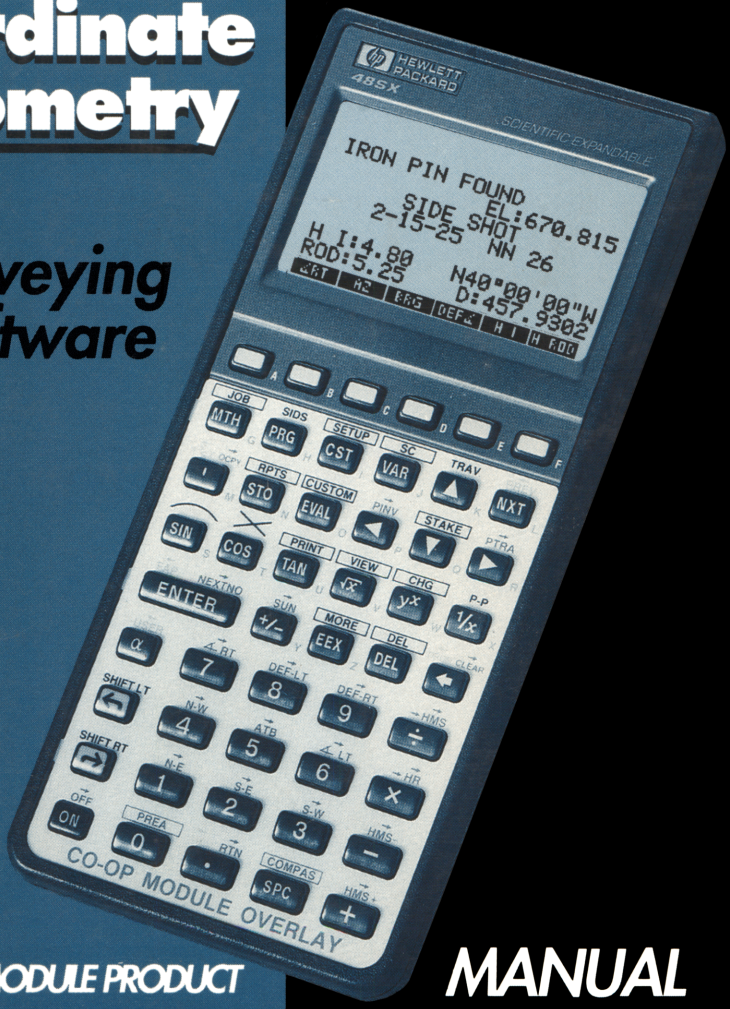
S.M.I.

48AC

Advanced Coordinate Geometry

Surveying Software



A CO-OP MODULE PRODUCT

MANUAL

CO-OP 48AC

Manual

Surveyors Module Inc.
OCT 1990

CO-OP 48AC
ADVANCED COGO

SOFTWARE FOR SURVEYORS

for use with

THE HP 48SX
SCIENTIFIC EXPANDABLE
HAND HELD CALCULATOR/COMPUTER

by

Stanley and Kenneth Trent

Hardin and Patty Egerton

Thank you for purchasing our software package. This manual and the software it describes has been produced with great effort by SMI. Based upon the axiom that "Man and all of his works are fallible, and subject to corruption and deterioration", we present these products to you on an "as is" basis. SMI cannot be liable for errors produced, or incidental or consequential damages resulting from the use of this manual or hardware or software associated with this or any of our products. The copying of our software is forbidden by SMI and by the law.

TABLE OF CONTENTS

The software that this manual describes represents tens of thousands of man-hours of work and hundreds of thousands of dollars. We hope you will appreciate the effort. You are literally paying a minute percent of the total cost of producing the product you are enjoying. I have worked over 10 years in the evolutionary development of this product.

I would like to express great appreciation to my son Kenneth who has been very valiant in learning the language of the HP 28 and HP 48 and transferring the programs from the CO-OP 41 Survey system to this CO-OP 48 package. We have made many enhancements that were not possible in the 41. We have also made some improvements that we recognized should have been done on the 41.

Thanks to Sherry Emmert our office secretary who has worked hard and provided a pleasant attitude for us and our customers. A special thanks to Hardin and Patty Egerton who have taken valuable time from their survey business and helped with consultation, manual writing and testing.

I owe much of the success of this project to the support of my loving wife Clyda. She has kept things going at home with our eleven children. My children have also been supportive and helped whenever they could. I would also like to thank the 32 stockholders in this company. They have expressed their confidence by their actions. They have been very supportive.

We would like to thank you for using and loving our

products. To hear words like "It's a dream", "It's the best software I have had in my hand", "It has been worth what I paid for it many times over", "It's the best I have seen", and to hear comments like that several times a day certainly is music to my ears. You have been great. The response of the surveying community with the CO-OP 41 software has been overwhelming to me. Hundreds of you have told us how very beneficial the software has been to you. It is my feeling that we have had 98% satisfaction. The number one thing you have told us is that it is easy to use. We are keeping that as number 1 on the goals list as we develop new software. We have been listening to you and have appreciated your suggestions. We think you will find many of your requests incorporated in this package.

Stanley Trent

Items you should have received with the 48AC package:

A CO-OP 48 surveying card
A CO-OP Module overlay

Chapter 1

Becoming familiar with

The HP 48SX

*Note: Some illustrations and functions (especially **Soft Key Menus**) mentioned in this chapter will be defined in chapter 2.*

About the 48SX

The HP 48SX is both a calculator and a computer. This super calculator has a 256K operating system with an infinite stack, instead of the normal four register stack of the HP41, an eight line by 22 character display, and computational accuracy to 11 significant digits.

Turning it on

After a little diligent searching, you will find the [ON] key in the bottom left corner of the keypad under the two colored shift keys. To turn it on press [ON] firmly. To turn it off press [→] (SHIFT RIGHT), and press [ON].

Two shift keys

The HP 48SX has two shift keys. They are just above the ON key. Press the blue [→] (SHIFT RIGHT) key. When this key is pressed you will see at the top of the display window an arrow to the right. Press it again and the arrow in the display disappears. Press the orange [←] (SHIFT LEFT) key. You will see an arrow to the left appear at the top of the display window. Press it again and the arrow will disappear. These two keys will activate the functions on the keyboard which match their colors.

Use SHIFT to Turn USER on and off:

The benefit of user is that when keys are assigned by the user or by a program, the keys use these "user defined" functions when user is on. When user is off the normal keyboard is active. In chapter 2 "Introduction to CO-OP 48AC software" user will be normally on. When the user keyboard is assigned using K the CO-OP MODULE OVERLAY is active. Here we will just show you how to turn user on or off. [←] [USR] [←] [USR] (USER) (just below ENTER). Turn user off. Press [←] [USR].

Use ALPHA for alphanumeric entry:

Now turn alpha on. Press [α] [α]* *(Just below ENTER). Now key in these letters: Press A B C (top row). You should see ABC displayed.*

Use [↰] *for lower case letters:*

Now press [↰] *A,* [↰] *B,* [↰] *C. You will see ABCabc. Now use* [↱] *A,* [↱] *B, and* [↱] *C. You now see the Greek letters. To clear the display press* [⌫].

The stack display

We will be referring to the stack display in this manual. Our PC software allows us to send the HP 48 display to the PC for printing. Throughout this manual we will be showing you actual displays from the 48. Here is the stack display:

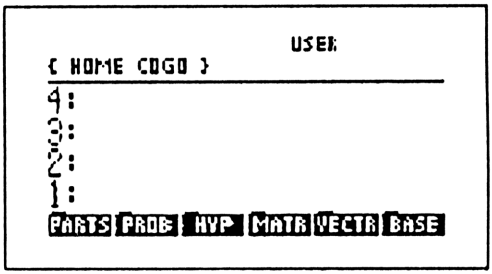


Figure 1 MATH MENU

In the display to the right USER is on. You are in the HOME directory. No values are on the four displayed levels of the stack. Six of the more than 2100 functions are displayed as soft key items along the bottom of the display.

**The CO-OP overlay assignment program (Chapter 2) sets flags so that alpha or user is executed only once to turn them on or off.*

HP 48SX basics

Keys A through F are called Soft Keys. They access the functions that appear across the bottom of the display. In the manual they appear in a darkened box.
Example: FIX.

If you are familiar with HP's Reverse Polish Notation (RPN) stack format you will feel comfortable adding, subtracting, multiplying, and dividing on the 48.

If RPN is unfamiliar to you here is how to use the standard four functions:

Key in a number, press ENTER. *Key in another number, (pressing* ENTER *again is optional). Press any of the four function keys. +, -, X, or ÷. Once you have performed a function the result is on Level 1 of the stack display. You may key in another number and perform another operation. An operation that only takes one argument, like SIN, COS, TAN, or √ (square root), uses the value on Level 1 of the stack.*

Example: Take the square root of 16. Key in 16, and press √x *(it is the key with the x under a square root symbol at the letter V). You should get 4.*

Another example: Take the cosine of 30 degrees. Key in 30, and press COS. *It's at the T key. If you are in standard mode* you should get 0.866025403784. Is that accurate enough for your work? Let's hope so!!!*

**To put the 48 in standard mode press* ↰ MODES *(The I key)* STD *(the A key). To change back to fix 4, key in 4 and press* FIX.

We have shown you two ways to execute functions. If there are two arguments necessary to perform a function: Key in the first number and press ENTER. Key the second and press the function key. If only one argument is required to perform a function, key in the number and press the function key.

The HP-41 and certain other HP calculators have four automatic storage registers. Since the numbers are stacked on top of one another this is called stack memory.

The HP 48SX has an infinite stack.
The number of items that can be stacked is limited only by the memory of the 48. Key in a number and press ENTER. Key in another number and press ENTER. Do this until you get tired of entering numbers. Now press [+] several times and watch the numbers add together as they drop to the position to be added. On the 41 the stack registers are called X, Y, Z, and T. On the 48 the stack levels are identified by numbers: Level 1, Level 2, Level 3, etc. The 48 has functions allowing all of the items of the stack to be put on one level. If you key in numbers or other "objects" to the input line separated by spaces or commas, they can be separated and placed into separate objects on the stack. Unlike the 41, when alpha is on, not only are the alpha keys directly accessible, but the number keys are also directly accessible. That is, you don't need to press shift to put a number in alpha.

Executing functions in the 48SX

We have mentioned a couple of ways to execute functions that are assigned to the keys on the keyboard. We will now talk about other ways to execute functions on the 48:

1. Key in the data, press ENTER, press α (alpha) on. Key in the name of the function and press ENTER.

Example: Take the SIN of 30 degrees. Key in 30. Turn α (alpha) on. Key in the letters S I N. Press ENTER. You will see 0.5000

Note: This method is helpful if the function is not on a hard key, or soft key, or is not easy to find. If you haven't already executed the K program you may need to press α α (alpha twice.) so it will stay on.

2. If the function is on the keyboard, key in the value and press the key.

Note: ↱ (SHIFT RT) accesses the functions in blue over the key. ↰ (SHIFT LT) accesses the function in orange over the key.

Example: Use the ASIN key on the keyboard to compute the arc sine of 0.5. Key in .5, and press ↰ (SHIFT LT) ASIN. It's on the S key. You will see 30.000

Note: To find ASIN the CO-OP MODULE OVERLAY should be off. If K has been used to assign the keyboard USER should be off.

3. If the function is on a soft key menu key in the data and press the soft key (top row of keys) under the function. To find a soft key press a boxed function that represents the general category of the needed function. If you don't see the soft key name try pressing NXT (next). NXT displays the next set of soft keys. We call it the next "page" of soft keys.

Example: Set the fix point to 4 places past the decimal. Press ↰ MODES. (To find MODES the overlay should be off. MODES is over the I key.) Key in 4, and press the

soft key under [FIX]. Numbers currently on the stack and future numbers will be fixed to four places past the decimal. Refer to the 48 users manual for more details on these and some of the other 2100 functions that are built into the HP 48SX.

Where appropriate, SMI has made an effort to use conventions similar to those HP uses to execute functions. SMI adds approximately 300 functions to HP's list of over 2100 functions.

Clearing 48SX memory

Caution!!! The following operation will clear any data or programs stored in the internal memory of the 48! Save data and programs to the PC before clearing memory. Do not proceed unless you are willing to lose your currently stored data. Take the card(s) out before clearing memory.

To clear the memory of the 48SX:

Hold down the [ON] key, the A key and the F key, then release all. The display will say "Try To Recover Memory?". On the soft keys are displayed [YES] and [NO]. Press the soft key under [NO]. The display will say "Memory Clear".

Types of cards available for the 48SX

Memory cards called RAM (random access memory) are added to the 48 for increasing memory. These cards are purchased through HP distributors. They come in 32K or 128K sizes. Program cards are EPROM (Erasable Programmable Read Only Memory) or OTP (One Time Programmable). These cards have programs in them that are not affected by clearing the memory of the 48. These

also come in 32K and 128K sizes. K refers to the number of bytes of memory. Thirty two K is 32,000 bytes. One character is one byte.

Memory cards for the 48SX

The 48SX comes with the 32K of internal memory. This allows up to 1200 north, and east coordinate pairs to be stored without additional memory. Adding a 32K memory card gives another 1200 points (2400 total).

Maximum point storage 6,000 points

To get the maximum point storage at one time while the CO-OP 48 survey card is installed, use a 128K card. This gives you over 6,000 points. The number of points you can store will be reduced by approximately one third if you work with elevations or notes. The number of points that can be stored will be reduced by approximately one half. You work with both elevations and notes.

Installing a card

Before removing or installing cards in the 48, be sure calculator is turned off (↱ ON). Remove the plastic cover from the top of the calculator. Slide the card in either of the two ports with the tab facing you and replace plastic cover. When you turn the calculator on, the stack will be cleared and you will be in the HOME directory. If you have a memory card that you want to use with the CO-OP 48 software, you should put the software card in the port closest to the calculator and the memory card in the other port.

To merge, or not to merge.
When memory card data is not merged with internal memory: When the memory of the calculator is full, you can back up the data to an unmerged card, delete it from internal memory, fill the HP 48SX memory with data again, and store the data to the card until it is full. You can then insert a new card for renewed storage. In this way you are only limited in memory by the number of cards that you have. After a time this could start getting expensive. In fact, even though you may not now own a PC, you might find that the purchase of an inexpensive PC would be the less expensive than buying memory cards for job storage.

When memory cards are merged with 48SX memory: The CO-OP SOFTWARE allows the use of HP 48 memory without any memory cards. If you have a memory card you may merge its memory with the memory of the 48. This way you can have lots of active memory in the 48 (up to 160K which is over 6,000 points). This still leaves room for your program card. You should periodically back up your memory to the PC. It is a good practice to do this daily.

Keep your jobs in the 48SX for quick access
When you download to the PC you need not necessarily delete the job from your 48. In fact you may want to keep several active jobs in the 48 at one time even though they are backed up on the PC. This would allow you to go to the job at a moments notice without going to the PC to download the job file.

Merging card memory with the 48SX memory

Turn the calculator on and press ↰ MEMORY *(J)* NXT NXT 2 MERG. *The memory of the card is now part of the memory of the calculator. Before removing the memory card, its memory must be made independent of the calculator. To do this see pages 649-650 in your HP 48SX Owner's Manual.*

HP 48SX batteries

Use AAA alkaline batteries. With normal use batteries should last several months. Transferring data using Infrared and serial communications creates a heavier than normal drain on batteries and will reduce the battery life. When the batteries get low a low battery annunciator will be displayed at the top of the display just right of center. This low battery display will show even when the 48 is off. Each time the 48 is turned on it will beep and display "Warning:" LowBat (s). The warning display will then disappear but the low battery annunciator will remain displayed, whether the 48 is on or off.

