5 to 6).

4 [R/S]	4.0000

The calculator beeps to acknowledge that it is done. Now let's check if it adjusted the angles.

5 [ ] [OCCUPY]	5.0000
[RCL] [N]	5,000.0000
[RCL] [E]	5,000.0000

ACRES

Name: Acres

Purpose: This function is used to display the acreage, square feet and perimeter of a closed traverse. The traverse can be entered with the traverse functions (TRAVRS, TRA, PTRA), or the traverse can be entered by

having the CO-OP 41 do it automatically by the AUTO function.

Keystrokes: [ ] [ACRES]

Entry Conditions: Before executing this function you need to have done a complete traverse.

Operation: This function has no prompts, it simply displays the calculated information. The first value the function displays is the acreage:

```
ACRES=#.####
```

Pressing [R/S] displays the square feet contained within the traversed area.

```
SQ FT=#.####
```

Pressing [R/S] once more displays the perimeter of the traversed area.

```
PERIMETER=#.####
```

Remarks: Certain functions, (such as OCCUPY) clear the information that the CO-OP 41 needs to compute the acreage. After executing one of these functions, it is necessary to re-traverse the points in order to run ACRES (this is easily done with the PTRA and TRA functions)

See Also: PTRA, TRA, TRAVRS, AUTO

Example: See the CO-OP 41 User's Manual for an example.

ATB

Name: Azimuth To Bearing

Purpose: This is used to convert an azimuth into a bearing, and put the bearing in both the display and the ALPHA-register.

Keystrokes: ☐ [ATB]

Entry Conditions: Enter the function with the azimuth in the X-register (in degree, minute, second format).

Operation: There are no prompts or displays, the function simply returns the calculated bearing to the display.

Example: Find the bearing of an angle with an azimuth of 205 degrees.

205 ☐ [ATB] | S25 00' 00" W

AUTO

Name: Auto Traverse

Purpose: Uses the random point file. The CO-OP 41 automatically traverses around a set of known points stored clockwise in the random point file. Area and perimeter are calculated.

Keystrokes: ☐ [AUTO]

Entry Conditions: To enter this function, a job file must have already been entered into the CO-OP 41, and be the current job. The points to traverse must be stored in the random point file.

Operation: When you execute this function, the CO-OP 41 automatically traverses around all the points stored in the random point file, and displays the acreage.

```
ACRES=#.####
```

Pressing [R/S] shows the number of square feet contained in the traversed area.

```
SQ FT=#.####
```

Pressing [R/S] one more time shows the perimeter of the area traversed.

```
PERIMETER=#.####
```

Remarks: **The points in the random point file must be entered clockwise.** When curve data is entered, a positive radius indicates the curve is outward (convex), a negative radius indicates the curve is inward (concave).

AV

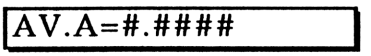
Name: Average

Purpose: Used to average two or more sun shots.

Keystrokes: [XEQ] [ALPHA] AV [ALPHA]

Entry Conditions: You must have performed several sun shots to compute the average.

Operation: When executed, the CO-OP 41 displays the average of all the measured sun shots for a particular point. If you haven't entered grid constants, then it shows the average astronomical azimuth.



If you have entered the grid constants, then the CO-OP 41 will display the average grid azimuth.

BACKS

Name: Back Sight

Purpose: This function is used to set up the back sight in order to take angle measurement readings. Note that the back sight is automatically updated after a traverse.

Keystrokes: ☐ [BACK-S]

Entry Conditions: There are no entry requirements for this function, except that you must be occupying a point before executing the function.

Operation: When executed, a scrolling prompt comes up.

```
:BACK PT?
:BACK BRG?
:BACK AZ?
```

BACK PT? If you are back sighting to an already stored point, then simply key in the point number of the point you are back sighting to.

BACK BRG? If you are back sighting along a certain bearing, then key in the bearing.

BACK AZ? If you are back sighting along a certain azimuth, then key in the azimuth.

Remarks: Back sight also sets up the forward tangent azimuth for the curve functions.

Example: Your instrument is set up, and you need to tell the CO-OP 41 that the instrument's back sight is along a bearing of 15 degrees in the S-W quadrant (quadrant 3).

☐ [BACK-S]	:BACK PT?
[R/S]	:BACK BRG?
15 [R/S]	:QUAD?
3 [R/S]	S15° 00' 00" W

BB

Name: Bearing Bearing Intersect

Purpose: This function is used to compute the intersection of two lines, defined by bearings, coming from two known control points.

Keystrokes: [XEQ] [ALPHA] BB [ALPHA]

Entry Conditions: The two control points must have already been entered into the current job file.

Operation: When executed, the CO-OP 41 prompts for the information to define the first intersecting line (see the section titled: *Defining a Line).* After you have keyed in the information for the first control point and line, the CO-OP 41 prompts for the information for the second control point. This is entered exactly the same way as the information for the first control point and line.

Then the CO-OP 41 displays the distance from the first control point to the intersection point.

```
1ST D=#.####
```

Pressing [R/S] displays the distance from the second control point to the intersection point.

```
2ND D=#.####
```

Pressing [R/S] again displays the following prompt for point number to store the intersection point to.

```
PT NO?
```

If you key in a point number to store, the CO-OP 41 saves the intersection point under that new number.

See Also: BD, DD

Example: See the examples in the User's Manual on intersection functions.

BD

Name: Bearing Distance Intersect

Purpose: This function is used to compute the intersection of a line coming from one known point along a certain bearing, and a point a given distance away from a second known point.

Keystrokes: [XEQ] [ALPHA] BD [ALPHA]

Entry Conditions: The two points must have already been entered into the current job file.

Operation: When executed, the CO-OP 41 prompts for the information to define the first intersection line (see the

section titled: *Defining a Line*). After entering the information for the first point, the CO-OP 41 prompts for the information on the second point.

```
2ND PT?
```

Enter the second point number. Then the CO-OP 41 prompts for the distance from the second point to the point of intersection.

```
DIST?
```

Key in the distance. The CO-OP 41 displays the distance from the first point to the intersection point.

```
1ST D=#.####
```

Pressing [R/S] displays the bearing from the second point to the point of intersection.

```
X### ####" X
```

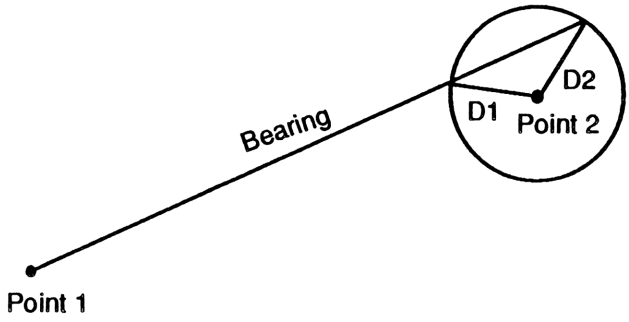
Pressing [R/S] again causes the CO-OP 41 to prompt for the new point number.

```
PT NO?
```

Key in the point number and press [R/S]. The CO-OP 41 will save the intersection point as the new point number.

Remarks: There are actually two solutions to a bearing-distance intersection problem. To get the second solution, press [R/S] without keying in the point number at the PT NO? prompt. The CO-OP 41 displays the information for the second solution, and you may then store this answer if it is the one you are after.

See Also: BB, DD



BTA

Name: Bearing To Azimuth

Purpose: This function is used to convert an angle given by a bearing, into an azimuth.

Keystrokes: [XEQ] [ALPHA] BTA [ALPHA]

Entry Conditions: None

Operation: When executed, the CO-OP 41 prompts for the bearing and quadrant number. Quadrant number 1 is for NE, number 2 is for SE, number 3 is for NW, and number 4 is for SW. After you key in the bearing, the CO-OP 41 exits the function with the formatted azimuth in the display and ALPHA register. The azimuth is also stored in the X-register.

Remarks: The OUTPUT function determines what the function displays on exit. The above explanation assumes that output is set to azimuth output only. For more information see the OUTPUT function.

COORST

Name: Coordinate Store

Purpose: Allows you to manually store coordinate information to point numbers.

Keystrokes: [ ] [COOR-ST]

Entry Conditions: None

Operation: Prompts for the point number to store the data to.

```
PT?
```

Enter the point number, then press [R/S]. The CO-OP 41 then prompts for the north coordinate and east coordinate of the point (and the elevation and descriptive note, if these options are turned on).

```
N?
E?
EL?
DESC?
```

After you have answered each of these prompts, the CO-OP 41 stores these coordinates under the new point number. It then prompts for the next point coordinates. The CO-OP 41 stores the coordinates at the next consecutive point number.

Every time you key in the information for the last prompt the CO-OP 41 briefly displays the next consecutive point number, then prompts for the coordinates and

information for the next point. To stop entering coordinates, simply ignore the N? prompt and execute another function.

COORTR

Name: Coordinate Traverse

Purpose: Allows the traverse around an area by giving coordinates. Carries acreage and perimeter, but does not store points.

Keystrokes: [XEQ] [ALPHA] COORTR [ALPHA]

Entry Conditions: None

Operation: When this function is executed the CO-OP 41 prompts for the initial north coordinate.

```
N?
```

After you key in the north coordinate of the point, the CO-OP 41 prompts for the initial east coordinate.

```
E?
```

After entering the east coordinate, the CO-OP 41 occupies this point, zeroing the acreage and perimeter information. The CO-OP 41 then prompts for the other north and east coordinates, keep answering these prompts until you have traversed the perimeter of the entire area that you wish to cover. At this point, you can run the ACRES function to find the area, perimeter and square footage.

CR

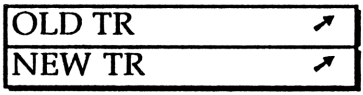
Name: Compass Rule

Purpose: This function adjusts traverses in a job by the compass rule. The traverse may be an open ended or closed loop traverse, a consecutive point or random point traverse, or a new or old traverse.

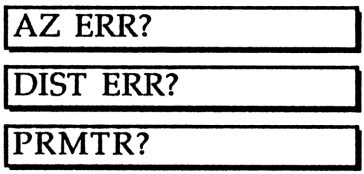
Keystrokes: [XEQ] [ALPHA] CR [ALPHA]

Entry Conditions: None

Operation: When executed the CO-OP 41 will bring up a scroll menu, allowing you to select an old traverse or a new one.



OLD TR ↗ An "old" traverse is one in which the direction and distance of error have been lost (such as after occupying a point, or recalling an old job from mass storage). When OLD TR is selected, the CO-OP 41 prompts for several values.

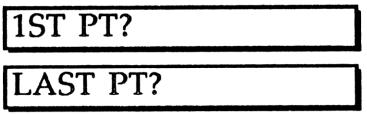


When you inverse the last point of a traverse to the beginning point, the angle of direction is the AZ ERR, and the distance is the DIST ERR.

NEW TR ↗ In a new traverse the line should be traversed using either TRASTO, TRAVRS, or PTRA, then the last point in the traverse should be inversed to the first point. Once you traverse a line and then inverse the final point to the first point, the HP-41 automatically stores the "direction of error," the "distance of error", and the perimeter. With these numbers stored, the CR computations can be performed automatically when NEW TR is selected.

When NEW TR or OLD TR is selected, and all the data is entered, the CO-OP 41 displays a scroll menu allowing the selection of adjustment to consecutive points, or points stored in the random point file.

CONSECUTIVE ↗ Adjusts a series of points stored consecutively in the CO-OP 41. When selected, it prompts for a beginning and ending point number.



RDM FILE ↗ Adjusts random points stored in the random point file. When selected, the CO-OP 41 automatically adjusts the coordinates of the points specified in the random point file.

As the function is running, the CO-OP 41 displays the point number of the point it is currently adjusting. After all the adjustments are done, the CO-OP 41 beeps to signal completion.

CRIS

Name: Compass Rule Including Side Shots

Purpose: This function will adjust traverses and side shots in a job by the compass rule.

Keystrokes: [XEQ] [ALPHA] CRIS [ALPHA]

Entry Conditions: In order to use this function, you need to store the points in the survey consecutively. (If a traverse point number is 5, and there are three side shots from 5, the side shots should be numbered 6, 7, and 8. Then the next traverse point should be 9). Use the RDMPTS function to store only the traverse points in the random point file. Don't store the side shot points.

Note:  Any point missing from the sequence in the random point file is assumed to be a side shot point from the previous point.

Finally you must know the direction and distance of the error and the perimeter of the traverse. You can calculate the direction and distance of the error by inversing between the last point and the first point in the traverse. The perimeter can be calculated using the AUTO function after you have stored the traverse points using RDMPTS.

Operation: The CO-OP 41 prompts for the values needed to adjust the traverses and side shots. Inverse the last point of a traverse to the beginning point. The direction is the AZ ERR and the distance is the DIST ERR.

```
AZ ERR?
DIST ERR?
PRMTR?
```

After all of these values have been keyed in, the CO-OP 41 automatically adjusts all the traverse points and side shot points. Each point is displayed as it is being adjusted, and the CO-OP 41 beeps when it is finished.