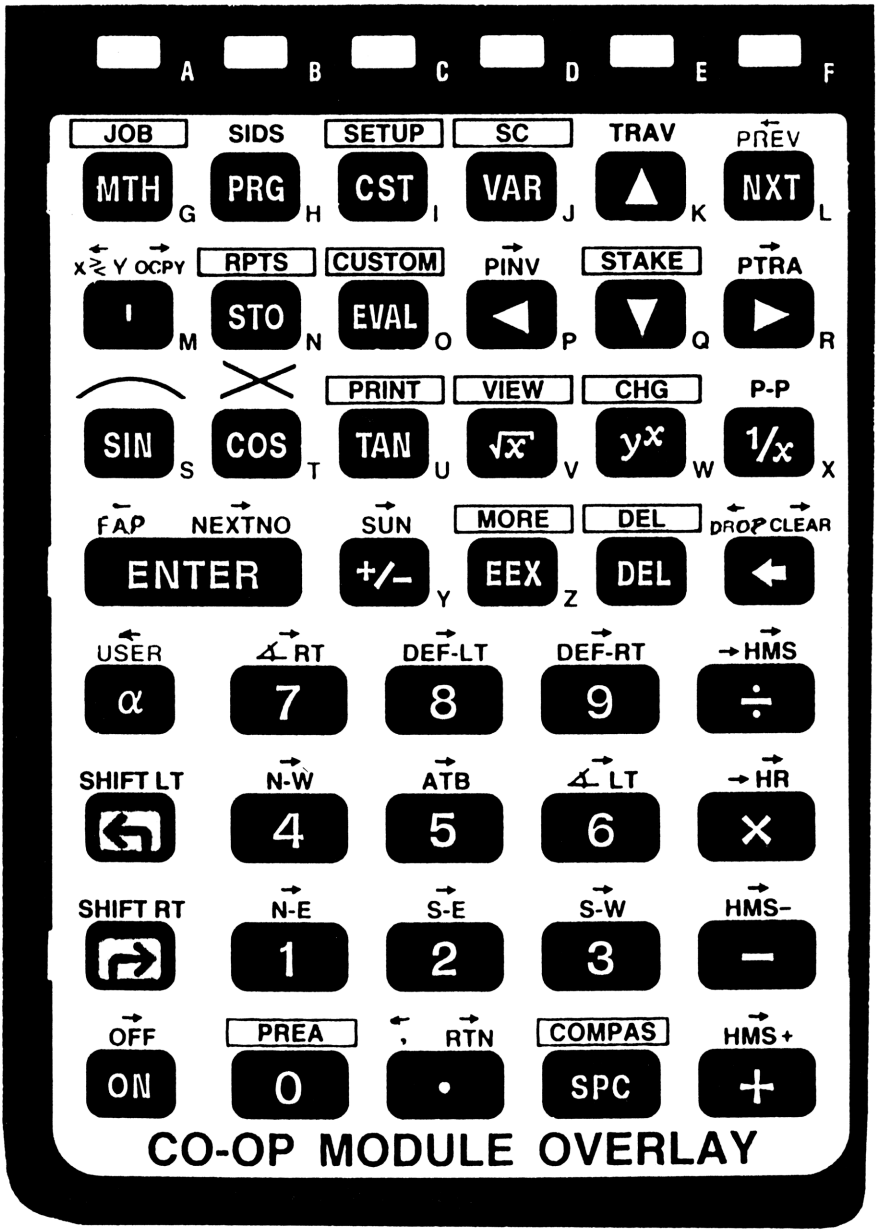
Replacing Batteries: Turn the 48 off. Remove the battery cover on the back of the 48 under the serial number. Replace the batteries being careful to place them in as shown in the battery holder of the 48. Be careful to not press the ON *key while installing new batteries.*

NOTES

CHAPTER 2

INTRODUCTION TO

CO-OP 48 SOFTWARE



The CO-OP 48 overlay
A keyboard overlay is provided with your CO-OP 48 Data Collector. The overlay allows quick and easy access to functions and soft key menus.

Install the overlay

To install the overlay put the tabs into the slots provided on the HP 48 by sliding the tabs on one side into the slots on that side. Then gently push up and in on the tabs on the other side with your thumbnail along the edge of the calculator causing the overlay to bend slightly until the tabs drop into the slots. It was tough for me too the first time I tried!!

The K program assigns the overlay keys

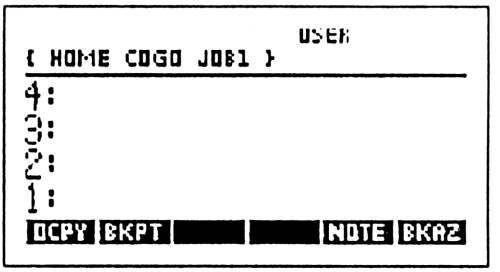
In addition to assigning the keys, it is necessary to be in a job directory to use the HP-48 as a data collector. The program "K" will insure that a cogo directory exists and that you are in a job directory named JOB1. It also reassigns the keys for the overlay.

Note: If the keys have been assigned, k will not reassign the keys. However, it will perform the other functions including putting you in the right directory and in JOB1. If you want to force the keys to re-assign, use "KK" instead of "K".

Executing the K program

To execute "K" press [α] *(alpha), K,* [ENTER]
This will take a few seconds.

After the copyright and version number flash on the screen, you will be in the [SETUP] *Menu.*



The 48 allows the use of directories like a PC. Directories

allow for the separation of data into categories. The display shows the directory path. In the above display you see { HOME COGO JOB1 } The third item on the path is the name of the current job. In this case JOB1. If the job name disappears while you are working with the 48, that means you have fumbled and got out of the job. If you lose COGO also from the directory path, that means you are out of the CO-OP 48 software directory.

K also creates JOB1 and stores point 1

"K" automatically creates a job named JOB1 with a beginning point number of 1 having a north coordinate of 5000 and an east coordinate of 5000. USER is turned on.

Using the CO-OP overlay

In order for the functions printed on the CO-OP Module overlay to match the functions that you get when you press the keys on the HP-48, two things have to happen:

*1. The keys **must** be assigned using K explained above.*

*2. USER **must** be on. for the functions to be available. You are in USER mode when the USER annunciator is shown at the top of the display window. To toggle in and out of USER mode, press [↰] and [USR].*

Understanding overlay colors

***Black:** The keys under the functions in black can be pressed directly to access that particular function.*

***Red:** Alpha characters are in red and located to the right of their key. They can be used by activating the Alpha-entry mode, which can be turned on and off by pressing the [α] key. The α (alpha symbol) will be shown*

at the top of the display window when Alpha-entry mode is on.

Orange: Functions in orange are accessed by first pressing the orange ↰ key and then the key under the name of the function.

***Blue:** Functions in blue are accessed by first pressing the blue ↱ key and then the key under the name of the function.*

Soft key principles
Soft keys are the keys A through F along the top row. When α (alpha) is off, pressing these keys executes the function along the bottom of the display.

Press JOB (on the overlay). Key in 1000 and press N (a soft key). Key in 1200 and press E (a soft key). Now press NEW (a soft key). key in A and press ENTER (the largest key on the keyboard). You have just created a job (A) with coordinates of 1000 and 1200 for the coordinates of point 1. You are occupying point 1.

***Press JOB to enter an OLD job, or to start a NEW job.** To go to another job, press JOB, and choose OLD or NEW. OLD will prompt for an "OLD JOB?". The soft key menu will list the old jobs. Key in an existing job name and press ENTER, or choose a name from the soft key menu, by pressing the soft key under the job name and press ENTER (If you don't see the old job you are looking for, press NXT until you see it. Press the soft key under the old job name and press ENTER.)*

PICTURE OF JOB DISPLAY showing

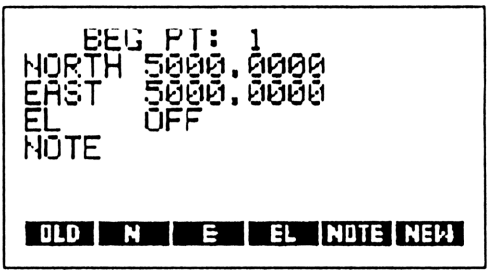
OLD | N

E | EL

NOTE | NEW

Soft key menu

Soft keys



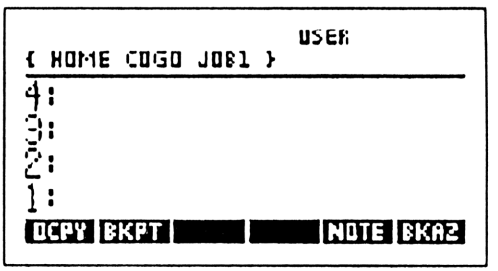
UPPER PART OF THE OVERLAY

Executing CO-OP 48AC functions

Like many of the HP built in functions, many of SMI's CO-OP functions can be executed by keying in data to the stack and then executing the function. Most of these functions that require input can also be executed using prompting which HP calls "command line input" discussed below. A third type of function does not require input. These functions are in the CHG menus most of these functions are toggles. The toggle functions will be discussed later.

Some of the functions on the overlay have a box around them. An example is SETUP.

Press SETUP. *You will see the display shown at the right.*



Key in the data first, then press the function key. In this manual we will normally use the convention of keying in the data first, then pressing the function key. This is an appropriate way to enter the data whether the functions are on the overlay or soft key menus.

For example, to start storing at point 100, key in 100 and press ↱, NEXTNO. *Now press* SETUP *and you will see on the display "NN 100" instead of "NN 2". When the next point is stored it will be stored in point number 100.*

Press the function first and get a prompt

Sometimes you may want to see what a function means.

Example: Press ↱, OCPY *without keying in a number first, you get a prompt: OCCUPIED PT? and you get a cursor flashing. The proper response is to key in the point number (1) and press* ENTER. *The 48 will then display the occupied point and a soft key menu. This is an appropriate way to execute functions. One additional keystroke is required if you press the function first.*

Also pressing the function first can cause problems:
If you press a function first without keying in data, you could get into trouble if something is already on the stack. The program will think you want to use the data that is on the stack as an argument. This could cause an argument between you and the 48. That's ok as long as you win the argument. To help solve this problem you may use the ON *key to clear the stack. Read about* ON *below.*

More about prompted (command line) input

When there is a prompt, the cursor is flashing, PRG is displayed in the upper right corner of the display (the program is running), and you don't see the conventional stack numbers aligned vertically on the left of the display, you are in "COMMAND LINE ENTRY" mode. When you see the above conditions you are being prompted for input. Answer the prompt and press ENTER.

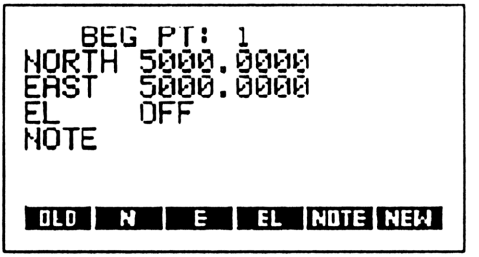
Error recovery when being prompted

To stop the running program and exit the command line prompt:

1. Empty the command line. If there is data in the command line press ON. *This will empty the command line. (The command line is at the bottom left of the display where data is entered into the 48.)*

2. Press ENTER. *The 48 will beep and display CANCELLED. You will see the standard stack display. You will then be ready to execute any other function.*

Example: Press SETUP COPY *(The soft key at A). Now press* ENTER. *The 48 will beep, display CANCELLED and show the standard stack display.*



Error recovery (if you get out of the job)
If you find yourself in the condition at the right where USER is off and a job is not showing in the directory path: To recover from this condition where only { HOME } or { HOME COGO } is showing on the directory path, you only need to enter a job.

Press ↰ **USER** **JOB** *and choose* **NEW** *or* **OLD**, *answer the question and press* **ENTER**.

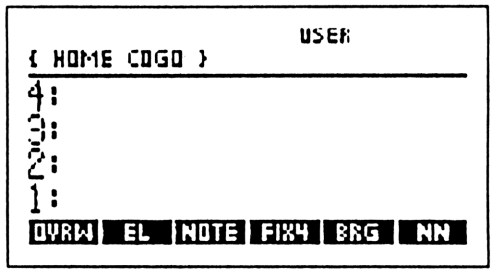
EXAMPLE:
To get out of the job: ↰ **USER** *(off)* ↱ *M (Under the overlay it says HOME).*

To get back in the job: ↰ **USER** *(on)* **JOB** **OLD** **JOB1** **ENTER**

Summary of data input

Enter data your way.
Enter data and press the key, or press the key, get a prompt, key in the answer and press **ENTER**. *Press* **ON** *to clear the stack. If nothing is on the stack, soft keys requiring input may be pressed for a more detailed prompt of the input needed. This normally brings you to a prompt with the cursor flashing and PRG showing in the display. This is called" command line entry mode". Key in the desired input and press* **ENTER** *for execution of the function.*

Toggle functions are for changes that do not require input of data



Press CHG *and you see:*
Some functions are toggles and do not require an input. Most of the toggle functions are located in the CHG *(change options) menu. When a toggle key is pressed the function is changed.*
Example: Turn notes on then off. Turn elevations on then off. (The CO-OP MODULE OVERLAY should be on. User should be on, and the keys should have been assigned using K.)

Press CHG*. Press* NOTE *The display says WILL PROMPT FOR NOTE. The soft key is changed to* NTE■*, indicating notes are on.*
To turn notes off press NTE■ *again. The display says "WON'T PROMPT FOR NOTE", and the soft key displays* NOTE *again. To turn elevations on Press* EL *(elevations). The display shows "WILL STORE ELEVATIONS". The soft key displays* EL *with a box after the L, indicating elevations are on. To turn elevations off press* EL *again. The display will say "WON'T STORE ELEVATIONS".*

One exception to the menu above is the FIX menu. It is not a toggle key. Key in 3 and press FIX*. This fixes the output to three places past the decimal.*

The ON key will clear the stack if user is on

Sometimes you will want to add, subtract, or do another computation. If the standard stack is not displayed press [ON]. *This normally will bring you to the stack display. If data is on the stack press* [ON] *again to clear the stack. This method of clearing the stack can solve the problem of being in a prompted mode with the cursor flashing and program running when you want to do something else. Remember,* [ON] *exits the program. Sometimes this turns user off.*

Chapter 3

JOB1

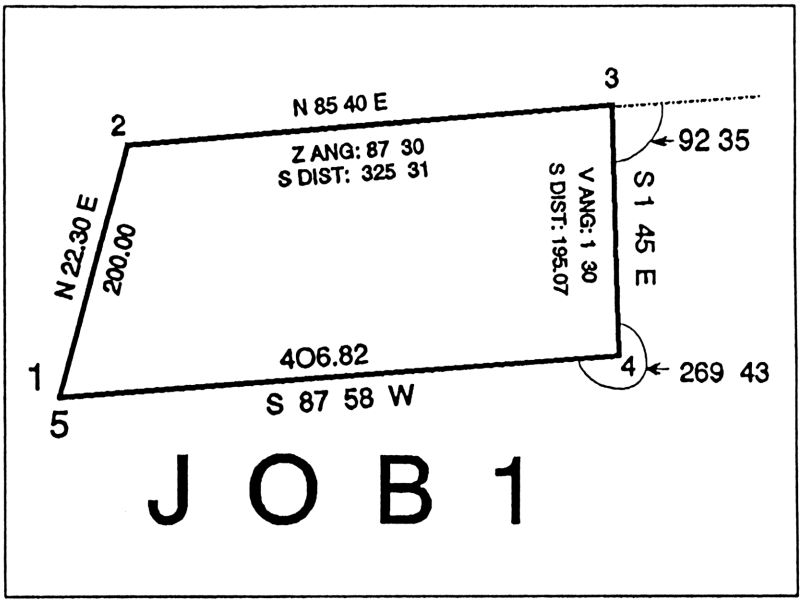
If you have just executed the K program you can skip to the next page. (If you have not executed the K program see Chapter 2 "Executing K".)

If you have been "experimenting" with entering points and want to start JOB1 on point 1, and store points consecutively from point 1:
Key in 1, Press ↱ [OCPY]
Key in 2, press ↱ [NEXTNO].
Now you are ready to go to the next page.

If you want those "experimental points" to be automatically overwritten: Press [CHG] *and* [OVRW].

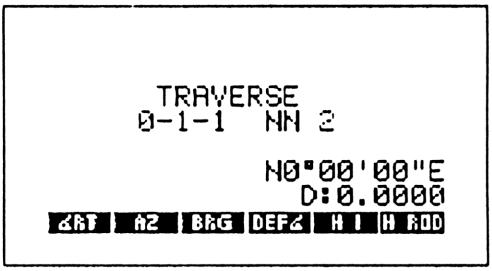
Note: You can change the overwrite status back to "CHECK BEFORE REPLACING POINTS" at any time by pressing [CHG] *and* [OVW].
You are now ready to go to the next page.

But, maybe you want to create a new job. If so do the following:
Press the [JOB] *key and press* [NEW]. *Key in the job name, and press* [ENTER]. *This will put you in the SETUP menu. Go to the next page.*



Entering traverse data

Press **TRAV**. *You should see the following display:*

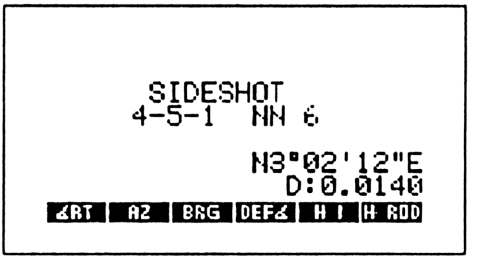


We will now describe to you the keystrokes needed to enter the above data into the HP 48. We will also describe how you can compute the closure, area in acres, square feet, perimeter and precision.

STA	KEY IN	PRESS	PROMPTS
1-2	22.30	AZ	
	200	HDIST	
2-3	85.40	BRG	QUADRANT?
	1	ENTER	
	87.30	Z△	
	325.31	SDIST	
3-4	92.35	DEF△	
	1.30	V△	
	195.07	SDIST	
4-5	269.43	△RT	
	406.82	HDIST	

Check the closure:

Press 1 ↱ PINV *(P)*
You will see the direction and distance of the error:

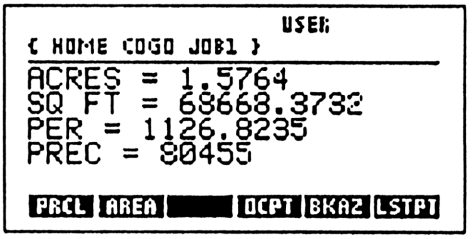


The numbers under SIDE SHOT are Backsight point (4), occupied point (5), last point stored or recalled(1), and the next number to be stored (6). In the lower right corner is the direction and distance to the last point. In this case you see the direction and distance of the error (5-1). The CHG *key on the overlay moves you to options that allow you to choose output in the form of bearing, angle right or*

azimuth.

Check acres, square feet, perimeter, and precision:

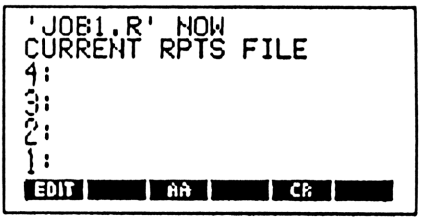
Press [VIEW]. *Press* [AREA].



The display to the right shows that user is on, you are in JOB1. The boundary data is displayed here (ACRES, SQUARE FEET, AND PERIMETER). Certain soft keys are displayed at the bottom of the display.

Compass Rule Adjustment:

Press [↱] [COMPAS]. *You will see the display at the right:*



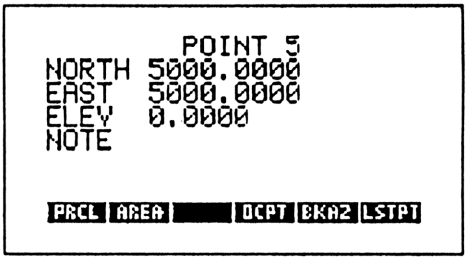
Storing random point numbers

Press [EDIT] *You will see: JOB1 (with a cursor flashing) Key in 1.5* [SPC] *1* [ENTER] *(or 1* [SPC] *2* [SPC] *3 4* [SPC] *5* [SPC] *1* [ENTER]*).*

You will see: NAME OF RPTS FILE JOB1.R
Press [ENTER], *or change name and press* [ENTER].

Press CR. *The 48 will beep and display DONE when finished.*

View the adjusted coordinates of point 5: Press 5 [VIEW] [PRCL]. You will see:



To view another point, key in the point number, press [PRCL]. To view additional consecutive numbers just press [PRCL].

How did you get along entering the data for JOB1? Did you run into any trouble? If so, here is a way to solve your problem when you get into trouble. You possibly pressed a wrong key. Possibly?? Obviously!!!

SOME RULES TO REMEMBER

RULE NUMBER ONE

***USER should be ON.** When user is on USER will show in the display. To turn user on press [↰] [USER]. (It's on the alpha key under [ENTER]).*

RULE NUMBER TWO

***When the cursor is flashing key in the desired input and press [ENTER].** If you really get confused and want to exit the program press [ON] and [ENTER].*

Note: ON is to delete the information from the data entry line called "command line". If there is no information on the data entry line don't press ON, just press ENTER.

When keying in alpha data, alpha should be ON. *When alpha is on it will show as* [α] *(Greek alpha character) in the display. If* [α] *is off, just press the* [ENTER] *key to turn it on.*

NOTE: Normally alpha will automatically be turned on for you when it is needed in the program. There are a few exceptions.
For example: When alpha macros can be entered by pressing a soft key. A macro is the ability to press one key and get a group of characters. Sometimes when you are prompted for an existing job, the name of the job is on a soft key. When you press the soft key you get the whole job thrown to the display, rather than turning alpha on and entering one key at a time. The macros could not be accessed if alpha were on.

Summary of JOB1

We have given you an example of manual data entry, inversing by point number, area computation, compass rule adjustment, and the viewing of coordinates.
We slid in the use of the random point file without you realizing it. Normally to store random point numbers you would press [RPTS] *and* [EDIT]. *In JOB1 you stored a random point file from in the COMPASS menu. The use of random point numbers will be discussed in more detail in later chapters.*

As you did JOB1. We hope you were able to see the power and efficiency of the CO-OP software, allowing data entry and computation with a minimum of keystrokes. We recommend that you do this job several times until you are able to do JOB1 with speed and efficiency. You will find that it is not necessary to wait for the 48 to finish each step before you enter new data. Unlike the HP-41. The HP 48 has a key buffer allowing you to enter data up to 15 keystrokes ahead of the program. If you know where a soft key should be in the next step you can press the soft

key in the right place in the entry sequence even though the program is so far behind your entry that something else is displayed in that soft key position.

NOTES

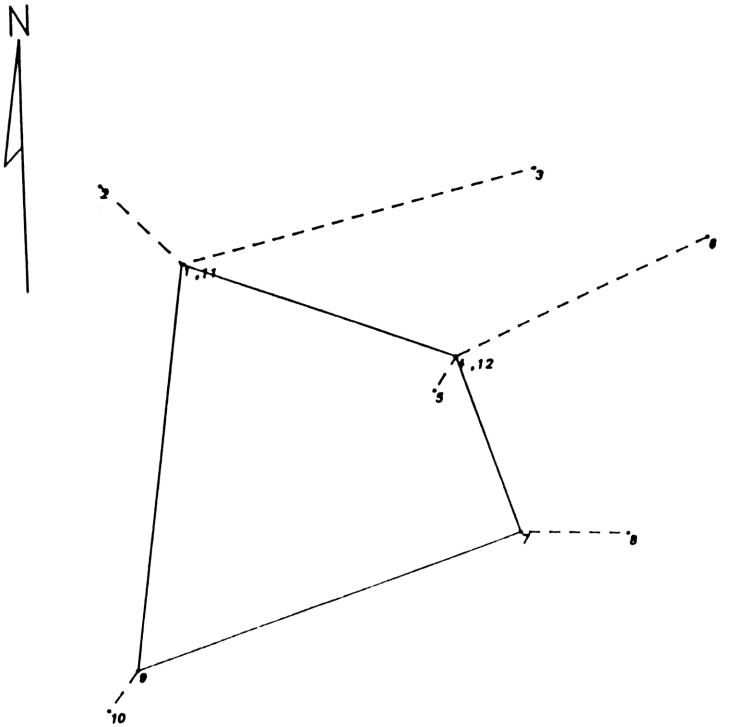
Chapter 4

JOB2

Entering and Computing

Field Book Data

What you will learn to do in JOB2
Create a new job.
Use setup to start a job.
Beneficial optional information
Enter field book data using side shot and traverse.
Store points in random point files.
Check boundary closure.
Work with notes.
Transform coordinates (Rotate and translate) using a program called CX.
Do curve computations.
Compute intersections.
Compute areas using a random point traverse.
Use predetermined area.
Stake points using STAKE.



Create JOB2

Press JOB *then* NEW.

(These additional details can be skipped)

Choose the coordinates for point 1

If you would like to choose different coordinates than is shown on the display key in the desired north coordinate (for example 10000) and press N. *You will see the north coordinate changed (to 10000). In a similar way you can change any of the beginning coordinate values, including note, even though notes are not turned on. Press* NOTE. *You will be prompted for a note entry. Key in your starting note. Press* ENTER. *The note will be stored even though NOTES are not turned on.*

Key in J O B 2 and press ENTER. *This stores in point 1 what you were viewing on the display.*

(This discussion is not necessary for the performance of JOB2.)

Setting parameters:

Our instrument is reading angle right and horizontal distances. However in JOB1 you discovered that you can use zenith, or vertical angles and slope distances.

If you want to turn elevations on: Press CHG *and* EL. *You will see:*

In the CHG menu you get toggles. Press the key. No entry is required. When you press a key the display tells you what you have done. When you pressed EL *you saw "WILL STORE ELEVATIONS". If you press* NOTE *you see "WILL PROMPT FOR NOTE". Press* NTE▪ *again and you see "WON'T PROMPT FOR NOTE". For more information about elevations go to chapter 5.*

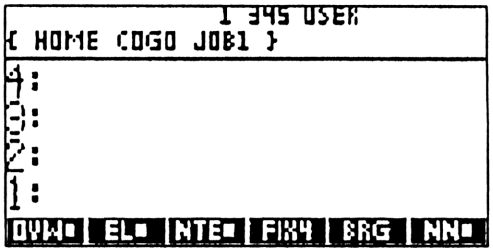
(Not necessary for JOB2).

Details about chg toggles

Just for practice you may experiment with changing the program options in the CHG *menu. Press* CHG *. When you press a soft key you change the option and get a definition of the new option. You may keep pressing a key to see all of the options. For example, when you pressed* NOTE *above you saw "WILL PROMPT FOR NOTE". The name changed to* NTE▪ *, and it displayed "WON'T PROMPT FOR NOTE". Pressing* NOTE *one more time goes back to the one displayed above. If you press* ON *the 48 returns to the standard stack display. If elevations are on, you will see a 3 to the left of USER. Whenever you see this 3 displayed the programs that store points such as SIDS, SC, SHOT and TRAV will store elevations. Elevations may be turned on or off at any time by pressing* CHG *and* EL *. For JOB2 we will leave elevations off(a 3 is not showing).*

Some* CHG *menu options show on the display

You can determine the status of 4 options by the numbers displayed along the top of the stack menu. Look at the following stack display. Note the numbers 1 345 along the top just to the left of USER. These are displayable flags.



If 1 is displayed the 48 will automatically overwrite points that have been previously stored. If 1 is not displayed then the 48 will BEEP and display the point about to be replaced, giving you an opportunity to choose another number or you can press ENTER *without making a change and the point will be replaced anyway.*

Flag 2 is used in the 48DC package to allow storage of raw data. This feature is not available in this package.

If 3 is displayed elevations will be stored. HI and HROD will be in certain soft key menus (SIDS, TRAV, and STAKE) and their values will be displayed.

If 4 is displayed the 48 will prompt for notes before storing data. If 4 is not displayed (notes are off) you can still store a note in the last point stored by pressing NOTE *and answering the question: NOTE? (key in the note and press* ENTER *).*

If 5 is displayed codes are turned on. You will be prompted for a code before a point is stored. (Some PC packages use codes to determine drawing commands. So that when the data is sent to the PC the plat is drawn.)

Manual entry using "MAN2"

MAN2, is also manual entry, but when you press SIDS *or* TRAV*, you will be prompted for all of the data to be entered a certain way (slope distance, zenith angle and angle right), separated by spaces (* SPC *). The prompt at the top of the display indicates the order in which you enter data. This is a clumsy way of entering data for JOB2. However, in your normal work you might decide you like this manual entry method better, especially if you like to enter the slope distance first.* MAN1 *or* MAN2 *can be selected on the second page of the* CHG *menu.*

FIELD BOOK INFORMATION JOB2

(Keystrokes will be shown on pages ahead)

BACK AZ: 315.30 (dms)

BS-OCPY-FS	ANG RT	HDIST	NOTE
SIDE SHOT			
- 1 - 2	0 00 00	89.26	IRON ROD FOUND
- 1 - 3	121 19 16	291.42	SET STONE FOUND
TRAVERSE			
- 1 - 4	154 45 44	230.42	TRAVERSE POINT
SIDE SHOT			
1 - 4 - 5	283 14 09	32.33	CONCRETE MONUMENT
1 - 4 - 6	136 05 50	222.23	CONCRETE MONUMENT
TRAVERSE			
1 - 4 - 7	231 22 38	148.74	T P

SIDE SHOT			
4 - 7 - 8	111 23 20	85.32	18 IN WHITE OAK
TRAVERSE			
4 - 7 - 9	270 11 16	324.87	T P
SIDE SHOT			
7 - 9 - 10	145 36 20	40.25	HUB AND TACK
TRAVERSE			
7 - 9 - 11	296 14 00	325.53	SAME AS POINT 1
9 - 11 - 12	282 12 10	230.42	SAME AS POINT 4

Let's use the above data and show you the keystrokes for storing into the 48.

If you want to work with notes on, press [CHG] [NOTE]. **and continue below.**

If you don't want to take the time to key in the notes in this job skip to "IF NOTES ARE TURNED OFF...".

==========

48 keystrokes: [JOB] [NEW] JOB2 [ENTER]

==========

BACK AZ: 315.30 (dms)

==========

48 keystrokes: [NXT] 315.30 [BKAZ]

==========

Note: If a soft key function is to be pressed but is not displayed you may need to press [NXT] one or more times to find the soft key function.