CTR

Name: Clear Top Row

Purpose: This function clears the key assignments from the top row of the keyboard. The shifted key assignments are not disturbed. CTR is useful if you use the plotter Module as the plotter Module assigns special functions to the top row of keys.

Keystrokes: [XEQ] [ALPHA] CTR [ALPHA]

Entry Conditions: None

Operation: Simply execute the function. The CO-OP 41 clears the top row of key assignments.

CX

Name: Coordinate Transformation

Purpose: This allows the transformation, rotation and/or scaling of the points in the job.

Keystrokes: [XEQ] [ALPHA] CX [ALPHA]

Entry Conditions: None

Operation: The CX function does any number of the following operations at the same time: translating coordinates; rotation of points about a specific point; changing the scale factor; and/or changing the elevation of a series of specified points.

The CX function can be used when you have traversed several points and find that one of your earlier traverses was in error. It can automatically adjust the subsequent traverse points to correct for the error.

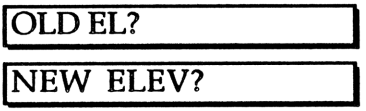
When executed the CO-OP 41 prompts for the point number about which to rotate.

```
ROT/PT NO?
```

Key in the point number you want to rotate the job about. The CO-OP 41 then prompts for the new north and east coordinates of the rotation point (and, if applicable, old and new elevation).

```
NEW N?
```

```
NEW E?
```



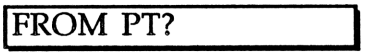
If you don't enter NEW N? or NEW E?, you need to do one of the following:

1. Occupy a point before executing this function - the rotation point number will then be transferred to these coordinates.

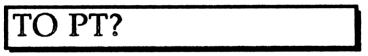
2. Occupy the rotation point before you execute this function. (This means you only want the rotation.)

If you want the north and east coordinates to change, key in the appropriate values. If you don't want them to change, press [R/S] at each prompt.

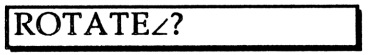
Then the CO-OP 41 prompts for the starting point number to rotate and/or transform.



Key in the lowest numbered point that you wish to rotate and/or transform. The CO-OP 41 prompts for the last point you wish to rotate and/or transform.



The CO-OP 41 prompts for how many degrees you wish to rotate the specified points about the rotation points.



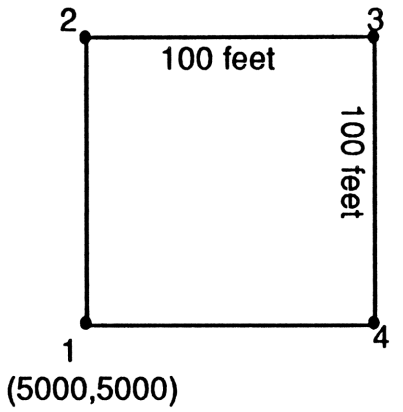
If you wish to rotate the points, key in the angle of rotation. If no rotation is desired, simply press [R/S]. Finally the CO-OP 41 prompts for the scale factor.

```
SCALE FACT?
```

Key in the scale factor desired. The CO-OP 41 adjusts all distances between the specified points by the scale factor (scale factor of .5 means all calculated distances will be half of the old distance). The CO-OP 41 performs all transformations, rotations and scaling - displaying each point number as it is changed. When finished the CO-OP 41 beeps.

See Also: AA

Example: In your job file you have four points stored that define a square 100' on a side, with initial coordinates of 5,000 north and 5,000 east.



You want to move the job so that point 1 is where point 4 is currently, and also rotate the job 45 degrees. The first step is to occupy point 4, so that the CO-OP 41 can automatically update point 1's coordinates.

4 [ ] [OCCUPY]	4.0000
[XEQ] [ALPHA] CX [ALPHA]	ROT/PT NO?
1 [R/S]	NEW N?
[R/S]	NEW E?
[R/S]	FROM PT?

As we pressed [R/S] for the NEW N? and NEW E? prompts, point 1 now has the coordinates of the point we occupied before executing the function (the coordinates of point 4). We want to move and rotate all the points, so:

1 [R/S]	TO PT?
4 [R/S]	ROTATE<?
45 [R/S]	

CY

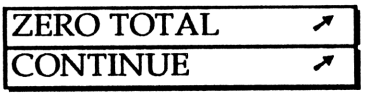
Name: Cubic Yard

Purpose: Computes and displays the cubic yards contained in two cross sections.

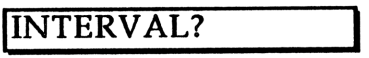
Keystrokes: [XEQ] [ALPHA] CY [ALPHA]

Entry Conditions: None.

Operation: When executed the CO-OP 41 displays a scroll menu allowing you to zero the total cubic yardage held by the TCY function or to continue accumulating cubic yardage in that function.

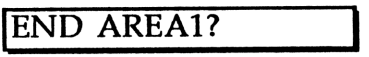


Select ZERO TOTAL if you want to zero the previously accumulated total volume and start a new volume computation. When one of these has been selected, the CO-OP 41 prompts for the distance between the cross sections.

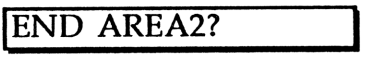


The interval is assumed the same between all the subsequent cross sections until you change it. You can change the interval by executing the CY function again and selecting the CONTINUE ↗ option.

After the interval is keyed in, the CO-OP 41 prompts for the first end area of a block.



Enter the square feet of the cross sectional end area. Then the CO-OP 41 prompts for the second end area of the block.



Enter the square feet of the second cross section. The CO-OP 41 displays the volume between the two cross sections.

Press [R/S] again to continue to the next block. You don't need to enter the first end area of the next block, just press [R/S] at the END AREA1? prompt. The CO-OP 41 uses the last END AREA2? as the END AREA 1 for successive blocks.

Remarks: Execute the CY function and select the CONTINUE ↗ option when you need to change the interval.

To view total accumulated volume, execute the TCY function.

If the forward end area (END AREA2) is not yet computed, use ENDA to compute it (see ENDA function). Then return to the CY function. When you get to the prompt END AREA1?, you may press [R/S] to use the previous END AREA2. When you get the prompt END AREA2?, press [R/S] and the area you computed using ENDA is used.

DD

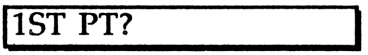
Name: Distance Distance Intersect

Purpose: This function is used to determine the intersection of two lines of defined length coming from two control points.

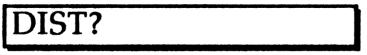
Keystrokes: [XEQ] [ALPHA] DD [ALPHA]

Entry Conditions: There are no entry conditions for this function, except that the two control points must have already been entered into the CO-OP 41.

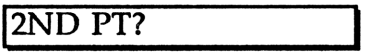
Operation: When executed, the CO-OP 41 prompts for the first point.

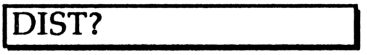


After you key in the point number of the first control point, the CO-OP 41 prompts for the distance of the line from the first control point to the point of intersection.



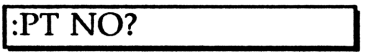
When you key in this distance, the CO-OP 41 prompts for the second control point and distance.





When all the information has been keyed in, the CO-OP 41 displays the azimuth and/or bearing of line from the first control point to the point of intersection (whether it displays the azimuth and bearing is controlled by the OUTPUT function).

If you press [R/S], the CO-OP 41 displays the azimuth and/or bearing of the line from the second control point to the point of intersection. Pressing [R/S] after this brings up the prompt for the point number to store the point to.



You can either key in a point number, or press [R/S] to see further information.

The DD function calculates two points of intersection (as shown below). If you press [R/S] at the :PT NO? prompt the CO-OP 41 displays the bearing information for the

second intersection point and then displays the :PT NO? prompt. If the second point of intersection is the one you want to store, then press [R/S] at the first :PT NO? prompt and scroll through the information for the second point of intersection.

When the CO-OP 41 displays the :PT NO? prompt again, key in the new point number. The CO-OP 41 saves the second point of intersection to that point number.

See Also: BB, BD

DEF-LT

Name: Deflection Left

Purpose: This function is used when you have measured a deflection-left and need to convert it to an azimuth. To measure a deflection-left, the back sight must be correct in the CO-OP 41. (See the BACKS function.)

Keystrokes: [ ] [DEF-LT]

Entry Conditions: The function is entered with the deflection-left (in degree, minute, second format) in the X-register.

Operation: There are no prompts or displays, the function simply returns the converted azimuth to the X-register (in degree, minute, second format).

Example: Your back sight is set at 90 degrees, and you have measured a deflection-left of 20 degrees 02 minutes 16 seconds. Find the azimuth of the target point.

20.0216 [ ] [DEF-LT] | 249.5744

DEF-RT

Name: Deflection Right

Purpose: This function is used when you have measured a deflection-right and need to convert it to an azimuth. To measure a deflection-right the back sight must be correct. (See the BACKS function.)

Keystrokes: ☐ [DEF-RT]

Entry Conditions: The function is entered with the deflection-right (in degree, minute, second format) in the X-register.

Operation: There are no prompts or displays, the function simply returns the converted azimuth to the X-register (in degree, minute, second format).

Example: Your back sight is set at 90 degrees, and you have measured a deflection-right of 32 degrees 15 minutes 2 seconds. Find the azimuth of the target point.

32.1502 ☐ [DEF-RT]	302.1502

DELETE

Name: Delete File

Purpose: Allows the user to delete an old job file from the CO-OP 41.

Keystrokes: ☐ [DELETE]

Entry Conditions: None

Operation: When executed, the CO-OP 41 prompts for the file name of the file to be deleted.

```
DELETE FILE?
```

If the file is found, the CO-OP 41 deletes that file and displays that it has been deleted.

EDM

Name: EDM (Electronic Distance Measurer)

Purpose: To tell the CO-OP 41 that you have a top mounted EDM, and to have it adjust zenith angle readings as necessary.

Keystrokes: [XEQ] [ALPHA] EDM [ALPHA]

Entry Conditions: None.

Operation: When executed, the CO-OP 41 prompts for the offset distance (the distance between the target gun and your EDM).

```
EDM OFFSET?
```

Key in this value in feet. From now on whenever you enter in a zenith angle, the CO-OP 41 automatically corrects the reading for the offset. To cancel this correction, execute this function again and enter in zero (0) for the EDM offset.

Remarks: Some stations compensate their readings automatically for the offset distance of a top mounted EDM. This function is available for those that don't.

ENDA

Name: End Area

Purpose: Calculate the end area, of a cross section, in square feet.

Keystrokes: [XEQ] [ALPHA] ENDA [ALPHA]

Entry Conditions: None

Operation: When executed, the CO-OP 41 prompts for the offset elevation of the first break point. The offset is the difference of elevation between the break point and the control point.

```
EL?
```

After this is keyed in, the CO-OP 41 prompts for the offset distance. The offset is the horizontal distance between the break point and the control line.

```
DIST?
```

Once this is keyed in, the CO-OP 41 prompts for the next elevation. You can key in another elevation, or just press the [R/S] key. If the [R/S] key is pressed without entering another number, the CO-OP 41 displays the square footage of the cross section.

```
SQ FT= #.####
```

After viewing the accumulated square footage, you can press [R/S] again to continue at the EL? prompt. To start a new cross section, you need to execute the ENDA function again.

Example: You want to compute the end area of a cross section:

[XEQ] [ALPHA] ENDA [ALPHA]	EL?
8 [R/S]	DIST?
25 [R/S]	EL?
10 [R/S]	DIST?
70 [R/S]	EL?
4 [R/S]	DIST?
100 [R/S]	EL?
0 [R/S]	DIST?
110 [R/S]	EL?
[R/S]	SQ FT=735.0000

FILE

Name: File Directory

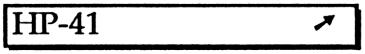
Purpose: This function is used to view the file names of all the job files you have stored in either the CO-OP 41 or the HP-41's extended memory. By viewing the file names in one of these blocks of memory, you are also choosing that memory as the storage and working memory of the CO-OP 41.

Keystrokes: [FILE]

Entry Conditions: None

Operation: When you execute FILE, a scroll menu is displayed allowing you to select either CO-OP 41 memory or the HP-41 Extended Memory.

This is the prompt that chooses Data Collector memory.



This is the prompt that chooses HP-41 Extended Memory.

After selecting the block of memory you want to work with, the CO-OP 41 displays the prompt.

At this point, the CO-OP 41 is in the memory block that you requested (either the HP-41's extended memory, or the CO-OP 41's memory). Pressing [R/S] causes a list of the files in that memory to be displayed. While the file list is being displayed, you can press [R/S] to stop the listing. After stopping the listing, [R/S] re-starts the listing. [SST] displays the next file and [ ] [BST] displays the previous file displayed.