BS-OCPY-FS	ANG RT	HDIST	NOTE
SIDE SHOT			
- 1 - 2	0 00 00	89.26	IRON ROD FOUND
- 1 - 3	121 19 16	291.42	SET STONE FOUND

48 keystrokes: [SIDS] 0 [∠RT] 89.26 [HDIST] IRON ROD FOUND [ENTER]
121.1916 [∠RT] 291.42 [HDIST] SET STONE FOUND [ENTER]

TRAVERSE			
- 1 - 4	154 45 44	230.42	TRAVERSE POINT

48 keystrokes: [TRAV] 154.4544 [∠RT] 230.42 [HDIST] TRAVERSE POINT [ENTER]

SIDE SHOT			
1 - 4 - 5	283 14 09	32.33	CONCRETE MONUMENT
1 - 4 - 6	136 05 50	222.23	CONCRETE MONUMENT

48 keystrokes: [SIDS] 283.1409 [∠RT] 32.33 [HDIST] CONCRETE MONUMENT [ENTER]
136.0550 [∠RT] 222.23 [HDIST] [ENTER]

TRAVERSE			
1 - 4 - 7	231 22 38	148.74	T P

==========

48 keystrokes:(We are going to let you take it from here. Look below to find what to do if you make a mistake.)

==========

SIDE SHOT			
4 - 7 - 8	111 23 20	85.32	18 IN WHITE OAK
TRAVERSE			
4 - 7 - 9	270 11 16	324.87	T P
SIDE SHOT			
7 - 9 - 10	145 36 20	40.25	HUB AND TACK
TRAVERSE			
7 - 9 - 11	296 14 00	325.53	SAME AS POINT 1
9 - 11 - 12	282 12 10	230.42	SAME AS POINT 4

If you have entered the data above, skip to page 35. "Now let's find the angular difference in 1-4 and 11-2."

If notes are turned off JOB 2 can be entered like this:

JOB2

==========

48 keystrokes: JOB NEW *JOB2* ENTER

==========

BACK AZ: 315.30 (dms)

==========

48 keystrokes: 315.30 NXT BKAZ

==========

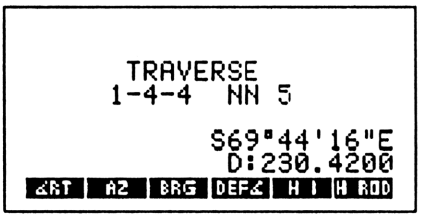
Press [SIDS].

STATION	KEY IN	PRESS
1-2	0	
	89.26	[∠RT] [HD/ST]
1-3	121.1916	
	291.42	[∠RT] [HD/ST]

Press [TRAV].

1-4	154.4544	
	230.42	[∠RT] [HD/ST]

You will see:



Press [SIDS].

	KEY IN	PRESS
1-4-5	283.1409	
	32.33	[∠RT] [HD/ST]
1-4-6	136.0550	
	222.23	[∠RT] [HD/ST]

Press [TRAV].

1-4-7	231.2238	
	148.74	[∠RT] [HD/ST]

Press [SIDS].

4-7-8	111.2320 85.32	△RT HDIST

Press [TRAV].

4-7-9	270.1116 324.87	△RT HDIST

PRESS [SIDS].

7-9-10	145.3620 40.25	△RT HDIST

Press [TRAV].

7-9-11	296.1400 325.53	△RT HDIST

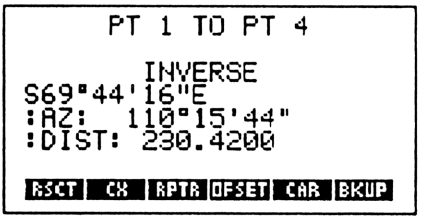
We are now back to the starting point. We will turn a closing angle to point 4 since it represents a longer shot than to 2. Shooting on a long shot increases the angle accuracy.

Press [SIDS]

	KEY IN	PRESS
9-11-12	282.1210 230.42	△RT HDIST

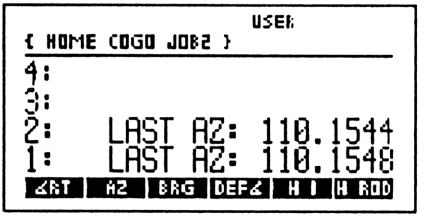
***Find the angular difference** in 1-4 and 11-12*

Press 1 [ENTER] 4 [P-P].
You will see:



Press [↱] [AZ].
Display will show: LAST AZ: 110.1544

Key in 11 press [ENTER].
Key in 12, press [P-P].
Press [↱] [AZ].
You will see:



Press [↱] [HMS-]
You will see -0.0004. This is the angular error in DMS.

Find the precision of the traverse

Press [RPTS] Then [EDIT].
Key in the traverse points:1 [SPC] 4 [SPC] 7 [SPC] 9 [SPC] 11 [SPC] 1
Your display should show: JOB2 1 4 7 9 11 1 (with a cursor flashing). Press [ENTER]. Your display should show: JOB2.R Press [ENTER] again. This stores a random point file called JOB2.R.

* (If a previous job name and random point file are in the display, delete these and key in the current job name, and put a space after the job names.)

Store a random point traverse

Press [MORE] and [RPTR]. You will see the 48 start displaying your traverse data. To pause the data press [SPC]. To continue the program press [SPC] again.

If you pause at the inverse between 11 and 1, you will see the direction and distance of error.
When the program is finished you will see the acres, square feet, perimeter, and precision.

This is what I got:
ACRES = 1.3962
SQ FT = 60,816.62O6
PERIMETER = 1029.56
PREC = 38749
What? You got something different? Well then maybe I pressed a wrong key!

***If you want to check your work** here is a suggested procedure: Press* [CHG]*. and press the F key (the one that displays* [BRG] [AZ] *and* [∠RT] *as you press the key). until you see "DISPLAY ANGLE RIGHT" in the display. Lets suppose you want to start from point 1 and check all entries.*

KEY IN	*PRESS*
1	[↱] [OCPY] *(on the overlay)*
2	[BKPT] *(soft key)*
3	[↱] [PINV] *(overlay)*
4	[↱] [PTRA]
	[PINV] *(PTRA leaves the next point on the stack)*
6	[PINV]
7	[PTRA]
	[PINV]
9	[PTRA]
	[PINV]
11	[PTRA]
	[PTRA]

I think this is quite an exciting way to check data entry.

Did you find any mistakes? If you did and you want to correct it/them continue reading.

If you make a mistake

We will now discuss what you can do when you make a mistake. You can make more mistakes than we can anticipate, however, with the following ideas you will get a "feel" for what to do if you make a mistake. There is no good substitute for practice. Doctors "practice" on real live patients. What is wrong with you "practicing" surveying with this wonderful software package? The worst thing that could happen is a $500,000 liability suit. Incidentally Doctors get those too. We suggest that you practice on these jobs or jobs you have already performed until you feel comfortable doing a real job.

1. If you enter data incorrectly and have not yet left the command line display. Use the back arrow key. Clear the erroneous data, type in the correct data and continue as if nothing had happened.

2. You are entering data but you haven't proceeded to the point that you have stored the new point. Press the overlay key that started the entry process (SIDS, TRAV, STAKE etc.) start re-entering the data for the point and continue.

3. You are in the SIDE SHOT mode, you have entered incorrect data and stored a point erroneously. Let's say you are occupying point 10. You have just stored point 21

incorrectly. Key in 21 and press ↱ [NEXTNO] *(the enter key). Key in the data for point 21 again. The 48 will beep and tell you that point 21 is used. Press* [ENTER] *and the old point 21 will be replaced with the new point 21.*

4. You are occupying point 20. Your backsight point is 10. You stored points 21 through 34 as side shots. You store point 35 as a traverse point, but the data was entered incorrectly. How do you restore it correctly?

Key in 20. Press ↱ [OCPY]. *Key in 10. Press* [BACK]. *Key in 35. Press* ↱ [NEXTNO]. *Press* [TRAV] *and re-enter the data for point 35.*

5. You traversed the whole boundary before you realized you made an error at point 50. There were 500 points total. Some were side shots. Point 50 was a traverse point. Point 50 is correct, but all points after point fifty are 3 degrees and 10 minutes and 31 seconds (too far clockwise). What do you do now!!!

Press [RPTS] [EDIT]. *You will see the name of your job, a space, and the cursor flashing ready for input. Key in 50.500 (You want to correct points fifty to five hundred, right!). Press* [ENTER], *Press* [ENTER] *again. Press* [MORE] *MORE* [CX] *(transformation). Key in 50. Press* [OLDP]. *Key in 50. Press* [NEWP]. *(Since 50 is correct we use it as the old point and new point.) Press* [NXT]. *Key in 3.1031 and press* [+/-]. *(To see what changes you have made press* [SHOW]). *Press* [RUN]. *All of the points from 50 to point 500 will be rotated counterclockwise the specified amount.*

6. You have the same conditions as in 5 above except you shot points 50 through 59 as side shots and they were OK. Point 60 was a traverse point, but it was shot with erroneous data. The data from point 50 to point 60 had the wrong distance the wrong horizontal angle, and the wrong zenith angle. What do you do?

Re-shoot point 60.

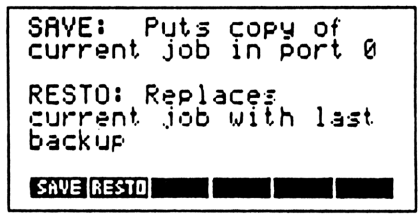
Key in 50 (the correct occupied point) and press ↵ OCPY. Key in point 45 (the back sight point) and press BKPT. Key in 501 (a point not yet used) and press NEXTNO (at ENTER) Press TRAV and enter the correct data to point 60. It will store point 501 (old point 60).

Press RPTS EDIT. If there is data after the job name press back space (the back arrow key) until the cursor is flashing with one empty space between the cursor and the job name. Key in 60.500 and press ENTER. Press MORE. Press CX. Key in 60 and press OLDP. Key in 501 and press new point. Key in 50 SPC, 60 and press DIR1 (old direction 50 to 60). Key in 50 SPC. Key in 501 and press DIR2 (new direction). (Press SHOW to see the changes that are to be made.) Press RUN. The coordinates will be rotated, translated, and the elevations will be adjusted if elevations are on.

Make a backup of your unadjusted job file

Press MORE Press BKUP.

To save a backup file press **SAVE**.
(To restore your last backup, press **REST**.*)*



Angle adjustment including side shots

To do an angle adjustment including side shots we will first define the traverse points and side shot points:
Press **RPTS**. *Then press* **EDIT**.

Details:
The job name, JOB2, is displayed followed by previous random points. Use back arrow to delete points not needed. Leave one space after the job name (JOB2) then key in the point numbers leaving a space between each number. Side shot points are entered as negative numbers. When you get to the end of the line on the display use ↵ **RTN** *(the . key) to move to the next line. When you finish, the file should look like this:*

JOB2 1 4 -5 -6 7 -8 9
-10 11 12 1 4

More details:
Points 11 12 represent the closing line. The last two points (1 4) are the line to be adjusted to (The correct direction). Point 1 will not be adjusted, so it is not necessary to enter the side shot points from point 1. The angle adjustment program will not change the side shots from the second traverse point (4) but we will also use this

file to do a compass rule adjustment later, so we just enter it now for convenience. This procedure can also be used for an open line traverse, where you tie into a known line at the end of the traverse.

Press [ENTER] *and* [ENTER].
Press [↱] [COMPAS].

Press [AA]. *The angles to the traverse points as well as to the side shot points will be adjusted appropriately. Inverse from 11 to 12 to see if the azimuth or bearing is the same as the direction of 1 to 4.*

Compass rule including side shots

Press [RPTS] *Press* [EDIT] *Press the back space (back arrow) key until you get rid of the last three numbers (12 1 4). Key in the closing point number (1). There is an edit soft key menu to aid you in changing the numbers.*

Press [↱] [COMPAS]. *Now press* [CR]. *The 48 will now perform a compass rule adjustment including side shots.*

View coordinates of point 11.
Key in 11. Press [VIEW], [VIEW].
Compare to point 1. Key in 1, press [PRCL]
Another way to compare is 1 [SPC] *11* [P-P].

Rotate job to reference bearing
The state highway plans show a bearing from point 6 to

point 5 of S 62 30 W. Our bearing is S 62 20 09 W. The delta angle is + 0 09 51.

Press [RPTS]. *Press* [EDIT]. *Delete the numbers not needed. You want to rotate all points from 1 to 12. If you want to enter a series of points you may enter the first and the last point number separated by a decimal. In this example we want to rotate all points from 1 to 12. Key in 1.12. You should see: JOB2 1.12. Press* [ENTER]. [ENTER].

Press [MORE] [CX]. [NXT]. *0.09 51* [ROTA]. [SHOW] *(optional)* [RUN]

Compute the outside boundary

Press [EDIT].

Delete the point numbers to one space past the job name. Key in the boundary points: 2 3 8 10 2 2 (the additional 2 is for precision computation, otherwise this is not necessary).

Press [ENTER] [ENTER]. *Press* [MORE].

Press [RPTR]. *(Random point traverse)*

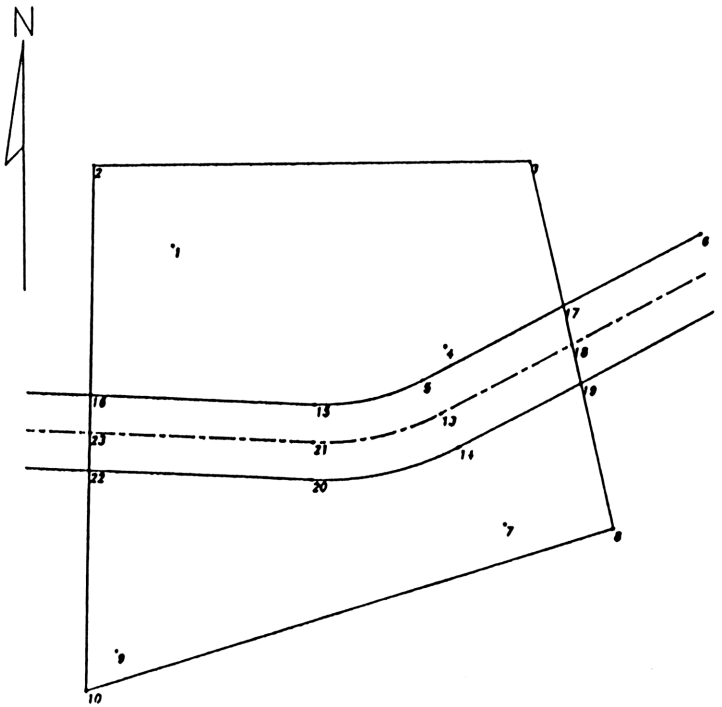
Whenever you want to pause to see the data between two points press [SPC]. *Press* [SPC] *again to start the program running again. When it finishes you will see the acreage, square feet, perimeter, and precision. In this case precision will not have any significance. (Precision is the preceding distances divided by the last distance.)*

Working with curves

In JOB2 point 6 is a concrete monument on the sideline tangent. Point 5 is the PC of a curve to the right. The

Delta is 30 degrees, the Radius of the centerline is 200 ft. Point 5 is 30 ft from the centerline making the radius of the sideline 170 ft. Create points on the sidelines and centerline of the curve. Create points at the place where the sidelines of the 60 ft. road right-of-way intersects the property lines.

The [curve] (curve) program allows us to enter whatever parameters we have. It computes the missing data for the curve. It will also traverse along the curve storing points



Keys to press to store point 13:

5 [↵] [OCPY] 6 [BKPT] 13 [↵] [NEXTNO] [SIDS] 90 [ΔRT] 30 [HDIST].

Now store 14:
90 [∠RT] *60* [HDIST].
We have created the centerline and the outside sideline PC station of the road.

Traverse through the curve and store the P.T.:
You are already occupying 5 and the back point is 6.
Keys to press:
Press [⌒] *(the curve symbol is above the S key).*
Key in 30 and press [Δ] *(delta).*
Key in 170 and press [R]. *The display will show you the curve data. Press* [RIGHT]. *Key in 15 and press* [STORE].