GRID

Name: Grid Constants

Purpose: Allows the entry of state plane grid constants into the CO-OP 41 for sun shots.

Keystrokes: [XEQ] [ALPHA] GRID [ALPHA]

Entry Conditions: None

Operation: When executed, the CO-OP 41 prompts for the central meridian in your area.

```
C LONG?
```

After you have keyed this in, the CO-OP 41 prompts for the zone constant.

```
Z. CONST=?
```

The zone constant only needs to be entered if your state plane coordinate system is Lambert. If your state plane coordinate system is Mercator then you don't have to answer this prompt (just press [R/S]).

Remarks: After running this function you will be ready to compute state plane grid north. The GRID function runs right into the SUN function, so that you can compute state plane grid north (see the SUN function for more details).

IC

Name: Delta and Chord

Purpose: This function is used to traverse around or compute the data of a curve when the delta and chord are known. When run, the CO-OP 41 calculates the new area and perimeter.

Keystrokes: [XEQ] [ALPHA] IC [ALPHA]

Entry Conditions: None

Operation: When executed, the CO-OP 41 prompts for the delta angle.

```
DELTA∠?
```

Enter the delta angle. The CO-OP 41 then prompts for the chord.

```
CH?
```

The output from here behaves exactly the same as the other curve functions (see *Curve Functions,* at the front of this manual, for more details).

ID

Name: Delta and Degree of Curve

Purpose: This function is used to traverse around or compute the data of a curve when the delta and degree of curve are known. When run, the CO-OP 41 calculates the new area and perimeter.

Keystrokes: [XEQ] [ALPHA] ID [ALPHA]

Entry Conditions: None

Operation: When executed, the CO-OP 41 prompts for the delta angle.

```
DELTA∠?
```

Enter the delta angle and press [R/S]. The CO-OP 41 then prompts for the degree of curve.

```
D?
```

From here the function behaves exactly as the other curve functions (see the section titled: *Curve Functions,* at the front of this manual, for more details).

IE

Name: Delta and External

Purpose: This function is used to traverse around a curve when the delta and external are known. When run, the CO-OP 41 calculates the new area and perimeter as if you had traversed around the perimeter of the given curve.

Keystrokes: [XEQ] [ALPHA] IE [ALPHA]

Entry Conditions: None

Operation: When executed, the CO-OP 41 prompts for the delta angle.

```
DELTA∠?
```

Enter the delta angle and press [R/S]. The CO-OP 41 then prompts for the external.

```
E?
```

This function then behaves exactly as the other curve functions (see the section titled: *Curve Functions,* at the front of this manual, for more details).

INVERS

Name: Inverse

Purpose: This function is used to compute the distance between a set of coordinates, and the azimuth of the line connecting them.

Keystrokes: [ ] [INVERS]

Entry Conditions: To use this function you must be occupying the point to inverse from.

Operation: When executed, the CO-OP 41 prompts for the north coordinate of the point inversing to.

```
N?
```

Key in the north coordinate and press [R/S]. The CO-OP 41 then prompts for the east coordinate.

```
E?
```

The CO-OP 41 then displays the azimuth (and/or bearing depending on output options). The distance between the points will be in the Y-Reg. (If you press [R/S] again, the display will show the distance.)

IP

Name: Delta and Center Point

Purpose: This function is used to traverse around or compute the data for a curve when the delta and center point are known. When run, the CO-OP 41 calculates the new area and perimeter.

Keystrokes: [XEQ] [ALPHA] IP [ALPHA]

Entry Conditions: None

Operation: When executed, the CO-OP 41 prompts for the delta angle.

```
DELTA∠?
```

Enter the delta angle and press [R/S]. The CO-OP 41 then prompts for the center point.

```
CENTER PT?
```

Enter the center point number and press [R/S]. The position of the center point determines whether the curve is concave or convex. From here, the function behaves exactly as the other curve functions (see the section titled: *Curve Functions,* at the front of this manual, for more details).

IR

Name: Delta and Radius

Purpose: This function is used to traverse around a curve when the delta and radius of the circle are known. When run, the CO-OP 41 calculates the new area and perimeter.

Keystrokes: [ ] [IR]

Entry Conditions: None

Operation: When executed, the CO-OP 41 prompts for the delta angle.

```
DELTA∠?
```

Enter the delta angle and press [R/S]. The CO-OP 41 then prompts for the radius.

```
RADIUS?
```

From here the function behaves exactly as the other curve functions (see the section titled: *Curve Functions,* at the front of this manual, for more details).

IT

Name: Delta and Tangent Distance

Purpose: This function is used to traverse around or compute the data of a curve when the delta and tangent of the curve are known. When run, the CO-OP 41 calculates the new area and perimeter in the traverse.

Keystrokes: [XEQ] [ALPHA] IT [ALPHA]

Entry Conditions: None

Operation: When executed, the CO-OP 41 prompts for the delta angle.

```
DELTA∠?
```

Enter the delta angle and press [R/S]. The CO-OP 41 then prompts for the tangent distance.

```
T?
```

From here, the behaves exactly as the other curve functions (see the section titled: *Curve Functions,* at the front of this manual, for more details).

JOBS

Name: Start Job

Purpose: Used to set up and start a new job in the CO-OP 41.

Keystrokes: ☐ [JOBS]

Entry Conditions: None

Operation: When executed, the CO-OP 41 displays a scrolling menu allowing you to select an old job or a new job.

NEW JOB ↗
OLD JOB ↗

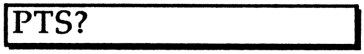
When selected, the CO-OP 41 prompts for the job name.

JOB NAME?

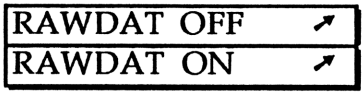
Key in the job name and press [R/S]. The CO-OP 41 displays a scroll menu for the selection of the type of information to be stored in the job.

N/E ONLY ↗
NOTE ON ↗
ELEV ON ↗
ELEV/NOTE ↗

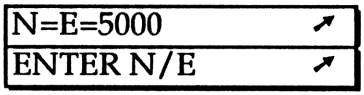
When ELEV is on, the annunciator '3' will be turned on. When NOTE is on, the annunciator '4' will be turned on. Next the CO-OP 41 prompts for how many points are stored in the job.



After this, the CO-OP 41 displays a scroll menu for selecting whether raw data should be stored or not for this job.

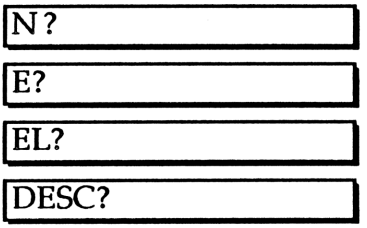


When Raw Data is on, annunciator '2' is turned on. When one of these is selected, the CO-OP 41 displays a scroll menu to allow the selection of manual entry of the initial starting coordinates for point 1, or the automatic entry by the CO-OP 41.



N=E=5000 ↗ This selection automatically assigns the starting coordinates of 5,000 north and 5,000 east to point 1. If elevation and note are being used, 100 is assigned to elevation and "START" to note.

ENTER N/E ↗ This selection tells the CO-OP 41 to prompt you for the initial north and east coordinates (and depending on the system the elevation and note).



K

Name: Keys

Purpose: This function sets up the keys on the keyboard to match the Survey ROM overlay.

Keystrokes: [XEQ] [ALPHA] K [ALPHA]

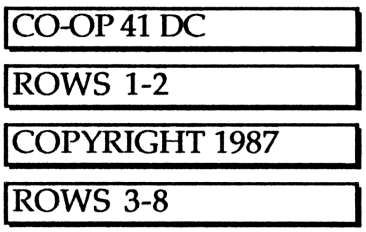
Entry Conditions: None

Operation: This program must be run in any of the following cases.

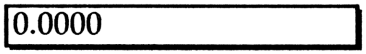
1. The first time the Surveying Module is plugged into the calculator.

2. If the HP-41C ever experiences a data loss.

When you execute the K function, it begins assigning keys. This will take a while. While it is assigning keys, the K program displays several messages.



At this point, all the keys have been assigned and the calculator should be in USER mode. When the program is completed the display shows:



Remarks: Upon completion, the display output is set to bearing and azimuth with the next number prompt turned off. The memory is set to the CO-OP 41 memory block, as opposed the HP-41's extended memory. If you want to change these parameters then execute the FILE, OUTPUT, and/or NN functions.

See Also: FILE, OUTPUT, NN

LOAD

Name: Load

Purpose: Loads a job file (or part of a job file) in from a mass storage device.

Keystrokes: [XEQ] [ALPHA] LOAD [ALPHA]

Entry Conditions: None

Operation: When executed, the CO-OP 41 prompts for the job file name.

```
JOB NAME?
```

Key in the name (up to 6 characters), and the CO-OP 41 prompts for the number of points to load.

```
LOAD PTS?
```

Then, the CO-OP 41 prompts for the point number to start loading from (you can load in just part of a large file).

```
FROM PT?
```

After keying in the starting point number, the CO-OP 41 prompts for the last point number to read in.

```
TO PT?
```

Key this in, and the CO-OP 41 loads in the specified part of the file from the mass storage device.

LP

Name: Arc Length Center Point

Purpose: This is used to traverse around a curve when the arc length and center point of the circle are known. When run, the CO-OP 41 calculates the new area and perimeter of the traverse.

Keystrokes: [XEQ] [ALPHA] LP [ALPHA]

Entry Conditions: None

Operation: When executed, the CO-OP 41 prompts for the arc length.

```
ARC L?
```

Enter the arc length and press [R/S]. The CO-OP 41 will then prompt for the center point.

```
CENTER PT?
```

Enter the center point and press [R/S]. The location of the center point will determine if the curve is concave (inward) or convex (outward). This then behaves exactly as the other curve functions (see the section titled *Curve Functions*, at the front of this manual, for more details).

LR

Name: Arc Length Radius

Purpose: This is used to traverse around or compute the data of a curve when the arc length and radius of the circle are known. When run, the CO-OP 41 calculates the new area and perimeter of the traverse.

Keystrokes: [ ] [LR]

Entry Conditions: None

Operation: When executed, the CO-OP 41 prompts for the arc length.

```
ARC L?
```

Enter the arc length, and press [R/S]. The CO-OP 41 then prompts for the radius.

```
RADIUS?
```

From here, the function behaves exactly as the other curve functions. (See *Curve Functions* for more details).

METER

Name: Meter

Purpose: Toggles functions in the CO-OP 41 so that distance measurements can be entered in as meters. The CO-OP 41 automatically converts the meter inputs to feet.

Keystrokes: [XEQ] [ALPHA] METER [ALPHA]

Entry Conditions: None

Operation: When executed, this function displays a scroll menu with two menu options:

DIST METER ↗
DIST FEET ↗

When in meter mode, all distances are considered to have been entered in as meters, and it will automatically convert them to feet.

Remarks: This does not affect displays, all output is still in feet.

N-E

Name: North East

Purpose: This function is used when you have measured a bearing in the North-East quadrant (quadrant 1) and need to convert it into an azimuth.

Keystrokes: [ ] [N-E]

Entry Conditions: The function is entered with the bearing angle in the X-register.

Operation: There are no prompts or displays. The function simply returns the converted azimuth to the X-register (in degree, minute, second format).

N-W

Name: North West

Purpose: This function is used when you have measured a bearing in the North-West quadrant (quadrant 4) and need to convert it into an azimuth.

Keystrokes: ☐ [N-W]

Entry Conditions: The function is entered with the bearing angle in the X-register.

Operation: There are no prompts or displays. The function simply returns the converted azimuth to the X-register (in degree, minute, second format).

NEXTNO

Name: Next Number

Purpose: This function is used to change the next point number to store coordinate data to.

Keystrokes: ☐ [NEXTNO]

Entry Conditions: Enter with the next point number in the X-register.

Operation: When executed, the CO-OP 41 displays the selected next point number.

```
NEXT NO: #
```

The next time you do a function that will store data to the coordinate file (such as TRAVERS or SIDS) the CO-OP 41 stores the data to the point number specified by NEXT NO, and then increments the next point number.

NN

Name: Next Number Prompt

Purpose: This function allows the toggling of the next number prompt on and off.

Keystrokes: [XEQ] [ALPHA] NN [ALPHA]

Entry Conditions: None

Operation: If the next number prompt is on, then each time the CO-OP 41 stores a point it prompts for the point number to store the data under. If the next number prompt is off, then the CO-OP 41 automatically tries to store the point in the next consecutive point number. The selection is made by a scroll menu.

NEXTNUM OFF ↗
NEXTNUM ON ↗

NOTE

Name: Note

Purpose: This function allows you to put longer notes into the raw data file.

Keystrokes: [XEQ] [ALPHA] NOTE [ALPHA]

Entry Conditions: RAW DATA has to be set to ON.

OCCUPY

Name: Occupy

Purpose: This function is used to occupy a previously entered point. When you occupy a point it means that all traverses and side shots are taken relative to that point. OCCUPY zeroes the back sight. After executing OCCUPY, you must use the BACKS function to set a new back sight.

Keystrokes: [ ] [OCCUPY]

Entry Conditions: Execute this function with the point number you wish to occupy in the X-register.

Operation: There are no prompts or displays in this function It simply occupies the new point.

Remarks: Occupying a point zeros the acreage and perimeter information, starting a new traverse.

OFFSET

Name: Offset

Purpose: Automatically stores points a given offset away from a series of points stored in the random point file.

Keystrokes: [XEQ] [ALPHA] OFFSET [ALPHA]

Entry Conditions: Must have stored in the random point file a series of points from which to offset.

Operation: Enter the series of points that you wish to mark an offset distance from into the random point file.

When executed, the CO-OP 41 prompts for the offset distance.

```
OFFSET DIST?
```

This is the distance that you want each new point to be away from the points in the random point file. Key in the distance and press [R/S], then the CO-OP 41 prompts for the beginning point number that you want the new series of points stored to.

```
BEG PT STO?
```

Key this in, and press [R/S]. The CO-OP 41 goes through the random point file and automatically measures the offset distance from the points stored therein and assigns the coordinates of the measured points to the new point numbers.

Remarks: Offset points are not created for the beginning and ending points in the random point file. Offset points are created only for the points between the beginning and ending point in the random point file. Enter the OFFSET DIST as a positive number if the offsets are to the right, a negative OFFSET DIST will make offsets to the left.

OLDJOB

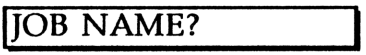
Name: Job Select

Purpose: This function is used to recall an old job previously entered into the CO-OP 41, and make it the current job.

Keystrokes: [XEQ] [ALPHA] OLDJOB [ALPHA]

Entry Conditions: None

Operation: When executed the CO-OP 41 prompts for the job name you wish to recall.



Once the job is recalled, points can be modified, added, and/or recalled. The area and perimeter can also be re-computed. After the job name is keyed in, the CO-OP 41 displays a scroll menu allowing you to select whether raw data was stored with the file.

If RAWDATA ON is selected, the CO-OP 41 prompts for the raw data file name where the raw data will be stored.

OUTPUT

Name: Output Select

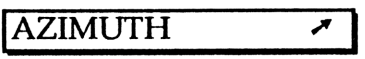
Purpose: This is used to select the angle display option.

Keystrokes: [XEQ] [ALPHA] OUTPUT [ALPHA]

Entry Conditions: None

Operation: Every time a function is run that computes an angle, the CO-OP 41 can display the angle in one of several ways, the method of display is selected by a scroll menu.

Displays angles as an azimuth.



Displays angles as a bearing. BEARING ↗

Displays angles as both azimuth and bearing. AZ/BER ↗

Return unformatted azimuth to X-register. NON PROMPT ↗

PERPO

Name: Perpendicular Offset

Purpose: Computes the perpendicular offset of a point from a line. Also computes the second, or long side of a triangle.

Keystrokes: PERPO

Entry Conditions: None

Operation: When executed, the CO-OP 41 prompts for the information needed to define the line to take the perpendicular offset from (see the section titled: *Defining a Line*).

Once the information for the line has been keyed in, the CO-OP 41 prompts for the point number of the offset point.

```
OFST PT?
```

Key in the point number that you want the calculated offset point stored at. The CO-OP 41 displays the offset distance.

```
OFST=#.####
```

PINV

Name: Point Inverse

Purpose: This function is used to compute the angle and the distance between the currently occupied point and another known point.

Keystrokes: [PINV]

Entry Conditions: You must be occupying the point to inverse from, and already have stored the point you are inversing to. Enter with the point number you want to inverse to in the X-register.

Operation: The CO-OP 41 displays the azimuth and/or the bearing to the point depending on the setting of the OUTPUT function.

```
AZ=###  ##' ##"
```

Pressing [R/S] displays the distance between the two points.

```
DIST = #.####
```

PPTS

Name: Print Points

Purpose: This function prints a series of points, and their coordinate information, on a printer connected to the CO-OP 41.

Keystrokes: [XEQ] [ALPHA] PPTS [ALPHA]

Entry Conditions: A printer must be connected to the CO-OP 41 by the HP-IL loop or the serial port.

Operation: When executed, the CO-OP 41 prompts for the starting point number to print.

FROM PT?

After you key in the point number, the CO-OP 41 prompts for the ending point number to print.

TO PT?

When one of these is selected, the CO-OP 41 displays a scroll menu allowing the selection of a long, or short form printout.

SHORT LINE ↗	(24 column printer)
LONG LINE ↗	(80 column printer)

When this has been keyed in, the CO-OP 41 prints the series of points and their coordinates.

Remarks: The steps needed to print to a serial printer are as follows:

1. [XEQ] [ALPHA] CLEAR [ALPHA]
2. put 14 or 8 in the X-register (14 for 9600 baud, 8 for 1200 baud for the serial port)
3. [XEQ] [ALPHA] BAUD [ALPHA]
4. Execute the PPTS function as normal.

PRAW

Name: Print Raw Data

Purpose: Prints out the raw data information on a printer connected to the CO-OP 41.

Keystrokes: [XEQ] [ALPHA] PRAW [ALPHA]

Entry Conditions: None

Operation: When executed, the CO-OP 41 will prompt for the file name of the file to print the Raw Data information from.

FILE NAME?

Next, the CO-OP 41 displays a scroll menu allowing the selection of long or short form printout.

SHORT LINE ↗	24 column printer
LONG LINE ↗	80 column printer

PREA

Name: Pre-Determined Area

Purpose: Calculates a cutoff line based on a pre-determined area for a plot of land.

Keystrokes: [XEQ] [ALPHA] PREA [ALPHA]

Entry Conditions: The points outlining the area need to be stored in the random point file (see example below).

Operation: After the points are entered into the random point file, the CO-OP 41 displays a scrolling prompt allowing you to specify the desired area or square footage that you want contained in the parcel of land.

```
:ACRES?
:SQ FT?
```

When this is entered, the CO-OP 41 displays the distance of the calculated line.

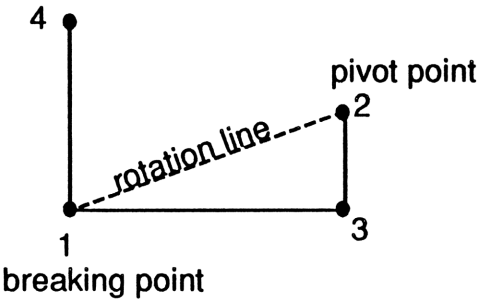
```
DIST= #.####
```

When you press the [R/S] key, the CO-OP 41 prompts for the point number to store the calculated end point of the line at.

```
NEW COR?
```

Remarks: To enter points into the random point file for the PREA function, use the following procedure:

1. Use RDMPTS to key in a random point file that defines the known polygon. The first and last point in the file should be the "breaking" point and the next to the last point should be the "pivot" point.



2. Finish keying in the random point file by keying in point 0 as usual. But this time, press [R/S] an additional time after entering point 0.

3. Key in the point that, along with the breaking point, defines the direction in which you want the new corner point to be established.

4. For the figure shown above the random point file sequence would be:

[ ] [RDM-PTS]	PT?
1 [R/S]	PT?
3 [R/S]	PT?
2 [R/S]	PT?
1 [R/S]	PT?
0 [R/S]	0.0000
[R/S]	PT?
4 [R/S]	

See the CO-OP 41 User's Manual for an example.

PREASL

Name: Pre-Determined Area Using Parallel Sides of a Trapezoid

Purpose: Computes a cutoff line based on a pre-determined area, and using parallel sides of a trapezoid.

Keystrokes: [XEQ] [ALPHA] PREASL [ALPHA]

Entry Conditions: None

Operation: When executed, the CO-OP 41 prompts for the information needed to define the first line that makes the first side of the trapezoid (see the section titled: *Defining a Line).*

When the first side of the trapezoid has been entered, the CO-OP 41 prompts for the information on the second side of the trapezoid.

When both sides of the trapezoid have been defined, the CO-OP 41 displays a scrolling prompt allowing you to specify the acreage or square feet to be encompassed by the trapezoid.

```
:ACRES?
```

```
:SQ FT?
```

When one of these has been keyed in, the CO-OP 41 displays the length of the first and second side of the trapezoid (press [R/S] to scroll to the second distance).

```
D1= #.###
```

```
D2= #.###
```

When you press [R/S] at the D2= #.### display, the CO-OP 41 prompts for the point number to store the ending point of the first side of the trapezoid.

```
3RD PT?
```

After this point number is keyed in, the CO-OP 41 prompts for the point number to store the ending point of the second side of the trapezoid.

```
4TH PT?
```

When this has been keyed in, the CO-OP 41 displays the distance between the two end points.

```
D4= #.###
```

PREC

Name: Precision of Closure

Purpose: Computes and displays the precision of closure for a traverse.

Keystrokes: [XEQ] [ALPHA] PREC [ALPHA]

Entry Conditions :

1. A traverse must have been completed and the perimeter computed.
2. You must inverse between the first and last point in a traverse before executing this function.

Operation: When executed, the function computes and displays the precision of closure.

```
PREC= #.
```

This number can be interpreted as "one in # closure" where # is the precision of closure given above.

PTDIR

Name: Point of Direction

Purpose: Assigns a point number to a point a certain distance and direction from a known point.

Keystrokes: ☐ [PT-DIR]

Entry Conditions: None

Operation: When this function is executed, the CO-OP 41 prompts for the information needed to define the line to the new point (see the section titled: *Defining a Line).*

Once the information on the line has been keyed in, the CO-OP 41 prompts for the distance that the new point lies along the defined line.

```
DIST?
```

Key in the distance to the next point from the last point created and the CO-OP 41 prompts for the point number to store the new point to.

```
NEW PT?
```

When keyed in, the point number shows in the display while the CO-OP 41 is creating the new point. The CO-OP 41 then displays the DIST? prompt again. You can enter another point number to store a new point on that line.

PTOP

Name: Point to Point Inverse

Purpose: This function is used to compute the angle and distance between two known points.

Keystrokes: [ ] [PTOP]

Entry Conditions: Both points must have already been entered into the CO-OP 41.

Operation: When executed, the CO-OP 41 prompts for the point to inverse from.

```
FROM PT?
```

After you key in the point number, the CO-OP 41 prompts for the point to inverse to.

```
TO PT?
```

When this is keyed in, the CO-OP 41 displays, depending on the setting of the OUTPUT function, the azimuth and/or bearing between the points.

```
AZ=#.####
```

PTRA

Name: Point Traverse

Purpose: Allows the traverse from the occupied point to another known point. Carries the acreage and perimeter information, but does not store the point information.

Keystrokes: [PTRA]

Entry Conditions: Enter with the point number to traverse to in the X-register.

Operation: There are no displays or prompts for this function. When executed the CO-OP 41 simply traverses to the new point, carrying the acreage and perimeter information. When the function is completed, the point you entered with in the X-register is the occupied point.

See the CO-OP 41 User's Manual for an example.

PTRCL

Name: Point Recall

Purpose: Recalls point information from a previously stored point. Does not affect the currently occupied point.

Keystrokes: [ ] [PTRCL]

Entry Conditions: Enter with the point number to be recalled in the X-register.

Operation: When executed, the CO-OP 41 displays the point number.

```
PT: #
```

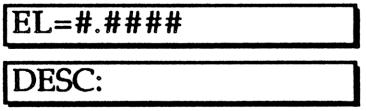
Press [R/S] and the CO-OP 41 displays the north coordinate of the recalled point.

```
N= #.####
```

Pressing [R/S] displays the east coordinate of the recalled point.

```
E= #.####
```

If applicable, the CO-OP 41 also displays the elevation and/or descriptive note.



Pressing [R/S] recalls the next consecutive point.

Remarks: This function will change the next point number. Be sure to reset next point in traverse or side shot whenever you recall a point.

R

Name: Reverse

Purpose: Transfers benchmark elevation and coordinates to the instrument position.

Keystrokes: [XEQ] [ALPHA] R [ALPHA]

Entry Conditions: Before you do the next traverse, the coordinates and benchmark elevation should be stored in the occupied point registers (N, E, ELEV, NOTE).

Operation: When executed, the CO-OP 41 displays a scroll menu allowing the selection of reverse on or off.

When one of these have been selected, enter the reading to the benchmark. Using TRAVRS, key in the appropriate angle and distance information from the instrument to the benchmark. The CO-OP 41 automatically reverses the information entered and stores the instrument position in the displayed point number. Reverse is automatically turned off by the TRAVRS function.