Store a temporary point for an intersection.
Press [TRAV] [↱] [AZ] [AZ] *500* [HDIST] *to use the azimuth coming out of the curve to store a temporary point.*

Now intersect the road sideline with the west property line.
Press [⊠] *(intersections) 15* [PT1] *16* [POL1] *10* [PT2] *2* [POL2]. *You will see the distances in the display. Key in 16, and press* [STORE] [ENTER] *to overwrite.*

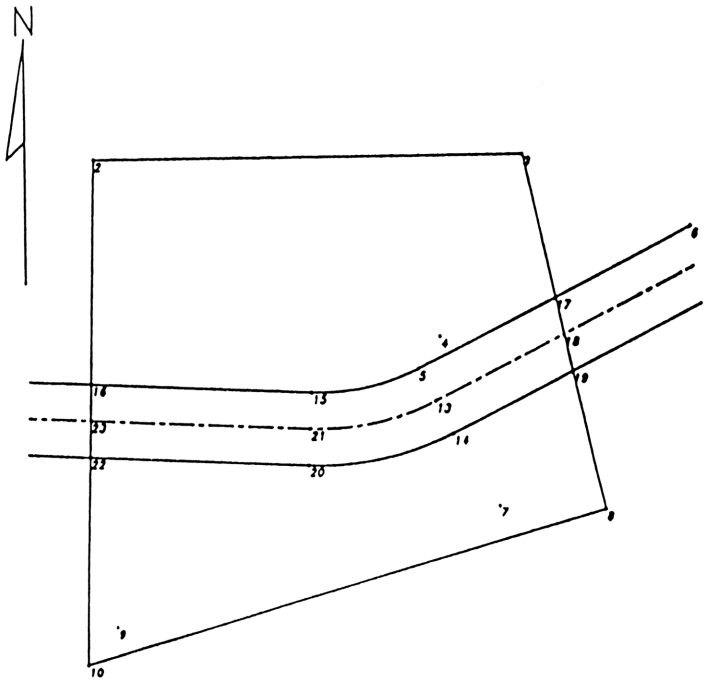
Intersect the road sideline with the east property line.
Use point 17 as intersection point number. Press [⊠].
Keys to press: 5 [PT1] *6* [POL1] *3* [PT2] *8* [POL2] *17* [STORE].

Intersect the centerline of the road with the east property line.

Press [X] *13* [PT1] *5* [SPC] *6* [AZ1] *(direction between 5 and 6) 3* [PT2] *8* [POL2] *18* [STORE].

Intersect the south side of the road with the east property line.

Press [X] *14* [PT1] *5* [SPC] *6* [AZ1] *8* [PT2] *3* [POL2] *19* [STORE].



Create the P.T.(point of tangency) of the south curve. *Call it point 20. Keystrokes: 14* [↱] [OCPY] *19* [BKPT] *Press the* [⌒] *(S) key. 30* [Δ] *230* [R] [RIGHT] *20* [STORE].

Check between 20 and 15: *15* [PINV] *Store point 21 on the centerline PT. Press* [SIDS] *20* [SPC] *15* [AZ] *30* [HDIST]

Intersect the south side of the road with the west property line. *Press* [⌧] *(the intersection key) (It is at T). 20* [PT1] *15* [SPC] *16* [AZ1] *10* [PT2] *2* [POL2] *22* [STORE].

Intersect the centerline of the road with the west property line. *Press the intersection key (T). 21* [PT1] *15* [SPC] *16 (or 20* [SPC] *22)* [AZ1] *10* [PT2] *2* [POL2] *23* [STORE].

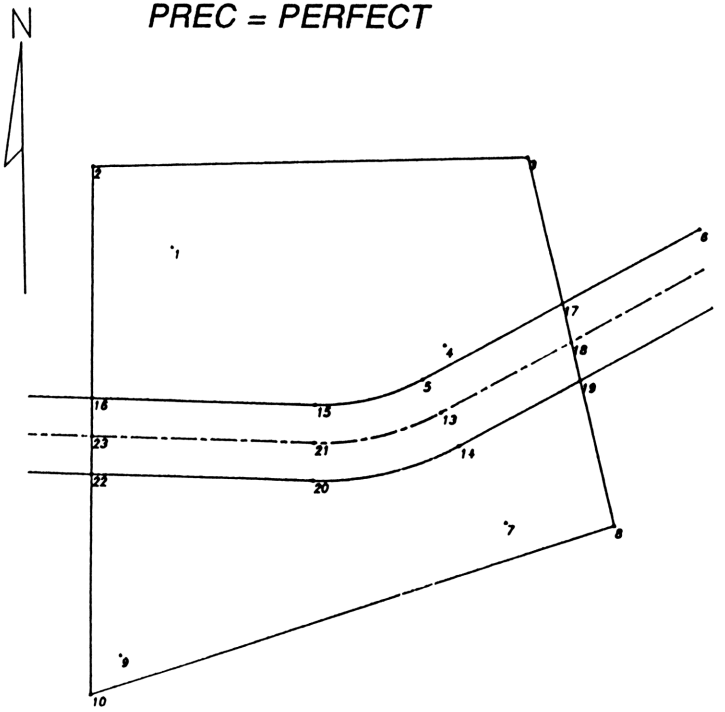
Compute the acreage around the property north of the road. *Key in the boundary points: 16, 2, 3, 17, 5, 15, 16. The keystrokes are: Press* [RPTS] [EDIT] *(clear to one space past the job name) 16* [SPC] *2* [SPC] *3* [SPC] *17* [SPC] [↱] [RTN] *(this moves you to the next line in the display.)* [↰] [—] *(this puts a quote to indicate curve data) 5* [SPC] [α] *R170* [α] [SPC] *15 R (the red R)* [SPC] *16* [SPC] *16*

When you finish the display should look like this: JOB2 16 2 3 17 "5 R170 15" 16 16

Press **ENTER** **ENTER** **MORE** **RPTR** *(random point traverse).*

After the calculator shows the traverses, you will see:

ACRES = 1.4564
SQ FT = 63441.1889
PER = 1039.2913
PREC = PERFECT



Pre-determined area

Determine the distance along the line from 2 to 3 that would divide the property above the road in half. Use point 15, the P.T. of the curve as the division point along the road. Store the division point on the upper side of the road at point 24.

Store the random points

Keystrokes: RPTS EDIT. (Press ⇐ to get rid of old random point numbers.) 13 SPC 16 SPC 2 SPC 3.
When finished you should see: JOB2 13 16 2 3
Press ENTER ENTER ↱ PREA.
The total acreage is 1.4614. To divide in half key in 1.4614 ENTER 2 ÷ ACRE. The distance will be displayed (from 2 toward 3). You should see 162.3123. Key in 24, and press STPT.

Check the acres

Press RPTS EDIT. You will see JOB2 13 16 2 3. Change the 3 to 24. (You may add another 24 to make the precision look good.) Press ENTER ENTER MORE RPTR.

Staking

If you turn angles right then you should set the output to angle right output. Press CHG and the F soft key until you see ∠RT. The display will show "DISPLAY ANGLE RIGHT".

We will occupy point 1, backsight point 4 and stake point 24. Press STAKE. Key in 1, and press OCPY. Key in 4, and press BKPT. Key in 24, and press FSPT. I get ∠RT: 307 32 44 D: 122.9072. Send the rod man to the approximate location and on the line. Take a reading:

Key in the data:

87.53 Z∠ *122.50* SDIST *You should see: GO .4908.*

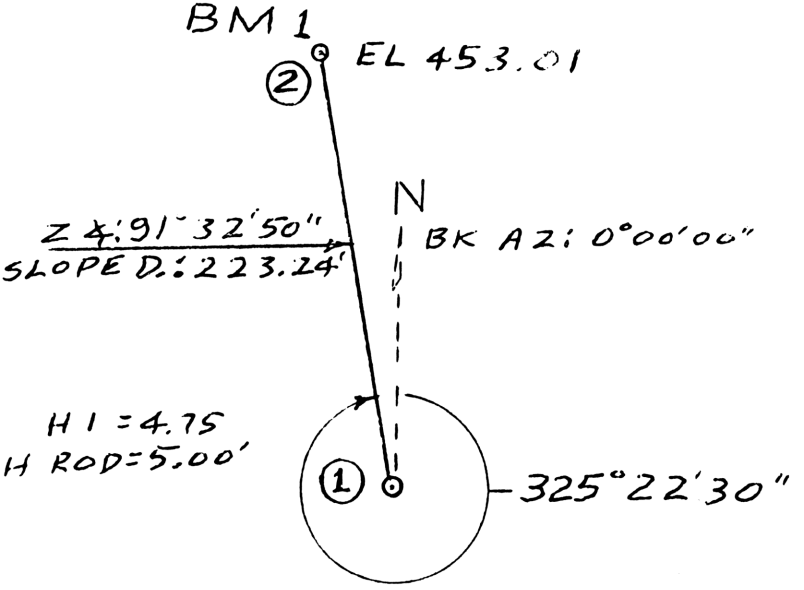
NOTES

Chapter 5

Working With Elevations

Working with elevations

In JOB3 we will show you how to pull an elevation from a benchmark to the instrument. We will work with H I (height of instrument) and H ROD (height of rod) settings.



JOB3

Turn elevations on: Press [CHG] [EL]

Create JOB3

48 keystrokes: [JOB] [NEW] *JOB3* [ENTER]*

Bring an elevation to the instrument
HI: 4.75, H ROD: 5.0 Back azimuth 0 00 00

Enter H I, H ROD and Back azimuth

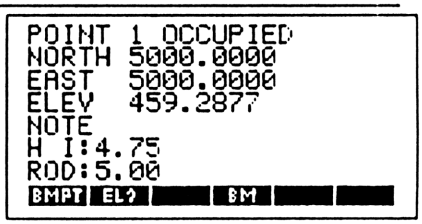
48 keystrokes: 4.75 [H I] ***5*** [H ROD] ***0*** [BKAZ]

The benchmark (BM1) elevation is 453.01. The zenith angle from point 1 to BM1 is 91 32 50. The slope distance is 223.24. Find the elevation of point 1.

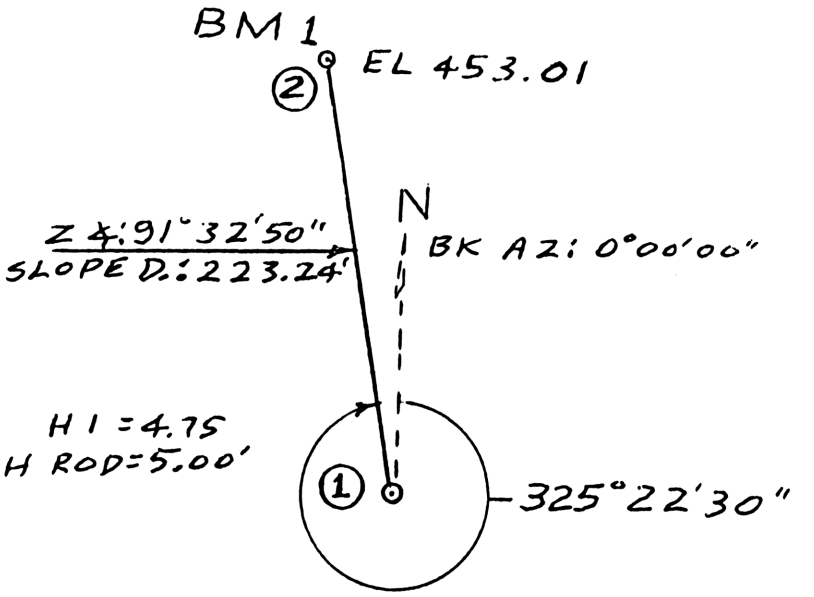
---

48 keystrokes: [NXT] ***223.24*** [SPC] ***91.3250*** [SPC] ***0 (The direction to BM1 can be entered as 0.)*** [ENTER] ***453.01*** [EL?]

You have just transferred the elevation from BM1 to the instrument. The elevation of point 1 is stored in the 48 with the coordinates of point 1 just as you see displayed here.



"If JOB3 already exists the 48 will beep and display "JOB3 ALREADY EXISTS". To delete job 3 and start over press [NXT] [DELET] [JOB3] [ENTER] [ENTER] .



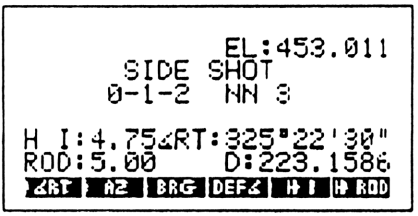
Reshoot BM1 to check the elevation

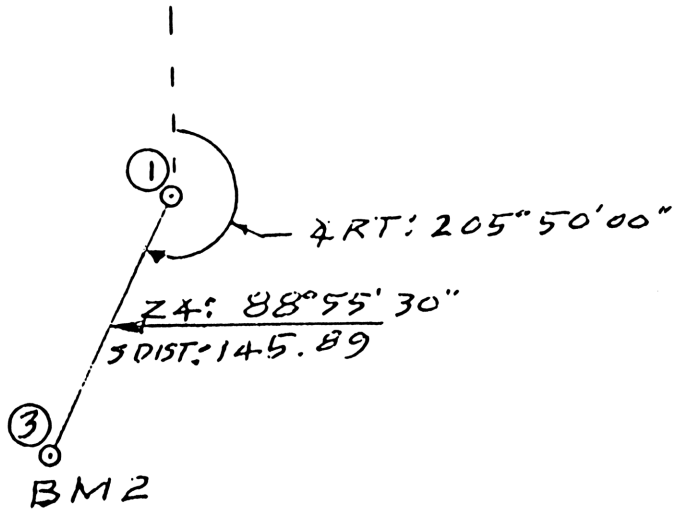
SIDE SHOT

STA	*ANG RT*	*Z ANG*	*S DIST*	*DESC.*
1-2	*325 22 30*	*91 32 50*	*223.24*	*BM1*

48 keystrokes: [SIDS] *325.2230* [∠RT] *91.3250* [Z∠] *223.24* [SDIST]

You should see the following display:





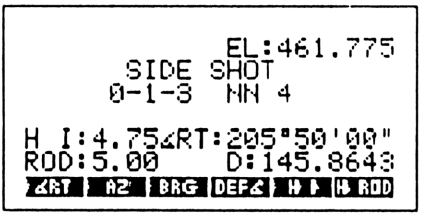
Create a BM with an elevation and coordinates

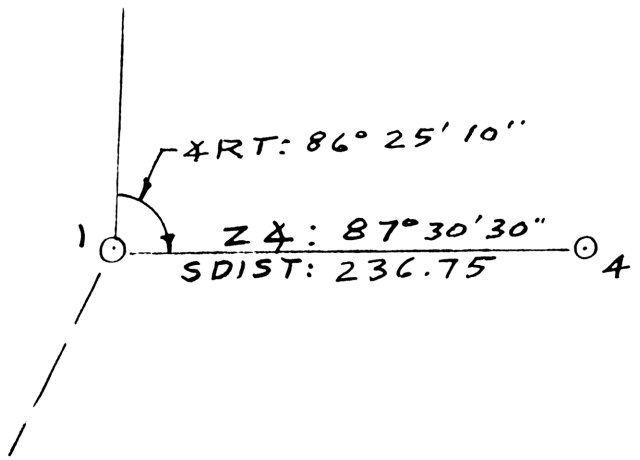
STA	*ANG RT*	*Z ANG*	*S DIST*	
1-3	*205 50 00*	*88 55 30*	*145.89*	*BM2*

---

48 Keystrokes: *205.50* [∠RT] *88.5530* [ZA] *145.89* [SDIST]

You should see the following display:


EL:461.775
SIDE SHOT
0-1-3 NN 4
H I:4.75∠RT:205°50'00"
ROD:5.00 D:145.8643
∠RT A2 BRG DEF∠ H I H ROD



Traverse with elevation and coordinates

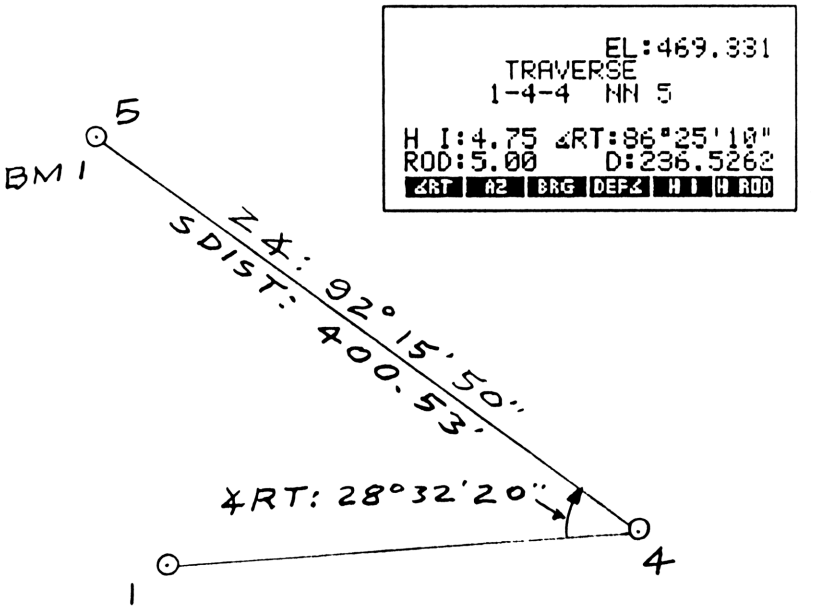
TRAVERSE

1-4 86 25 10 87 30 30 236.75 H&T

---

48 Keystrokes: TRAV ***5*** H ROD ***86.2510***
∠RT ***ANGRT, 87.3030*** ZA ***ZANG, 236.75*** SDIST

The display to the right is what you should see after you traverse to point 4.