Example: The benchmark coordinates are found to be:

North: 1285.67

East: 1573.29

Elevation: 1590.31

The instrument has been oriented to grid azimuth, and the azimuth from the instrument position is 315 degrees, 30 minutes, 20 seconds. The zenith angle is 82 degrees, 12 minutes, 42 seconds, and the slope distance is 255.74 feet. The height of the instrument is 5.25 and the height of the rod is 3.72. Find the coordinates and elevation of the instrument position.

Start a Temporary Job for this example:

☐ START	NEW JOB ↗
ENTER	JOB NAME?
RTST R/S	N/E ONLY ↗
R/S	NOTE ON ↗
R/S	ELEV ON ↗
ENTER	PTS?
3 R/S	RAWDAT OFF ↗
ENTER	N=E=5000 ↗
ENTER	1.0000

Initialize the coordinates of the instruments:

1285.67 [STO] [N]

1573.29 [STO] [E]

1590.31 [STO] [EL]

Execute the reverse function:

[XEQ] R	REVERSE ON ↗
[ENTER]	1590.31

Do a traverse:

[ ] [TRAVRS]	HI?
5.25 [R/S]	H ROD?
3.72 [R/S]	TRAVRS
	:AZIMUTH
315.3020 [R/S]	:ZENITH∠?
82.1242 [R/S]	SLOPE D?
255.74 [R/S]	

Now recall the instrument position:

[RCL] [N]	1104.9287
[RCL] [E]	1750.8695

RC

Name: Radius and Chord

Purpose: This is used to traverse around a curve when the radius and chord of the curve are known. When run, the CO-OP 41 calculates the new area and perimeter as if you had traversed around the perimeter of the given curve.

Keystrokes: [XEQ] [ALPHA] RC [ALPHA]

Entry Conditions: None

Operation: When executed, the CO-OP 41 prompts for the radius of the circle.

```
RADIUS?
```

After you key in the radius, the CO-OP 41 prompts for the chord.

```
CH?
```

From here, this function behaves exactly as the other curve functions (see the section titled: *Curve Functions* at the front of this manual for more detail).

RDMPTS

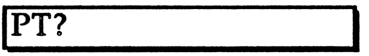
Name: Random Point Store

Purpose: Allows the storage of points and curve information to the random point file.

Keystrokes: [ ] [RDM-PTS]

Entry Conditions: None

Operation: When executed, the CO-OP 41 prompts for a point number to store in the random point file.



Key in the point number to store and press [R/S] to enter it into the random point file. If you just want to enter a point number consecutive to the last one that you entered then you can simply press [R/S] and the CO-OP 41 saves the next consecutive point number in the random point file. Key in a zero ([0] [R/S]) to close the file (see the section titled: *Random Point File,* for more information).

A series of consecutive point numbers may also be entered into the random point file by specifying a real number in the form of bbbb.eeee. Where bbbb is the beginning point number of the consecutive numbers, and eeee is the ending point number. Thus entering 6.0009 into the random point file would be the same as keying in points 6, 7, 8, and 9.

RDMRCL

Name: Random Point Recall

Purpose: This is used to display the points currently stored in the random point file.

Keystrokes: ☐ [RDM-RCL]

Entry Conditions: None

Operation: When executed the CO-OP 41 displays the first point stored in the random point file.

Pressing [R/S] scrolls through the points stored in the file, until the end is reached (see the section titled: *Random Point File,* for more information).

REP

Name: Repeat

Purpose: This program repeats a previous bearing and distance and stores it in the next consecutive point number.

Keystrokes: [XEQ] [ALPHA] REP [ALPHA]

Entry Conditions: None

Operation: When executed, the CO-OP 41 stores a point along the previously traversed azimuth at distances equal to the previously traversed distance. The CO-OP 41 displays the point number as it is being stored. Press [R/S] for between consecutive points.

RPSTK

Name: Random Point Stakeout

Purpose: Allows a point to be staked out from a random position, provided the position is accessible to two known points.

Keystrokes: [XEQ] [ALPHA] RPSTK [ALPHA]

Entry Conditions: The instrument must be set up at a position accessible to 2 known points.

Operation: When this function is executed, the CO-OP 41 prompts for the control point numbers of the two accessible points.

```
1ST PT?
```

```
2ND PT?
```

After the two point numbers have been keyed in, the CO-OP 41 prompts for the horizontal circle reading to the first control point.

```
CIR TO 1?
```

At this point, you can enter the reading, or press [R/S] without entering any angle. If you do not enter any angle, the CO-OP 41 reads the angle and distance information from a connected total station (note that the appropriate instrument function NIKON, TOPCON, LIETZ,... must have been executed prior to doing this). If you answer the CIR TO 1? prompt, the CO-OP 41 displays scrolling prompts to enter the distance to the first control point.

:H DIST?

:VERT∠?

:ZENITH∠?

H DIST? This is the prompt for the horizontal distance to the known point.

VERT∠? This is the prompt for the vertical angle to the known point. If you enter this value, the CO-OP 41 prompts for the slope distance to the point.

SLOPE D?

When you key in the slope distance, the CO-OP 41 automatically converts it to a horizontal distance in order to compute the coordinates of the staked point.

ZENITH∠? This is the prompt for the zenith angle to the known point. If you enter this value, the CO-OP 41 prompts for slope distance to the point.

SLOPE D?

When you key in slope distance, the CO-OP 41 automatically converts it to horizontal distance in order to compute the coordinates of the staked point.

When the distance information has been entered, the CO-OP 41 prompts for the circle reading to the second known point.

CIR TO 2?

If you are using a total station, then when you press [R/S] at this prompt, the CO-OP 41 will automatically take the reading to the second point using the total station. If you are not using a total station, the CO-OP 41 prompts for the distance to the second known point (see the information on entering information for the first point above).

```
:H DIST?
:VERT∠?
:ZENITH∠?
```

When the information for the second point has been entered, the CO-OP 41 shows the precision of closure for your readings.

```
PREC=#.####
```

Pressing [R/S] now, causes the CO-OP 41 to prompt for the point number to store the station position to.

```
STA PT NO?
```

Once this has been keyed in, the CO-OP 41 now has the position and back sight of your station stored. If you don't want to store the station point, just press [R/S].

The CO-OP 41 starts prompting for information for the actual staking point. The first prompt is for the point number of the stake out point.

```
STK PT?
```

When this point is keyed in, (it must be a known point) the CO-OP 41 displays the circle reading to that point.

```
CIR=#.####
```

Pressing [R/S] displays the horizontal distance to the point.

```
H.D.=#.####
```

Pressing [R/S] again either allows you to enter the distance information to the rod shot, or causes the total station to take a reading (if you are using a total station).

```
:H DIST?
:VERT∠?
:ZENITH∠?
```

Key in the information for the rod shot. The CO-OP 41 then displays the GO or COME distance, and, if working with elevation, the CUT or FILL distance (press [R/S] to view the next information).

```
GO #.####
COME #.####
CUT #.####
FILL #.####
```

If you press [R/S] now, the CO-OP 41 will prompt for STK PT? again. If you want to take another shot to the same stake point, just press [R/S]. If you wish to switch to stake out another point, key in the new point number.

RRDM

Name: Recall Random Point File

Purpose: Recalls a previously saved random point file from the CO-OP 41 memory.

Keystrokes: [XEQ] [ALPHA] RRDM [ALPHA]

Entry Conditions: None

Operation: When executed, the CO-OP 41 prompts for the file name of the random point file on the mass storage device.

```
RDMPTS FILE?
```

Key in the file name. Then the CO-OP 41 reads in the random point file from the CO-OP 41 memory, or HP-41 extended memory, and overwrites the current random point file with the new information.

S-E

Name: South-East

Purpose: This function is used when you have measured a bearing in the South-East quadrant (quadrant 2) and need to convert it into an azimuth.

Keystrokes: ☐ [S-E]

Entry Conditions: The function is entered with the bearing angle in the X-register.

Operation: There are no prompts or displays. The function simply returns the converted azimuth to the X-register (in degree, minute, second format).

S-W

Name: South-West

Purpose: This function is used when you have measured a bearing in the South-West quadrant (quadrant 3) and need to convert it into an azimuth.

Keystrokes: [ ] [S-W]

Entry Conditions: The function is entered with the bearing angle in the X-register.

Operation: There are no prompts or displays, the function simply returns the converted azimuth to the X-register (in degree, minute, second format).

SAVE

Name: Save Job

Purpose: Allows the user to save a job (or a portion of a job) to a mass storage device.

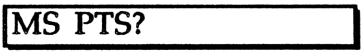
Keystrokes: [XEQ] [ALPHA] SAVE [ALPHA]

Entry Conditions: None

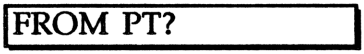
Operation: When executed, the CO-OP 41 prompts for the file name to store the job file to.

```
FILE NAME?
```

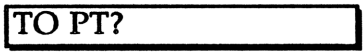
Key in the file name. The CO-OP 41 then prompts for the number of points for creating a proper size of file on the mass storage device.



The CO-OP 41 then prompts for the starting point number that you wish saved.



When this is keyed in, the CO-OP 41 prompts for the last point number to save.



SIDES

Name: Side Shot

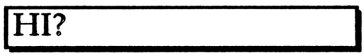
Purpose: Used to enter a side shot into the CO-OP 41.

Keystrokes: ☐ SIDS

Entry Conditions: None

Operation: When executed the CO-OP 41 displays that it is doing a side shot.

If you are working with elevation, the CO-OP 41 prompts for the height of the instrument.



After you key in this information, the CO-OP 41 prompts for the height of the rod.

H ROD?

The CO-OP 41 then asks for the angle information of the side shot.

:∠RT?
:BRG?
:AZIMUTH?

∠RT? This prompt is asking for the angle right reading of the side shot. To read an angle right, the back sight must be set.

BRG? This prompt is asking for the bearing angle of the side shot. See the section titled: *Keying in Bearings* for information on how to enter this information.

AZIMUTH? This prompt is asking for the azimuth of the side shot. Key in the appropriate value. The CO-OP 41 then prompts for the distance information.

:ZENITH∠?
:H DIST?
:VERT∠?

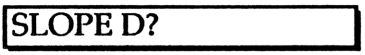
ZENITH∠? This prompt is asking for the zenith angle to the side shot point. If you enter this value, the CO-OP 41 prompts for the slope distance to the point.

SLOPE D?

When you key in the slope distance, the CO-OP 41 automatically converts it to a horizontal distance in order to compute the coordinates of the side shot point.

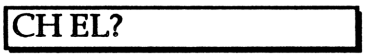
H DIST? This prompt is asking for the horizontal distance to the side shot point.

VERT∠? This prompt is asking for the vertical angle to the side shot point. If you enter this value, the CO-OP 41 prompts for the slope distance to the point.

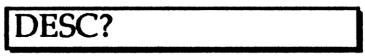


When you key in the slope distance, the CO-OP 41 automatically converts it to a horizontal distance in order to compute the coordinates of the side shot point.

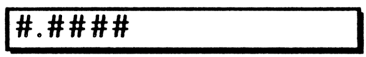
If you are working with elevation, the CO-OP 41 prompts for the change in elevation from the currently occupied point to the side shot point.



The CH EL? prompt only shows if elevation is on and if you entered a horizontal distance instead of a slope distance. If you are working with notes, the CO-OP 41 prompts for the note (or description).



After all of the information has been keyed in, the CO-OP 41 stores the information in the next consecutive point number. The CO-OP 41 then displays the next point number it is storing to.



Then the CO-OP 41 prompts for another side shot to be entered. You can either enter another side shot or execute another function.

Remarks: Any function that recalls the coordinates of a point alters the next point number. Use the NEXT NO function to set the correct next point number.

SRDM

Name: Store Random Point File

Purpose: Stores a random point file into the CO-OP 41 memory so that it can be recalled and used at another time.

Keystrokes: [XEQ] [ALPHA] SRDM [ALPHA]

Entry Conditions: None

Operation: When executed the CO-OP 41 prompts for the file name to store the random point file to.

```
RDMPTS FILE?
```

Key in the file name and the CO-OP 41 will store the random point file to the CO-OP 41 memory.

SSSTO

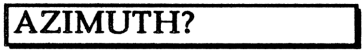
Name: Side Shot Store

Purpose: Quickly stores angle and horizontal distance information in to the CO-OP 41 as a side shot.

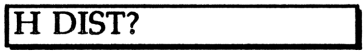
Keystrokes: [XEQ] [ALPHA] SSSTO [ALPHA]

Entry Conditions: None

Operation: When executed, the CO-OP 41 prompts for the azimuth of the side shot.



Key in the side shot azimuth and press [R/S]. The CO-OP 41 then prompts for the horizontal distance of the side shot.



When keyed in (and [R/S] is pressed), the CO-OP 41 stores this information to the next consecutive point number. This function is used as a quick two dimensional side shot function.