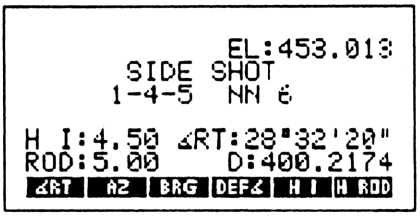
Check the elevation of point 4 by shooting the point at BM1. Store the shot at point 5.
Occupying point 4 shoot BM1.
HI= 4.5 H ROD= 5.0
SIDE SHOT

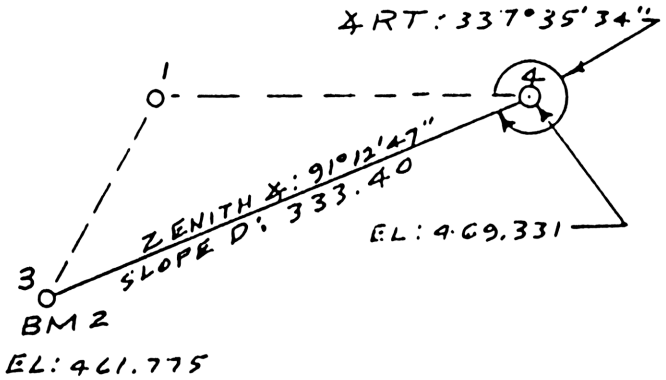
STA	*ANG RT*	*Z ANG*	*S DIST*	
4-BM1	*28 32 20*	*92 15 50*	*400.53*	*BM1*

---

48 Keystrokes: *4.5* [HI] [SIDS] *28.3220* [∠RT] *92.1550* [Z∠] *400.53* [SDIST]

The display to the right is what you should see after you take a side shot to point 5 (BM1).
Compare to the elevation of point 2



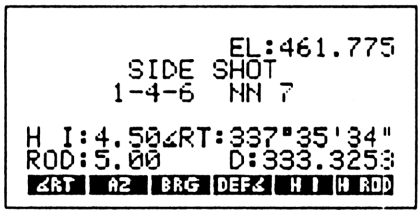


Check benchmark 2 (BM2).
The right angle is 337 35 34.
The zenith angle is 91.1247.
The slope distance is 333.40.

---

48 Keystrokes: 337.3534 [∠RT] *91.1247* [Z∠] *333.40* [SDIST]

The display to the right is what you should see after you take a side shot to point 5 (BM2).



NOTES

The above example illustrates transferring a benchmark to an instrument, transferring coordinates and elevation to another benchmark, traversing with coordinates and elevation to traverse point, and checking your work by tying to a known benchmark.

You can store a note in the point number of previously stored point even if notes are turned off. *If notes are off you may press* NOTE*, key in the note and press* ENTER*. The note will be stored with the point number you just shot.*

Further discussion about elevations and notes:

When elevations are turned on (using CHG *) the stack display will display a 3 near the top center. When the 3 does not show in the stack display elevations are off. Elevations can be turned on at any time or off at any time. If elevations are turned off elevations will not be stored with the coordinates of the job. You may turn elevations on at any time and start storing elevations. The status of elevations is not affected by the status of notes. Therefore, notes also may be on or off at any time in despite the status of elevations. If elevations are off no value will be stored and no extra memory is used. Even if elevations are off printed coordinates will have a 0.00 in the elevation position.*

Working with HI and H ROD.

When elevations are on H I and H ROD values are shown in the lower left corner of the SETUP, SIDS and TRAV display.

You may choose from the following options:

1. Leave the H I and ROD values zero and adjust the rod height to be the same as the instrument height. Bring an ELEVATION to the instrument using **BM**. *If you boot the rod the ROD should be set to the value of the boot.*

2. Measure the instrument height and rod height and enter them.

If you do not need the correct ground elevation of the instrument point you may use the following procedure. This option floats the elevation on the vertical axis of the instrument.

3. Leave H I and ROD zero. Don't measure the instrument height and rod height. When you bring a benchmark elevation to the instrument it will be a "reference elevation". The elevation at the instrument will be incorrect but the elevations of the points shot from the instrument will be correct if the rod height is not changed. If the rod is booted you may key in the boot and put it in as a ROD value.

H I Definition

NOTE: H I refers to the distance from the elevation at the point under the instrument to the axis of the scope. (A typical H I value is 4.80, not 458.50.) The elevation of the point under the instrument is used when you occupy a point with the 48. The H I value is added to this elevation of the point under the instrument to get the elevation of the axis of the instrument. In this manual we do not use the definition that refers to the H I as the elevation of the instrument.

NOTES

NOTES

APPENDIX A

EXPLANATION OF CO-OP 48SX OVERLAY FUNCTIONS

This appendix will explain the operation of menus and functions on the CO-OP 48 overlay. The order of explanation will be from left to right and top to bottom.

Pictures of the soft key menus will appear at the beginning of the menu explanations. After the picture of the soft key menus, an explanation of each of the soft keys in the order that they appear will follow.

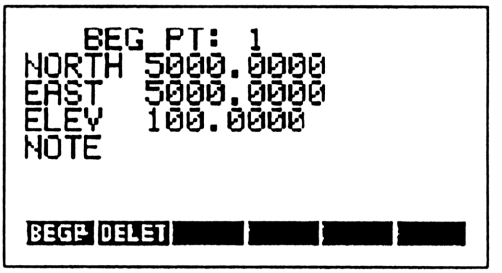
(Old and New Jobs)

Purpose: Create a new job or use an old job.

Keystrokes: JOB

JOB Menu -- Page 1

Press NXT



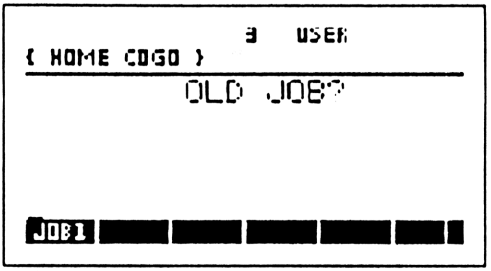
JOB Menu -- Page 2

Explanation of JOB Soft Keys:

OLD *Press to use an old job.*

Now press the soft key under the name of the job you want to use and press ENTER *. (In this case, JOB1 is the only job in the calculator.) If there are more than six jobs, press* NXT *to see the next six jobs listed. The*

job you select will become the current job and the SETUP Menu will be activated.



JOB Menu, OLD soft key

N *will change the north coordinate of the first point in the next job to be created. The value can be entered either before or after* N *is pressed.*

E *will change the east coordinate of the first point in the next job to be created. The value can be entered either before or after* E *is pressed.*

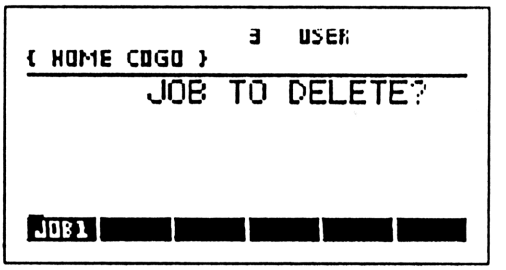
EL *will change the elevation of the first point in the next job to be created. The value can be entered either before or after* EL *is pressed.*

NOTE *will change the note of the first point in the next job to be created. The note should be entered after* NOTE *is pressed.*

NEW *uses the values displayed on the screen to create the first point in a job which you name after pressing* NEW .

BEGP *will change the number of the first point in the next job to be created. The number can be entered either before or after* BEGP *is pressed.*

DELE *Press to delete a job.*

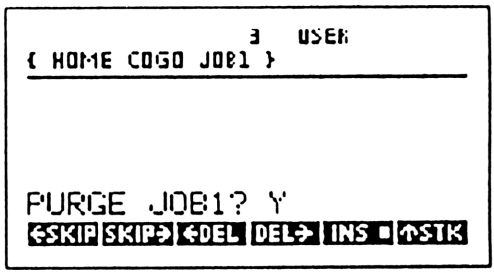


JOB Menu, DELET soft key

Now press the soft key under the name of the job you want to delete and press ENTER . *If there are more than six jobs, press* NXT *to see the next six jobs listed.*

The display will prompt with job name and a "Y". If you

will want to delete the job, press ENTER. *Otherwise, press* ON *and then* ENTER.



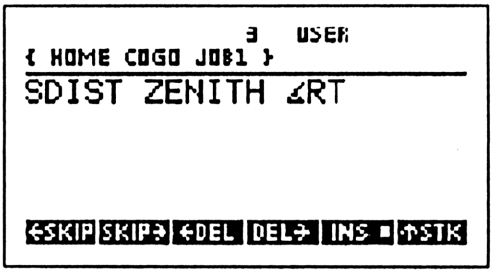
JOB Menu, DELET soft key prompt

(Side Shot)

Purpose: To perform a side shot and store a point.

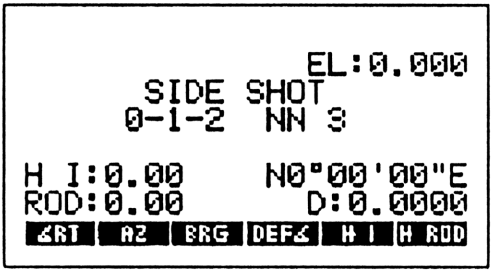
Keystrokes: SIDS

If using manual entry method two, you'll be prompted for slope distance, zenith angle, and angle right. After the point is stored, the SETUP Menu will be activated.



SIDS Menu, Manual Entry Method Two -- Page 1

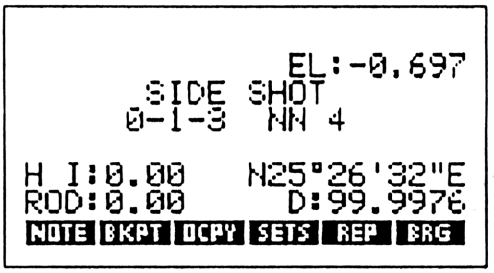
If using manual entry method one, you will see this display and soft key assignments.



SIDS Menu, Manual Entry Method One -- Page 1

Press NXT

Explanation of SIDS Soft Keys:



SIDS Menu -- Page 2

Manual Entry Method One

The first four soft keys are used to enter a direction to the side shot and call up a menu to enter a distance. This distance menu will be explained after the explanation of the keys on the menus above.

ΔRT *used to enter an angle right.*

AZ *used to enter an azimuth. Enter two point numbers if you want to use the inverse between them as the azimuth to the next point. If you want to use the last azimuth, press* ↱ **AZ** *to see the last azimuth and* **ENTER** *to use it. If you decide after seeing the last azimuth that you don't want to use it, just type over it and press* **ENTER** *. If you want to put the last azimuth value on the stack press* ↱ **AZ** *. To display the last azimuth press* ↰ **AZ** *.*

BRG *used to enter a bearing. After entering the bearing, you will be prompted for the quadrant. If desired, you can enter the quadrant as the first digit of*

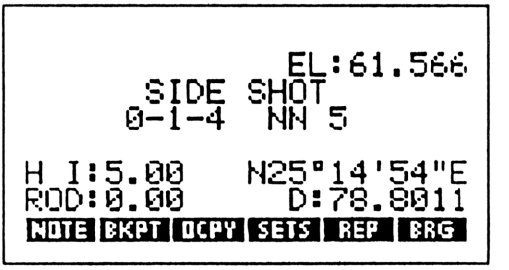
the bearing.

DEF∠ *used to enter a deflection angle to the right. Entering a negative number will cause a deflection to the left.*

HI *used to enter the height of the instrument. To use the last height of the instrument, press* **HI** *, with a clear stack, and then press* **ENTER** *.*

H ROD *used to enter the height of the rod. To use the last height of the rod, press* **H ROD** *, with a clear stack, and then press* **ENTER** *. Press* **↱** **H ROD** *to put the last value on stack, this value can be added to or subtracted from and then used by pressing* **H ROD** *.*

To see the next series of functions in the Side Shot Menu press **NXT** *and you will see...*



SIDS Menu -- Page 2

NOTE used to enter a note for the last point stored. After you press this key, you will be prompted for the note and the alpha keyboard will be activated. If the command line is empty when ENTER is pressed there will not be a note stored.

BKPT used to enter a back sight point.

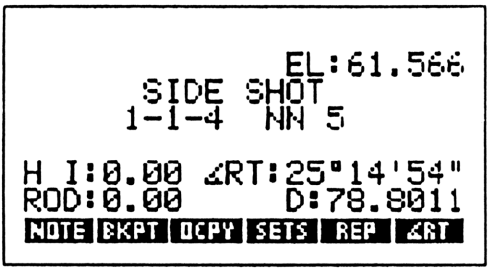
OCPY used to occupy a point.

SETS used to change the number of windings performed on each angle right.

REP used to repeat last direction and distance to store another side shot. If pressed while in traverse mode, it will use the last direction and distance to create a new traverse point.

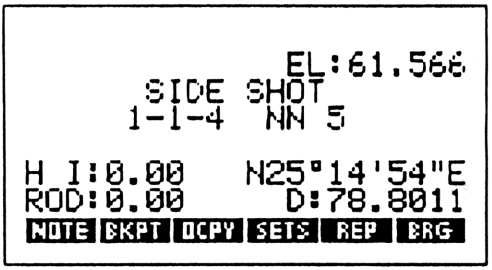
∠RT / BRG / AZ use this key as a toggle between the three methods of angle displays

Press AZ to toggle to angle right display and see...