STAKE

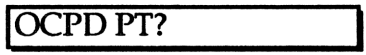
Name: Stake Out

Purpose: Used to stake out a point.

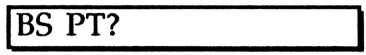
Keystrokes: [STAKE]

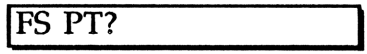
Entry Conditions: None

Operation: When this function is executed, the CO-OP 41 prompts for the point number that your station is occupying.

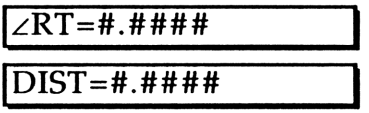


When this has been keyed in, the CO-OP 41 prompts for the back sight and fore sight point so that it will know how your instrument is set up.

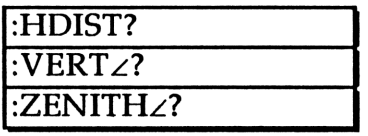




Once these are keyed in, the CO-OP 41 displays the angle right and distance to the fore sight point (press [R/S] to scroll to the next display).

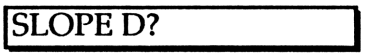


After you have viewed this information, the CO-OP 41 displays a scrolling prompt for the distance to the rod man.

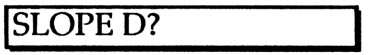


H DIST? This prompt is asking for the horizontal distance to the rod man.

VERT∠? This prompt is asking for the vertical angle to the rod man. If you enter this value, the CO-OP 41 prompts for the slope distance to the rod man.



ZENITH∠? This display is prompting for the zenith angle to the rod man point. If you enter a value, the CO-OP 41 prompts for the slope distance to the rod man.



When one of these has been keyed in, the CO-OP 41 displays the GO or COME distance, and, if working with elevation, the CUT or FILL distance (press [R/S] to view the next information).

```
GO #.####
COME #.####
CUT #.####
FILL #.####
```

Press [R/S] after viewing the information. The CO-OP 41 then prompts for the next reading of distance. Continue this until the rod is at the desired position.

Remark: If you want to stake another point from the current occupy point, execute the STAKE function again and press [R/S] at the OCPT prompt.

STK

Name: Stake out (no storage)

Purpose: To stake out a point which is not stored in the job file.

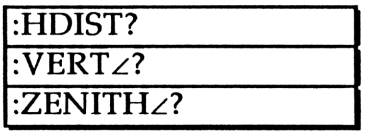
Keystrokes: [XEQ] [ALPHA] STK [ALPHA]

Entry Conditions: None

Operation: When executed, the CO-OP 41 prompts for the distance that the rod man should be at.

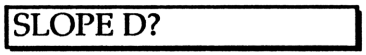
```
DIST?
```

After you have keyed this in the CO-OP 41 displays a scrolling prompt for the distance to the rod man.

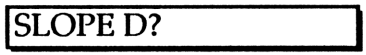


H DIST? This display is prompting for the horizontal distance to the rod man.

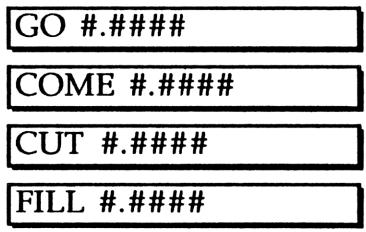
VERT∠? This display is prompting for the vertical angle to the rod man. If you enter this value, the CO-OP 41 prompts for the slope distance to the rod man.



ZENITH∠? This display is prompting for the zenith angle to the rod man point. If you enter this value, the CO-OP 41 prompts for the slope distance to the rod man.



When one of the above has been keyed in, the CO-OP 41 displays the GO or COME distance, and, if working with elevation, the CUT or FILL distance (press [R/S] to view the next information).



The program then loops back so that you can stake out another point.

STORE

Name: Store Point

Purpose: Used to store the currently occupied point data into the job file.

Keystrokes: ☐ [STORE]

Entry Conditions: The occupied point registers (the first four registers) must contain the point information to be stored. The current point number register (register 5) must contain the point number to be stored to.

Operation: When executed, the CO-OP 41 takes the information from the first four registers (the occupied point data) and stores it to the point specified by register 5 (the register containing the occupied point number). This can be used to key in coordinates and point numbers, or to manually change an old point.

SUN

Name: Sun Shot

Purpose: Determine the azimuth of a line by using the sun shot method.

WARNING!: USE A SUN FILTER

Keystrokes: [XEQ] [ALPHA] SUN [ALPHA]

Entry Conditions: If you want the HP-41 to automatically record the time (preferred) then you must set the Greenwich Meridian Time (GMT) and date in your HP-41CX, or HP-41CV with time module (see the HP-41 Owner's Manual for setting time).

If you want the SUN program to display the grid azimuth, then you must have stored the grid constants by running the GRID function (see GRID for more details).

Operation: The azimuth of a line, connecting two points on the earth's surface, can be determined by setting up a theodolite over one of these points and measuring the horizontal angle between the line and the sun, and using the precise time to determine the azimuth of the sun. This is what the sun shot program accomplishes.

Several items should be taken into consideration when choosing the station and second sighting point. These are:

1) There should be easy access to the station.

2) Must be able to determine the station's position on earth.

3) Must have a stable setup.

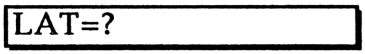
4) The second point should be 500 feet away or more (short distances make centering of the instrument critical). Marks several miles away are excellent, but they might not be visible all the time.

5) The observation should be made when the sun has an altitude less than 45 degrees. Lower altitudes are preferred.

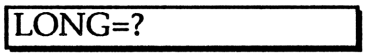
When you execute the function, the CO-OP 41 prompts for the date.

If you have the time and date of the Greenwich Meridian set in the HP-41, then press [R/S]. Otherwise you will have to key in the correct Greenwich Meridian date.

The CO-OP 41 prompts for your latitude.

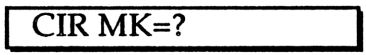


After your latitude is keyed in, the CO-OP 41 prompts for the longitude.

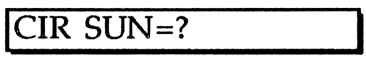


The CO-OP 41 now displays a scroll menu allowing you to select whether you are sighting on the center of the sun, or using the trailing edge.

Then, the CO-OP 41 prompts for the circular reading to the backsight.



Then, the CO-OP 41 prompts for the circular reading to either the center or trailing edge of the sun, whichever one you are using.



Position the vertical cross-hair a little ahead of where you want to take the reading–trailing edge or center. At this point, key in the circle reading. The display shows:

```
GMT
```

(If you are using an HP41CV but do not have a timer module, enter the Greenwich time here.) At the instant the vertical cross-hair is coincident with the chosen position on the sun, (trailing edge or center) press the [R/S] key. If you did not enter the grid constants, then the CO-OP 41 displays the astronomical azimuth.

```
A AZ=#.####
```

If you did enter the grid constants, then the CO-OP 41 will display the grid azimuth.

```
G AZ=#.####
```

Remarks: Accurate Greenwich Meridian Time is required. It is a good idea to check the time in the morning before you go out. Refer to the HP-41CX Manual, pp 60-65.

Accurate time can be obtained from the following sources:

- Realistic Timekube from Radio Shack. (5, 10, & 15 Mhz)
- Call 1-900-410-8463 (Time)
- Time is broadcast from Hawaii, and Fort Collins Colorado, 24 hours daily on 5, 10, 15, and 20 Mhz.

You may repeat the sun shot several times and then execute the AV function for an average reading. Subsequent sun shots can be taken by pressing the [R/S] key after viewing the azimuth angle. If you want to invert the scope and re-shoot the backsight, key in [XEQ] [ALPHA] [ ] [C] [ALPHA].

TCY

Name: Total Cubic Yard

Purpose: Computes and displays the total cubic yards contained in two cross sections.

Keystrokes: [XEQ] [ALPHA] TCY [ALPHA]

Entry Conditions : Must be used after a running a series of calculations using the CY function. Totals the results of the CY calculations.

Operation: When executed, the CO-OP 41 calculates the total cubic yards of several CY calculations and displays the total. The total is cleared by selecting ZERO TOTAL from the initial scrolling menu of the CY function.

TDC

Name: To Data Collector

Purpose: Allows the transfer of a file from the HP-41's extended memory to the CO-OP 41's memory.

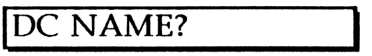
Keystrokes: [XEQ] [ALPHA] TDC [ALPHA]

Entry Conditions: None

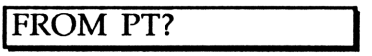
Operation: When executed, the CO-OP 41 prompts for the job file name stored in the HP-41's extended memory that you want to transfer.

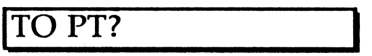
```
HP-41 NAME?
```

The CO-OP 41 then prompts for the name to store the job file under in the CO-OP 41's memory.



Next the CO-OP 41 prompts for the range of points to transfer from the HP-41's file to the CO-OP 41's file.





TFR

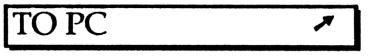
Name: Transfer

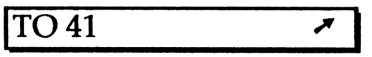
Purpose: Allows the transfer of job files and raw data files between the CO-OP 41 and a personal computer.

Keystrokes: [XEQ] [ALPHA] TFR [ALPHA]

Entry Conditions: None

Operation: When executed the CO-OP 41 displays a scroll menu, allowing the selection of which way the file transfer is to go.

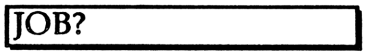




TO PC ↗ This selects file transfer from the CO-OP 41 to the PC.

TO 41 ↗ This selects file transfer from the PC to the CO-OP 41.

When the selection is made, the CO-OP 41 prompts for the file name to either store the data to, or to send from. It has the currently selected job as the default file.



You may key in a different job name if you want to transfer a job file which is not the current job file.

Remarks: This sets the serial interface to 9600 baud, no parity, 8 data bits, and 1 stop bit.

TFRM

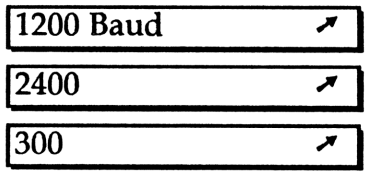
Name: Transfer Over Modem

Purpose: Allows the transfer of job files between the CO-OP 41 and a personal computer.

Keystrokes: [XEQ] [ALPHA] TFRM [ALPHA]

Entry Conditions: The CO-OP 41 should be connected to a modem via the serial port.

Operation: When this function is executed, the CO-OP 41 displays a scroll menu allowing the selection of the baud rate to use:



When one of these is selected, the CO-OP 41 displays the following prompt:

```
R/S OR CMD?
```

At this point, you may key in a command to send to the modem. For example you can enter ATA to answer the phone; check your modem's manual for details. Or you can press [R/S] and the function enters the TFR program (see TFR for details.) If you enter a command, the CO-OP 41 again displays the prompt to enter a modem command or to continue.

THP

Name: To HP

Purpose: Allows the transfer of an old job file from the Data Collector's memory to the HP-41's extended memory.

Keystrokes: [XEQ] [ALPHA] THP [ALPHA]

Entry Conditions: None

Operation: When executed the CO-OP 41 prompts for the file name in the Data Collector's memory that is to be transferred to the HP-41's extended memory.

```
DC NAME?
```

The CO-OP 41 then prompts for the file name to store the file under in the HP-41's extended memory.

```
HP-41 NAME?
```

Next the CO-OP 41 prompts for the range of point numbers to transfer from the CO-OP 41's memory to the HP-41's.

```
FROM PT?
```

```
TO PT?
```

TRA

Name: Utility Traverse

Purpose: Allows the entry of a traverse into the data collector, carrying perimeter and acreage information but not storing the new point numbers. This is only two dimensional.

Keystrokes: ☐ TRA

Entry Conditions: None

Operation: When this function is executed, the CO-OP 41 prompts for the azimuth that you want to move along.

```
AZIMUTH?
```

When the azimuth is keyed in, the CO-OP 41 prompts for the horizontal distance of the traverse.

```
H DIST?
```

Once this is keyed in, the CO-OP 41 updates the acreage and perimeter information and occupies the new coordinate position. However, it will not store the calculated coordinate data.

TRASTO

Name: Traverse Store

Purpose: Allows the quick entry of a two dimensional traverse point, carrying acreage and perimeter information and occupying the new point and storing the coordinate data.

Keystrokes: [XEQ] [ALPHA] TRASTO [ALPHA]

Entry Conditions: None

Operation: When this function is executed, the CO-OP 41 prompts for the azimuth that you want to move along.

```
AZIMUTH?
```

When the azimuth is keyed in, the CO-OP 41 prompts for the horizontal distance of the traverse.

```
H DIST?
```

Once this is keyed in, the CO-OP 41 updates the acreage and perimeter information and occupies the new coordinate position. It then stores the calculated coordinate data to the next point number.