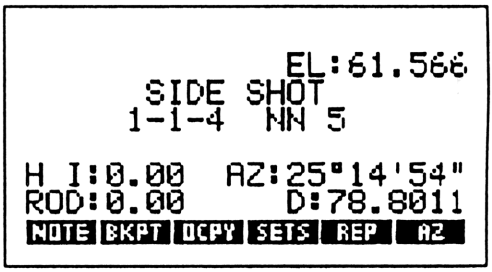
SIDS Menu -- Angle Right Display

Press **∠RT** *to toggle to bearing display and see...*



SIDS Menu -- Bearing Display

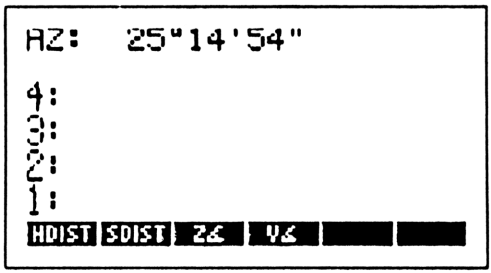
Press **BRG** *to toggle to azimuth display and see...*



SIDS Menu -- Azimuth Display

Distance Menu:

After a direction has been entered, it is converted to an azimuth and displayed. The next step is to enter a distance.



HDIST *used to enter horizontal distance. Enter two point numbers to use the inverse between them as the horizontal distance to the next point. To use the last horizontal distance press* **HDIST** *, with a clear stack,*

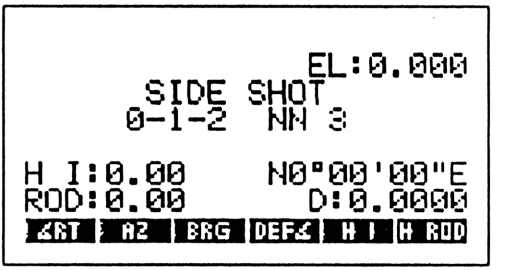
and then press ENTER . *Press* → HDIST *to put it on the stack, or* ← HDIST *to display it on the screen.*

SDIST *used to enter a slope distance. To use the last slope distance press* SDIST , *with a clear stack, and then press* ENTER . *Press* → SDIST *to put it on the stack, or* ← SDIST *to display it on the screen.*

Z∠ *used to enter a zenith angle. To use the last zenith angle press* Z∠ , *with a clear stack, and then press* ENTER . *Press* → Z∠ *to put it on the stack, or* ← Z∠ *to display it on the screen.*

V∠ *used to enter a vertical angle.*

After the distance has been entered, you will return to the Side Shot Menu.

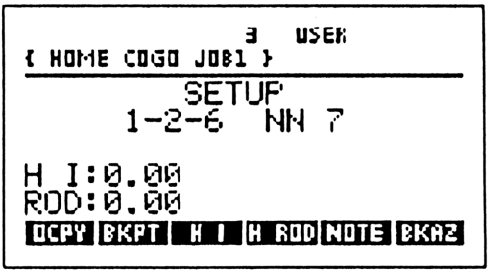


SIDS Menu, Manual Entry Method One -- Page 1

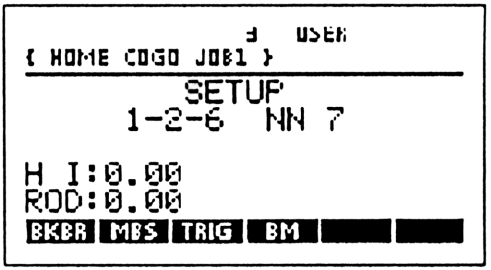
(Setup Side Shot and Traverse)

Purpose: Prepare for a side shot and traverse. Also contains routines for specialized kinds of side shots.

Keystrokes: SETUP



Press NXT



Explanation of SETUP Soft Keys:

OCPY *used to occupy a point.*

BKPT *used to create a back azimuth. Based on the inverse between the occupied point and the point given.*

HT used to store the height of instrument.

H ROD used to store the height of rod.

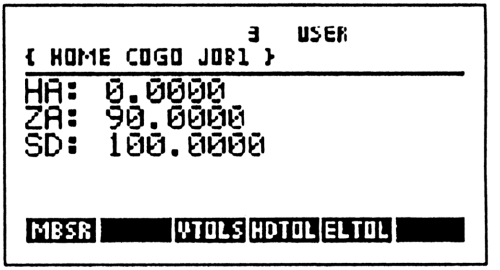
NOTE used to store a note for the last point stored.

BKAZ used to store the back azimuth.

BKBR used to store the back bearing. After entering the bearing you will be prompted for the quadrant. If you want to enter quadrant with the bearing, you can enter it as the first digit of the bearing. EX: Enter 369.3514 for S69°35'14"W.

MBS *used to shoot a back sight point directly and with the scope flopped. These two measurements will be averaged to recreate the occupied point's elevation. This new elevation and the new horizontal distance is averaged with the occupied point's elevation and horizontal distance from the back sight point. These values are used to restore the occupied point.*

After you enter the data it is displayed and a new menu is shown.



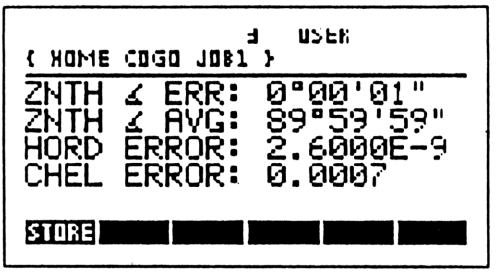
SETUP Menu -- Page 3, MBS Soft Key

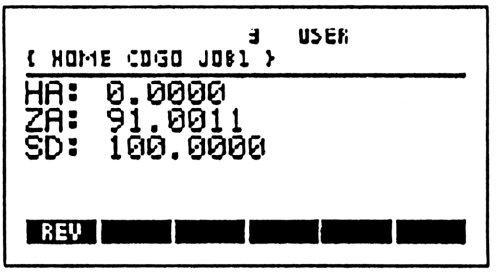
VTOL *used to change the zenith angle tolerance.*

HDTO *used to change the horizontal distance tolerance.*

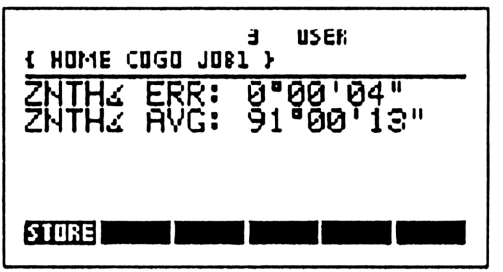
ELTO *used to change the elevation tolerance.*

MBSR *used to bring in the zenith angle and horizontal angle after the scope has been flopped. If any of the tolerances have been exceeded, the calculator will beep. If you decide to store the occupied point based on the meaned back sight, press* STORE .



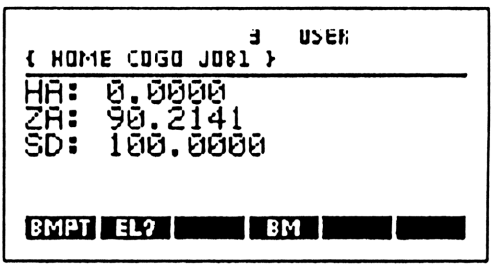


TRIG *used to do trig leveling on a shot. The first shot should be done without a flopped scope and the second shot assumes a flopped scope. You will be prompted for the input.*



REV *press to measure the angles with the scope flopped. You will be prompted for the input. The calculator will beep if the vertical angle tolerance was exceeded.*

STORE *press to store the point if satisfied with the results.*



BM *used to bring a benchmark elevation to the occupied point. The elevation can be based on a previously stored*

point or a known elevation. You will be prompted for the input.

BMPT *used to enter the point number of the point shot when* **BM** *was pressed. The elevation will then be brought to the occupied point and stored.*

EL? *used to enter the elevation of the point shot when* **BM** *was pressed. The elevation will then be brought to the occupied point and stored.*

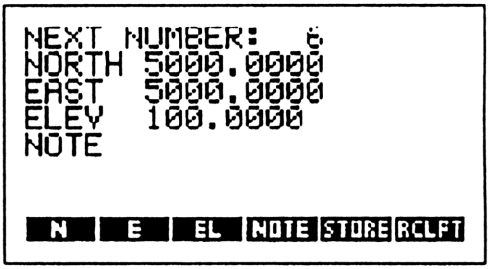
BM *allows you to bring in another benchmark. Used in the same way as explained above.*

SC

(Store Coordinates)

Purpose: To store points by their coordinates or to alter a previously stored point.

Keystrokes: SC



Explanation of SC Soft keys:

N *used to change the north coordinate.*

E *used to change the east coordinate.*

EL *used to change the elevation.*

NOTE *used to change the note.*

STORE *used to store a point using the displayed values on the screen. If you want to store the point at a point number other than the one shown as the next number, put the desired next number to store on the stack before pressing* STORE .

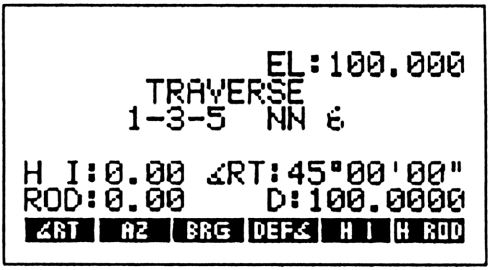
RCLP *used to recall a point's values and change the next number. Any of these values can be changed and stored again at this point or another point.*

TRAV

(Traverse)

Purpose: *To store a traverse point.*

Keystrokes: TRAV



Explanation of TRAV Soft Keys:

The traverse soft keys work identically to the side shot soft keys except that after the point has been stored, the new point is occupied and the back sight point and direction are updated. For an explanation of how to enter the data, read the explanation of the SIDS *menu.*

[PREV]
(Previous Page of Menu)

Purpose: *To change current menu page to the previous one. If the current page is the first page in the menu,* [PREV] *will make the last page in the menu the current page.*

Keystrokes: [↰] [PREV]

[X><Y]
(Swap)

Purpose: *To exchange the last two objects on the stack.*

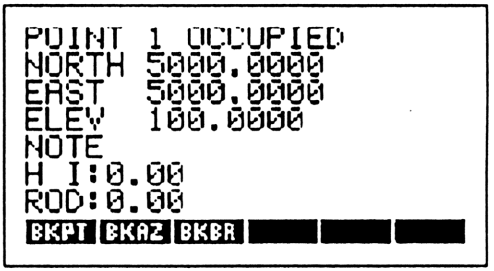
Keystrokes: [↰] [X><Y]

OCPY
(Occupy)

Purpose: *To occupy the point number that is on the stack.*

Keystrokes: ↱ **OCPY**

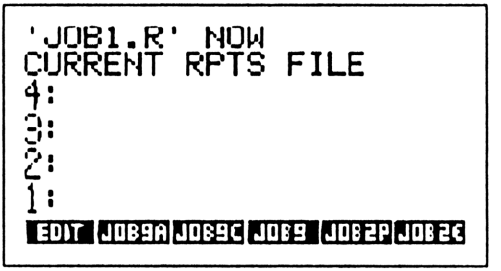
Explanation: *When the point is occupied, the information about the point is displayed and a menu for entering the back sight information is displayed.*



(Random Point Store)

Purpose: To store or recall a random point file for use in PRINT , CX *(Transformation),* RPTR *(Random Point Traverse),* OFSET *(Offset),* PREA *(Predetermined area),* AA *(Angle Adjustment), or* CR *(Compass Rule Adjustment).*

Keystrokes: RPTS



A .R extension is added to the current job name to make a random point file of that name the current random point file. To change the current random point file, press the soft key where the desired file is shown.

All of the keys shown in the soft key menu are random point files except EDIT . EDIT *is used to edit the current random point file. You can edit and add points to the file using the standard editing keys. The points will be used from the job named at the beginning of the file.*

To use points from another job, insert the job name before the points. Points from any number of jobs can be used. You can either type in the job name after turning on alpha mode or press STK *to select a job from the list of jobs in the calculator. To select a job,*

press the up and down arrow keys until the pointer is at the desired name on the stack. Press ECHO ENTER *and you will see the job inserted into the random point file.*

To use a range of points, put the first point number, a decimal, and the last point number in the range. The last point number is limited to 4 digits.

To enter a curve, press ↰ [—] *to get quotation marks, enter the point of curvature, a space, the center point or a radius preceded by an R (negative radius if curve is to the left), and the point of tangency.*

EX: JOB1 2 10.23 "50 51 53" JOB2 15 "20 R150 24"

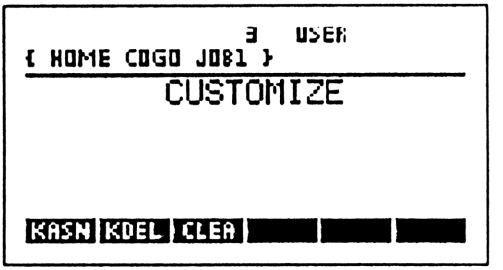
In the example random point file above, point 2, points 10 through 23 and a curve with a PC at point 50, center point at point 51, and PT at point 53 will be used from JOB1. Point 15 and a curve with a PC at point 20, radius of 150, and PT at point 24 will be used from JOB2.

When satisfied with the points entered, press ENTER *. You will then be prompted for the name of the random point file. If you don't want to change the name, just press* ENTER *. If you change the name, the old file will remain unchanged and the edited version will be stored under the new name. A .R extension is added to the name if it is not already there when* ENTER *is pressed. If you decide to abort the edit of the random point file, press* ON ENTER *while editing the file. The random point file will remain unchanged.*

(Customize Menu)

Purpose: To customize the user keyboard. Also to clean the COGO directory of variables that are not needed.

Keystrokes: CUSTOM



Explanation of CUSTOM Soft Keys:

KASN *used to assign a program to the keyboard. Enter the name of the command or object you want assign. If desired, you can enter several objects or even a program. When done, press* ENTER *and then the key that you want to assign.*

KDEL *used to delete the user assignment of a key. After you press* KDEL *, press the key you want to return to its original function.*

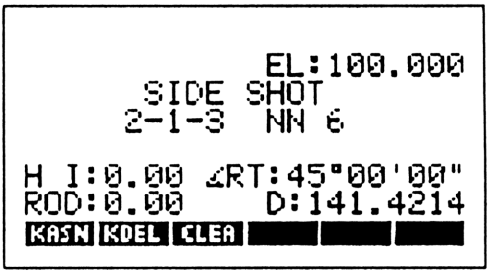
CLEA *used to clean the COGO directory. Use this function if low on memory.*

(Point Inverse)

Purpose: To inverse from the occupied point to another point.

Keystrokes: ↱ PINV

Displays the inverse from the occupied point without changing the menu.

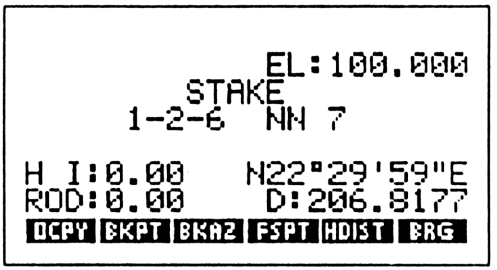


STAKE

(Staking)

Purpose: To stake a point or line.