TRAVRS

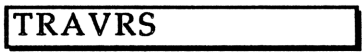
Name: Traverse

Purpose: Allows the entry of a traverse point into the CO-OP 41 carrying the acreage and perimeter information and storing the new point number.

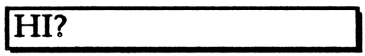
Keystrokes: [ ] [TRAVRS]

Entry Conditions: None

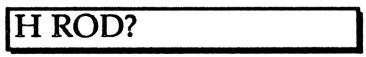
Operation: When executed, the CO-OP 41 shows that it is doing a traverse.



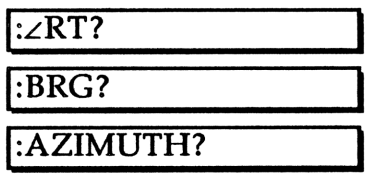
If you are working with elevation, the CO-OP 41 prompts for the height of the instrument.



After you key in this information, the CO-OP 41 prompts for the height of the rod.



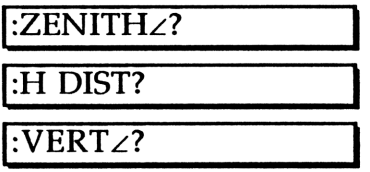
The CO-OP 41 then asks for the angle information of the traverse.



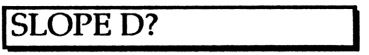
∠RT? Prompts for the angle right reading of the traverse. To read an angle right the back sight must be set.

BRG? Prompts for the bearing angle of the traverse. See the section titled: *Keying in Bearings* for information on how to enter this.

AZIMUTH? Prompts for the azimuth of the traverse. Key in the appropriate value. The CO-OP 41 then prompts for the distance information.



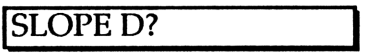
ZENITH∠? Prompts for the zenith angle to the traverse point. If you enter this value, the CO-OP 41 prompts for the slope distance to the point.



When you key in the slope distance, the CO-OP 41 automatically converts it to a horizontal distance in order to compute the coordinates of the traverse point.

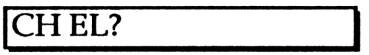
H DIST? Prompts for the horizontal distance to the traverse point.

VERT∠? Prompts for the vertical angle to the traverse point. If you enter this value, the CO-OP 41 prompts for the slope distance to the point.



When you key in the slope distance, the CO-OP 41 automatically converts it to a horizontal distance in order to compute the coordinates of the traverse point.

If you are working with elevation, the CO-OP 41 prompts for the change in elevation from the currently occupied point to the traverse point.



The CH EL? prompt shows only if elevation is on and a horizontal distance was entered instead of a slope distance. If you are working with notes, the CO-OP 41 prompts for the descriptive note.

```
DESC?
```

After all of the information has been keyed, in the CO-OP 41 stores the information in the next consecutive point number. The CO-OP 41 then displays the next point number it is storing to.

```
#.####
```

Finally, it loops back to the initial display and prompts so that another traverse can be entered without having to execute the function again.

Remarks: Any function that recalls the coordinates of a point alters the next point number. Use the NEXT NO function to set the correct next point number.

TS

Name: Time Stamp

Purpose: Puts a time stamp in the raw data file.

Keystrokes: [XEQ] [ALPHA] TS [ALPHA]

Entry Conditions: Need an HP-41CV with a time module, or an HP-41CX.

Operation: When executed the CO-OP 41 gets the date and time from the time module (this is built into the HP-41CX) and saves the date and time to the RAW data file. If RAW data is turned off then this function does nothing.

VSLOP

Name: Vertical Slope

Purpose: Converts a vertical angle and slope distance into a horizontal distance.

Keystrokes: [XEQ] [ALPHA] VSLOP [ALPHA]

Entry Conditions: None

Operation: When this function is executed, the CO-OP 41 prompts for the vertical angle.

```
VERT∠?
```

When the above information is keyed in, the CO-OP 41 prompts for the slope distance.

```
SLOPE D?
```

When the slope distance has been keyed in, the CO-OP 41 calculates and displays the horizontal distance.

```
H DIST=#.####
```

W

Name: Windings

Purpose: Allows the user to make a series of windings (angles right) for each traverse or side shot, and average out the readings.

Keystrokes: [XEQ] [ALPHA] W [ALPHA]

Entry Conditions: None

Operation: This function is used in conjunction with the angle right prompt (∠RT?) in side shot and traverse functions. When executed, it prompts for the number of sets.

```
SETS?
```

This is the number of times that you want to take angle right readings for each side shot or traverse for the purposes of averaging. Next the CO-OP 41 will prompt for the average error in seconds.

```
AVG ERR SEC?
```

This is prompting for the average error (in seconds), for each angle right reading, that is acceptable.

See CO-OP 41 User's Manual for example.

ZS

Name: Zenith and Slope No Earth Curve

Purpose: Convert a zenith angle and slope distance into a horizontal distance without taking into account the earth's curvature.

Keystrokes: [XEQ] [ALPHA] ZS [ALPHA]

Entry Conditions: None

Operation: When executed, the CO-OP 41 prompts for the zenith angle.

```
ZENITH∠?
```

When you have keyed in the zenith angle, the CO-OP 41 prompts for the slope distance.

```
SLOPE D?
```

When you have keyed in the slope distance, the CO-OP 41 displays the calculated horizontal distance. Note that, for this function, the CO-OP 41 does not take into account the curvature of the earth.

```
H DIST=#.####
```

ZSLOP

Name: Zenith and Slope With Earth Curve

Purpose: Convert a zenith angle and slope distance into a horizontal distance, taking into account the earth's curvature.

Keystrokes: ☐ [ZSLOP]

Entry Conditions: None

Operation: When executed, the CO-OP 41 prompts for the zenith angle.

```
ZENITH∠?
```

After keying in the zenith angle, the CO-OP 41 prompts for the slope distance.

```
SLOPE D?
```

When the above is keyed in, the CO-OP 41 displays the calculated horizontal distance, having taken into account the curvature of the earth.

```
H DIST=#.####
```

Appendix - A

Mass Storage Operations

If you are going to be using a mass storage device, then there are a couple more functions to be aware of. Below is a short description of the functions that you will need to operate a mass storage device. These are described in detail in the Hewlett-Packard HP-IL Owner's Manual.

DIR

Name: Directory

Purpose: Sequentially displays the files stored on the mass storage device.

Keystrokes: [XEQ] [ALPHA] DIR [ALPHA]

Entry Conditions: A mass storage device must be connected to the CO-OP 41, and turned on. An initialized cassette or disk must be in the mass storage device.

Operation: When executed, the CO-OP 41 sequentially displays all the files stored on the mass storage device. You can stop the directory listing by pressing [R/S].

NEWM

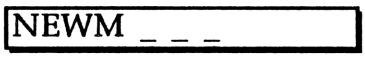
Name: New Medium

Purpose: Initializes the mass storage medium.

Keystrokes: [XEQ] [ALPHA] NEWM [ALPHA]

Entry Conditions: A mass storage device must be connected to the CO-OP 41 via HP-IL, and must be turned on. An un-initialized disk or cassette must be in the mass storage device.

Operation: Before a disk or casette can be used with a mass storage device, it must be initialized (this only needs to be done once for any disk or cassette). When executed the CO-OP 41 prompts for the number of files that you want to be able to store on the mass storage device.



Key in the number from 1 to 447 (200 is usually a good choice). Type in the number as a three digit number. Thus, to enter a 1 key in 001. When you key in the last number, the CO-OP 41 automatically initializes the mass storage medium.

PURGE

Name: Purge

Purpose: Removes a file from the mass storage device.

Keystrokes: [XEQ] [ALPHA] PURGE [ALPHA]

Entry Conditions: A mass storage device must be connected to the CO-OP 41, and turned on. An initialized cassette or disk must be in the mass storage device. The name of the file to be purged (removed) must be in the ALPHA register.

Operation: Type the name of the file that you wish to delete into the ALPHA register. When you execute this function, the CO-OP 41 deletes the file from the mass storage device

Appendix - B

CO-OP Program Flags

F-00: When set the traverse direction is reversed.

F-01: Local (used by plotter module)

F-02 - Raw data ON flag

F-03: If flag 3 is set, the surveying functions works with elevations as well as North and East coordinates.

F-04: If flag 4 is set, the surveying functions works with notes.

F-05: If flag 5 is set, the output for the traverse and inverse programs is non-prompted. Setting flag 5 speeds up inverse computations.

F-06: If flag 6 is set, and flags 5 and 7 are clear, the output for the traverse and inverse programs is prompted and is in bearings and distance, only (no azimuth).

F-07: If flag 7 is set, and flag 5 is clear, the output for the traverse and inverse programs is prompted and is in azimuth and distance, only (no bearings). If flags 5, 6, and 7 are clear, the output is prompted and is in bearings, azimuths, and distances. Flag 07 must be set if you use the top mounted EDM and sight the prism with the theodolite. The offset must also be stored in register 17, otherwise register 17 should be clear (0).

F-08: If flag 8 is set, the slope reduction programs convert input in meters to output in feet.

F-09: If flag 9 is clear, and a point is already stored, when we try to store another point in the same point number, the HP-41 beeps and prompts "PT USED" (R/S overrides this protection and stores the new point anyway, erasing the old point). If Flag 9 is set, there is no beep and no prompt. The new point is automatically stored and the old point erased.

F-10: used locally

F-11: used locally

F-12: used locally

F-13: used locally

F-14: used locally

F-15: used locally

F-16: Auto mode of PTRA.

F-17: LF flag

F-18: scratch

F-19: Side shot/Traverse flag

Appendix - C

CO-OP Program Registers

The system uses registers R00-R79 for system parameters, so do not use these registers in any of your programs. Registers R80 to R200 are used by the random point file. To increase the random point file to it's maximum size, execute the SIZE function and enter 290 for the SIZE. The key assignment routines use 22 registers, that leaves 97 registers available for your program use.

R-00: For indirect access of RDMPTS file.

R-01: North coordinate of occupied point.

R-02: East coordinate of occupied point.

R-03: Elevation of occupied point.

R-04: Note or description of occupied point.

R-05: Point number of occupied point.

R-06: Last azimuth traversed or last North recalled.

R-07: Last distance (horizontal) traversed or last east recalled or last horizontal distance reduced.

R-08: Change in elevation after a slope reduction. Last elevation recalled.

R-09: Note or description of side-shot or of last point recalled. Active only when working with notes (flag 4 set).

R-10: Point number of last side-shot point or last point recalled.

R-11: temporary point number buffer.

R-12: temporary point number buffer.

R-13: temporary point number buffer.

R-14: temporary point number buffer.

R-15: temporary point number buffer.

R-16: Elevation after "ZSLOP" (occupied point elevation should be in register 03 and difference in HI & H of Rod in register 24.

R-17: Place offset constant in this register when working with top mounted EDM. Flag 01 should be set also when you are doing slop reductions with a top mounted EDM. Otherwise, register should have "0" stored in it.

R-18: Point number offset constant. If your point numbering starts with "1", this register should have "0" stored in it. If you have saved 300 points & want to start numbering with 301, then you store 300 in register 18.

R-19: Local.

R-20: Indirect program access register for "NEXTNO".

R-21: Indirect program access register for "SIDS" & "TRAVRS".

R-22: Indirect program access register for Angle options.

R-23: Indirect program access register for Zenith angle, Vertical angle, horizontal distance options.

R-24: Indirect program access register for "NOTE" option.

R-25: Height of the instrument.

R-26: Indirect program access register for CH EL, EL option.

R-27: Raw data file name.

R-28: save user flags 0-7.

R-29: Not used.

R-30: Rod height.

R-31: Lines of memory used per point.

R-32: Degree character code.

R-33: Pen speed.

R-34: Back azimuth.

R-35: Error margin for winding.

R-36: Scratch.

R-37: Scratch.

R-38: Perimeter.

R-39: Square feet.

R-40: Used for computing acreage.

R-41: Constant for meteorological correction.

R-42: Constant (layout, rotation).

R-43: Multiples of 360 for winding angles right (Sets).

R-44: Perpendicular offset.

R-45: Perpendicular offset.

R-46: Not used.

R-47: Not used.

R-48: Local.

R-49: Indirect program access register for taking measurement from instrument.

R-50: Current work file name.

R-51: Local.

R-52: Local.

R-53: Local.

R-54: Local.

R-55: Local.

R-56: Local.

R-57: Plotter scale factor.

R-58: Letter size.

R-59: Local

R-60: Local

R-61: Low North. Changed by move job.

R-62: Low East. Changed by move job.

R-63: Local.

R-64: Local.

R-65: Local.

R-66: Local.

R-67: Local.

R-68: State plane C. constant.

R-69: State plane Z. constant.

R-70: Text file name.

R-71: Local.

R-72: Local.

R-73: Local.

R-74: Local.

R-75: Local.

R-76: Local.

R-77: Local.

R-78: Local.

R-79: Marker character (circular or dot).

Appendix - D

Error Messages

END OF FILE

DUP FL (SRDM)

FILE EXISTS

FL NOT FOUND

FL TYPE ERR

PT TOO BIG

PT TOO SMALL

PT USED

    OVR WRT ^

    NEW PT NO ^

R TOO SMALL (CURVE)

Appendix- E

Transverse Mercator Zones

Central Meridians of State Plane Coordinates

STATE	ZONE	C.M.	STATE	ZONE	C.M.
Alabama	E	85 50	Maine	E	68 30
	W	87 30		W	70 10
Alaska	2	142 00	Michigan	E	83 40
	3	146 00	(1934)	C	85 45
	4	150 00		W	88 45
	5	154 00			
	6	158 00	Mississippi	E	88 50
	7	162 00		W	90 20
	8	166 00			
	9	170 00	Missouri	E	90 30
				C	92 30
Arizona	E	110 10		W	94 30
	C	111 55			
	W	113 45	Nevada	E	115 35
				C	116 40
Delaware		75 25		W	118 35
Florida	E	81 00	New Hampshire		71 40
	W	82 00	New Jersey		74 40

Georgia	E	82 10
	W	84 10
Hawaii	1	155 30
	2	156 40
	3	158 00
	4	159 30
	5	160 10
Idaho	E	112 10
	C	114 00
	W	115 45
Illinois	E	88 20
	W	90 10
Indiana	E	85 40
	W	87 05
New Mexico	E	104 20
	C	106 15
	W	107 50
New York	E	74 20
	C	76 35
	W	78 35
Rhode Is.		71 30
Vermont		72 30
Wyoming	1	105 10
	2	107 20
	3	108 45
	4	110 05

Appendix - F

Lambert Zones

Central Meridians and

Zone Constants for State Plane Coordinates

N = North
S = South
C = Central
M = Mainland

NC = North Central
SC = South Central
I = Island
O = Offshore

STATE	ZONE	CENTRAL LONGITUDE	LATITUDINAL CONSTANT
Arkansas	N	92 00	0.581899
	S	92 00	0.559691
California	1	122 00	0.653884
	2	122 00	0.630468
	3	120 30	0.612232
	4	119 00	0.596587
	5	118 00	0.570012
	6	116 15	0.549518
	7	118 20	0.561243
Colorado	N	105 30	0.646133
	C	105 30	0.630690
	S	105 30	0.613378
Connecticut		72 45	0.663059

Florida	N	84 30	0.502526
Iowa	N	93 30	0.677745
	S	93 30	0.658701
Kansas	N	98 00	0.632715
	S	98 30	0.614528
Kentucky	N	84 15	0.622067
	S	85 45	0.606462
Louisiana	N	92 30	0.528701
	S	91 20	0.500013
	O	8	0.454007
Maryland		77 00	0.627634
Massachusetts	M	71 30	0.671729
	I	70 30	0.661095
Michigan	N	87 00	0.722790
	C	84 20	0.706407
	S	84 20	0.680529
Minnesota	N	93 06	0.741220
	C	94 15	0.723388
	S	94 00	0.700928
Montana	N	109 30	0.746452
	C	109 30	0.733354
	S	109 30	0.714901
Nebraska	N	100 00	0.673451
	S	99 30	0.656076
New York (Long Island)		74 00	0.654082

North Carolina		79 00	0.577171
North Dakota	N	100 30	0.744133
	S	100 30	0.729383
Ohio	N	82 30	0.656950
	S	82 30	0.634520
Oklahoma	N	98 00	0.590147
	S	98 00	0.567617
Oregon	N	120 30	0.709186
	S	120 30	0.684147
Pennsylvania	N	77 45	0.661540
	S	77 45	0.648793
South Carolina	N	81 00	0.564497
	S	81 00	0.544652
South Dakota	N	100 00	0.707738
	S	100 20	0.689852
Tennessee		86 00	0.585440
Texas	N	101 30	0.579536
	NC	97 30	0.545394
	C	100 20	0.515059
	SC	99 00	0.489913
	S	98 30	0.454007
Utah	N	111 30	0.659355
	C	111 30	0.640579
	S	111 30	0.612687

Virginia	N	78 30	0.624118
	S	78 30	0.606925
Washington	N	120 50	0.744520
	S	120 30	0.726396
West Virginia	N	79 30	0.637773
	S	81 00	0.618195
Wisconsin	N	90 00	0.721371
	C	90 00	0.705577
	S	90 00	0.687103

Functions by Group

CONVERSION FUNCTIONS

∠LT	Angle left. Converts angles left to azimuths. **Page 14.**
∠RT	Angle Right. Converts angles right to azimuths. **Page 15.**
ATB	Converts azimuths to bearings. Formats the bearing output. **Page 22.**
BTA	Bearing to Azimuth. Conversion function for a bearing into an azimuth with formatted output. **Page 30.**
DEF-LT	Converts deflections left to azimuths. Must be occupying a point with a back sight stored. **Page 44.**
DEF-RT	Converts deflections right to azimuths. Must be occupying a point with a back sight stored. **Page 45**
N-E	Converts bearings in the 1st quadrant (NE) to azimuths. **Page 62.**
N-W	Converts bearings in the 4th quadrant (NW) to azimuths. **Page 63.**
S-E	Converts bearings in the 2nd quadrant (SE) to azimuths. **Page 89.**
S-W	Converts bearings in the 3rd quadrant (SW) to azimuths. **Page 90.**

VSLOP — Vertical angle and slope distance. Returns horizontal distance. **Page 112.**

ZS — Converts zenith angle and slope distance to horizontal distance with no correction for earth curve. **Page 113.**

ZSLOP — Zenith and Slope. Converts zenith angle and slope distance to horizontal distance corrected for curvature of the earth. **Page 114.**

COORDINATE GEOMETRY

ACRES — Computes the area of a closed traverse. Requires a completed traverse. **Page 21.**

AUTO — Automatic Traverse. Traverses using points in the Random Point File. Computes area and perimeter. **Page 23**

COORST — Stores point. Prompts for coordinates. **Page 31.**

COORTR — Coordinate Traverse. Traverse to a set of coordinates. **Page 32.**

CX — Transform. Allows the translation, rotation and scaling of a group of points. **Page 37.**

INVERS — Inverse from occupied point to coordinates. **Page 53.**

OFFSET — Centerline offset. Creates offset points to points specified in the random point file. **Page 65.**

PERPO — Perpendicular Offset. Computes perpendicular offset of a point from a line. **Page 68.**

PINV — Computes the direction and distance from the occupied point to any other point in the file. **Page 69.**

PPTS — Print points. Prints (on an attached HP-IL printer) the requested range of point numbers and coordinates. **Page 69.**

PREA — Pre-determined area. Rotates one side of a trapezoid. **Page 71.**

PREASL — Pre-determined area using parallel sides of a trapezoid. **Page 73**

PTDIR — Point in direction. Stores a new point using a specified distance and direction. **Page 76.**

PTOP — Computes the azimuth, bearing, and distance between two points. **Page 76.**

PTRA — Point Traverse. Traverse by points number. Computes acreage and perimeter. **Page 77.**

PTRCL — Recalls the point specified in the X-register. **Page 78.**

REP — Repeats the last call and stores another point. **Page 84.**

STORE — Creates a new occupied point in the job file using data in registers 01 through 05 as the point elements. **Page 99.**

TRA	Traverse. Traverses using azimuth and distance. Doesn't store points. **Page 107.**

CURVE FUNCTIONS

3P	Prompts for 3 known points on a circle perimeter. **Page 13.**
IC	Prompts for delta and chord. **Page 50.**
ID	Prompts for delta and degree of curve. **Page 51.**
IE	Prompts for the delta and external. **Page 52.**
IP	Prompts for delta and center point. **Page 53.**
IR	Prompts for delta and radius. **Page 54.**
IT	Prompts for delta and tangent. **Page 55.**
LP	Prompts for arc length and center point. **Page 60.**
LR	Prompts for arc length and radius. **Page 61.**
RC	Prompts for radius and chord. **Page 82.**

EARTH WORK

CY	Calculates cubic yards after given a two of cross-sectional areas. **Page 40.**
ENDA	Calculates cross-sectional areas. **Page 47.**
TCY	Sums cubic yards calculated by CY. **Page 103.**

INITIALIZATION

CTR	Clear Top Row. Clears the top row of key assignments. **Page 36.**
EDM	Corrects for offset between top mount EDM and scope. **Page 46.**
GRID	Sets correction factor for determining grid north from a sunshot. **Page 49.**
K	Key assign and setup. Assigns functions to the correct keys and initializes the data collector. **Page 58.**
METER	Sets calculator to expect metric input. **Page 62.**
NEXTNO	Next number. Sets the next point number. The next point you create will get this number. **Page 63.**
NN	Next number prompting. Turns on or off prompting for next number. **Page 64.**
OUTPUT	Sets your preferences for output. **Page 67.**

INTERSECTION FUNCTIONS

BB	Bearing-Bearing intersection. Intersection function that prompts for two bearings. **Page 27.**
BD	Bearing Distance intersection. Prompts for a bearing and a distance. Has two solutions. **Page 28.**

DD	Distance-Distance intersect. Prompts for two distances. Has two solutions. **Page 42.**
PERPO	Perpendicular Offset. Computes perpendicular offset of a point from a line. Also computes long side or second leg of the triangle. **Page 68.**

JOB FILE FUNCTIONS

DELETE	Delete Job. Deletes a job file. **Page 45.**
FILE	Displays all job names in either HP-41 memory or data collector memory. Also used to select the destination for storing job files. **Page 48.**
JOBS	Starts a new job or opens an old job for editing. **Page 56.**
OLDJOB	Job select. Selects an existing job to work on, prompts for job name. **Page 66.**
TDC	To data collector. Transfers a file from HP-41 extended memory to data collector memory. **Page 103.**
THP	To HP. Transfers a file from data collector memory to HP-41 extended memory. **Page 106.**

MASS STORAGE

LOAD — Load job. Loads in the job file from mass storage. **Page 59.**

SAVE — Save job. Saves the job file to mass storage. **Page 90.**

RANDOM POINT FUNCTIONS

RDMPTS — Random point store. Creates a random point file to designate a line or boundary for calculations or for plotting. **Page 83.**

RDMRCL — Random point recall. Allows you to view your random points. **Page 84.**

RRDM — Recall random point file. Recalls a random point file. Prompts for file name. **Page 88.**

SRDM — Store random point file. Prompts for a file name and stores the RPF to memory. **Page 94.**

RAW DATA

NOTE — Note. Puts note into raw data file. **Page 64.**

PRAW — Prints raw data. **Page 71.**

TS — Time stamp. Puts a time stamp in the raw data file. **Page 111.**

SUN SHOT FUNCTIONS

AV	Averages sunshot results. **Page 24.**
GRID	Runs SUN function. First it prompts for grid north correction factor. **Page 49.**
SUN	Sunshot function. Prompts you through taking a sunshot to determine north. Uses factors set by GRID to correct to grid north for your location. **Page 99.**

SURVEYING FUNCTIONS

BACKS	Back sight. Stores a back azimuth. **Page 26.**
OCCUPY	Occupies the point specified in the X-register. **Page 65.**
R	Turns reversing on or off. **Page 79.**
REP	Repeats the last call and stores another point. **Page 84.**
RPSTK	Random instrument position stakeout. **Page 85.**
SIDES	Side shot store. Prompts for angle and horizontal distance values. Creates a side shot point. Does not move from the occupied point. **Page 91.**
SSSTO	Side shot store. Prompts for azimuth and horizontal distance. **Page 94.**

STAKE	Determines the angle right and distance for staking a point. Then allows you to enter your staking measurements. Determines "come" or "go" distances. **Page 95.**
STK	Staking function. Allows you to enter your staking measurements. Determines "come" or "go" distances. **Page 97.**
TRA	Traverse. Traverses using azimuth and distance. Doesn't store points. **Page 107.**
TRASTO	Traverse store. Prompts for azimuth and horizontal distance only. Stores a new point. **Page 107.**
TRAVRS	Traverse, prompted version. Prompts for point elements and creates a traverse point. Occupies new point and carries acreage and perimeter. **Page 108.**
W	Windings. Multiple angle measuring. **Page 112.**

TRANSFER FUNCTIONS

TFR	Transfer. Transfers files to and from a PC. **Page 104.**
TFRM	Modem transfer. Transfer files with modems. **Page 105.**

TRAVERSE ADJUSTMENT

AA	Angle adjustment. Adjusts the angles in a traverse. **Page 16**

CR	Compass rule. **Page 33.**
CRIS	Compass rule including side shots. **Page 35.**
PREC	Precision of traverse. **Page 75.**

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