Keystrokes: STAKE



Explanation of STAKE Soft Keys:

OCPY *used to occupy a point.*

BKPT *used to enter a back sight point.*

BKAZ *used to enter a back azimuth.*

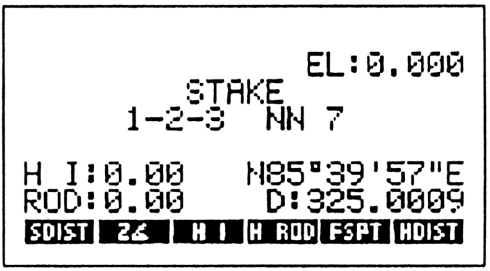
FSPT *used to stake a point or line. See the explanation of staking points and lines that begins on the next page.*

HDIST *used to enter a horizontal distance to stake instead of a point number. Results in the same menu as staking a point.*

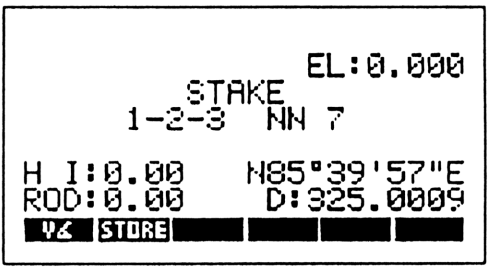
ΔRT / BRG / AZ *use this key as a toggle between the three methods of displaying angles.*

STAKING A POINT

If you press FSPT *with just one point on the command line or stack, the screen will show the inverse from the occupied point to the point given.*



Press NXT



Explanation of FSPT (point) Soft Keys:

SDIST *used to enter a slope distance.*

_____

ZA *used to enter a zenith angle.*

_____

HI *used to enter the height of the instrument.*

_____

HROD *used to enter the height of the rod.*

_____

FSPT *used to enter another point or line to stake.*

_____

HDIST *used to enter a horizontal distance to get a go or come value.*

_____

VA *used to enter a vertical angle.*

_____

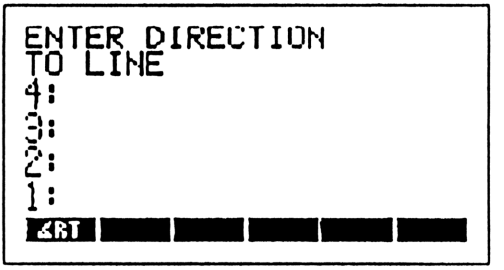
STORE *used to store the last shot made to the stake point.*

_____

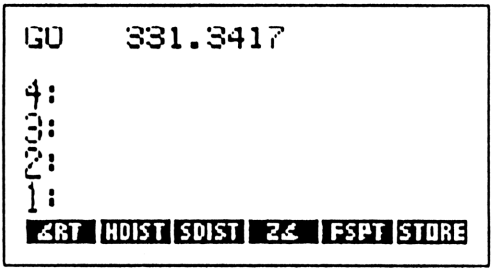
NOTES

STAKING A LINE

If you press **FSPT** *with two points on the stack or command line that define a line, you will be prompted for the angle to the line.*



∠RT *is used to manually get the angle right to the line.*



After giving the angle to the line, the distance to the line is displayed along with a menu to continue staking that line.

Explanation of the FSPT (line) Soft Keys:

SHOT *used to get the distance and angle to the line from the instrument for a go or come value.*

∠RT *used to enter a new angle right to the line.*

HDIST *used to enter a horizontal distance to the line to get a go or come value.*

SDIST *used to enter a slope distance to the line to get a go or come value.*

ZA *used to enter a zenith angle to the line to get a go or come value.*

FSPT *used to enter a new point or points defining a line to stake.*

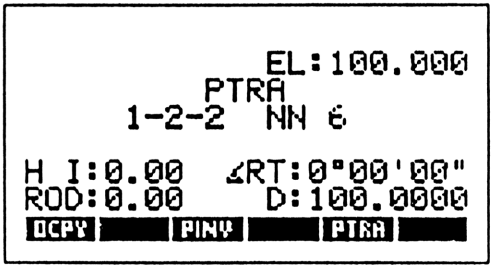
STORE *used to store the last shot to the line.*

(Point Traverse)

Purpose: *To traverse to a point carrying the acerage.*

Keystrokes: [↱] [PTRA]

The traverse information is displayed and the next sequential point number is left on the stack for use as the next traverse point.



Explanation of PTRA Soft Keys:

[OCPY] *used to occupy a point.*

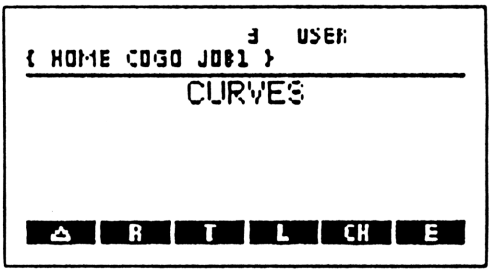
[PINV] *used to see the inverse from the occupied point to a given point. Works the same as* [PINV] .

[PTRA] *used to traverse to another point. Works the same as* [PTRA] .

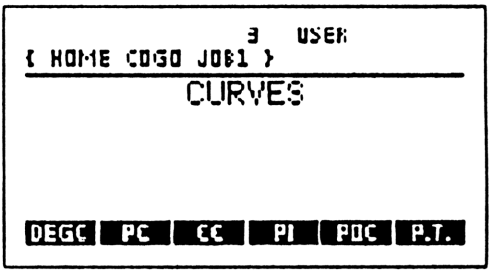
(Curves)

Purpose: To perform curve computations.

Keystrokes: [⌒]



Press [NXT]



When enough information has been entered, the curve is computed and displayed. Usually any two combinations of the elements described below are enough to compute the curve.

Explanation of CURVES (page 1) Soft Keys:

[Δ] *used to enter a delta value.*

[R] *used to enter a radius value.*

T used to enter a tangent length.

L used to enter a curve length.

CH used to enter a chord length.

E used to enter an external length.

Explanation of CURVES (page 2) Soft Keys:

DEGC used to enter the degree of curvature.

PC used to enter the point of curvature and occupy that point. If not entered, the current occupied point is assumed to be the point of curvature.

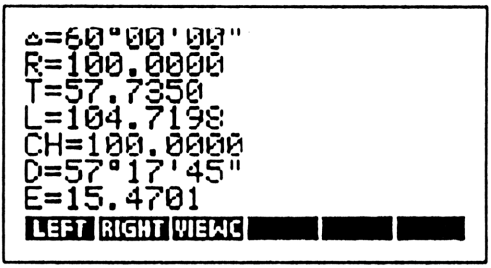
CC used to enter the point number at the center of the curve. The radius is calculated from this point to the point of curvature (the occupied point). The point of

curvature should be occupied before using this function to get a valid radius.

PI *used to enter the point of intersection. The point of intersection is the point at the intersection of the two tangents to the curve.*

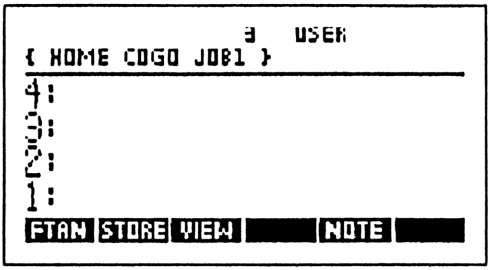
POC *used to enter a point on the curve. The curve can be calculated from this point if the point of tangency and the point of curvature have been defined.*

P.T. *used to enter the point of tangency. The chord of the circle is calculated between this point and the point of curvature (the occupied point).*



After the curve has been calculated, to traverse around the curve, choose the direction that it is turning. **VIEW** *allows you to view the curve information again.*

Now that the curve has been calculated, you have the option to store a point at the end of the curve.

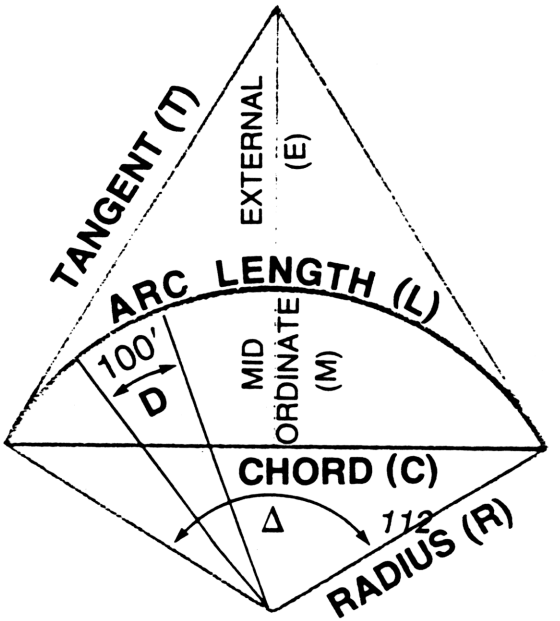


FTAN *allows you to change the forward tangent of the curve. If one is not entered, the forward tangent from the current back azimuth is used.*

STORE *used to store a point at the end of the curve just calculated.*

VIEW *used to redisplay the curve information.*

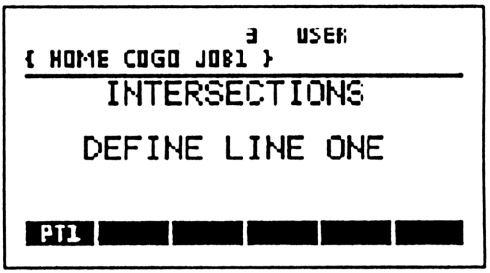
NOTE *used to store a note with the point after it has been stored.*



(Intersections)

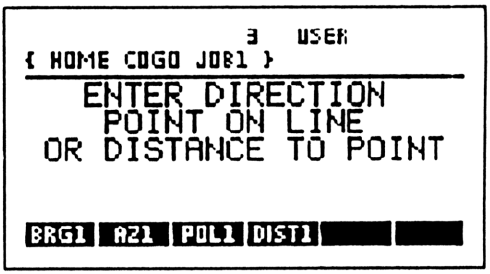
Purpose: To solve a distance - distance, bearing - bearing, bearing - distance, or perpendicular offset intersection and store a point at the intersection.

Keystrokes: ⌧



Explanation of the Intersection Soft Keys:

PT1 *used to enter the first point from which will come a distance or direction.*



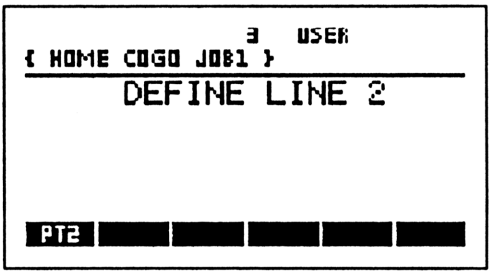
BRG *used to enter a bearing from the first point entered.*

AZ1 *used to enter an azimuth from the first point entered. If two point numbers are on the stack when* AZ1 *is pressed, the direction between the two points will be used as the azimuth from the first point.*

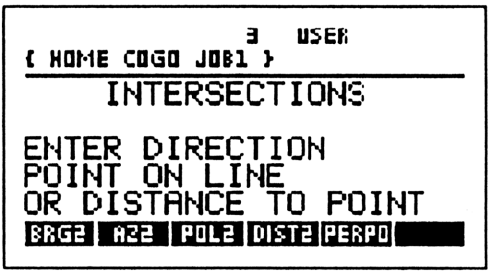
POL1 *used to enter a point on the line from the first point.*

DIST1 *used to enter a distance from the first point.*

After entering a direction or distance from the first point, you will be prompted for the second point.



PT2 *used to enter the second point from which will come a distance or direction to complete the intersection. You will then be prompted for a direction or distance.*



BRG2 *used to enter a bearing from the second point.*

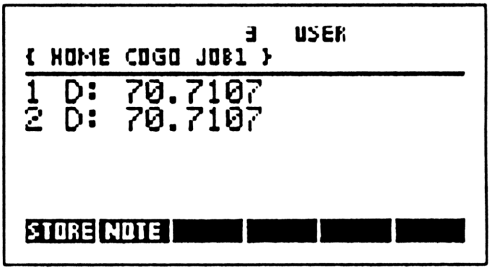
AZ2 *used to enter an azimuth from the second point. If two points are entered, the inverse between them will be used as the azimuth from the second point.*

POL2 *used to enter a point on the line from the second point.*

DIST2 *used to enter a distance from the second point.*

PERP *used to perform a perpendicular offset. Computes the point perpendicular from the second point to the line defined by the first point and direction.*

This display shows the solution for a bearing-bearing intersection. The distance from each point is shown.



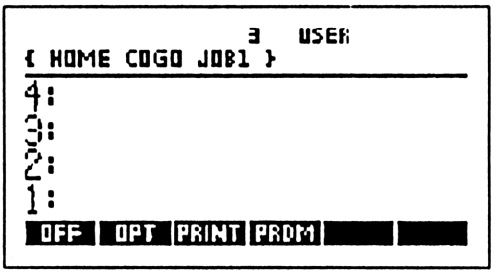
STORE *used to store a point at the solution found.*

NOTE *used to store a note with the point.*

(Print Menu)

Purpose: *To use a printer to print point information or raw data.*

Keystrokes: PRINT



Whenever the calculator is printing, you will see the arrow annunciator at the top right of the display come on. You can interrupt the printing of points by pressing ON .

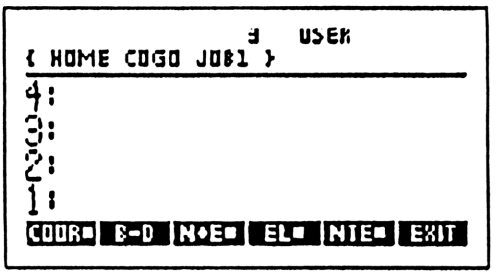
Explanation of PRINT Soft Keys:

OFF / ON *used to select printing that is displayed on the screen while in other menus such as* SIDS *or* VIEW *are being used.*

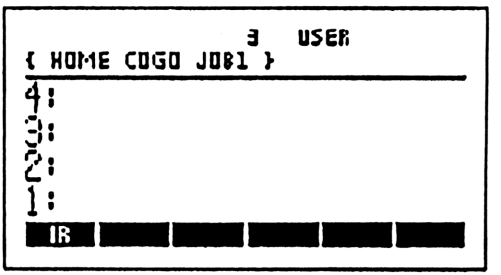
OFF *Certain functions will print both on the screen and on the printer.*

OFF *Only the routines in the PRINT menu will print to the printer.*

OPT *used to select several different printing options.*



Press NXT



Explanation of OPT Soft Keys:

COOR■ / COOR *used to toggle printing coordinates with the points..*

COOR■ *will print coordinates.*

COOR *won't print coordinates.*

B-D■ / B-D *used to toggle printing the bearing and distance between the points as they are printed.*

B-D■ *will print bearing and distance.*

B-D won't print bearing and distance.

N+E■ / N+E used to toggle printing the north and east coordinates of each point.

N+E■ will print the north and east coordinates.

N+E won't print the north and east coordinates.

EL■ / EL used to toggle printing the elevation of each point.

EL■ will print the elevation.

EL won't print the elevation.

NTE■ / NTE used to toggle printing the note of each point.

NTE■ will print the note.

NTE won't print the note.

EXIT will exit the OPT menu to the PRINT menu.

IR / SRIAL *used to toggle between an infrared printer and a serial printer.*

IR *printing will go out by infrared.*

SRIAL *printing will go out through the serial interface.*

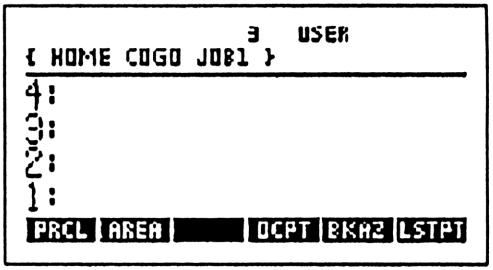
PRINT *used to print a point, a range of points, or the whole file. If there are no point numbers on the stack, all the points in the current job will be printed. If there is just one point number on the stack, only that point will be printed. If there are two point numbers on the stack, the range of points between them will be printed.*

PRDM *used to print the points in the current random point file.*

(View Menu)

Purpose: To view points, area, the back azimuth, or raw data.

Keystrokes: VIEW



Explanation of VIEW Soft Keys:

PRCL *used to view the contents of a point. Whenever a point is displayed, the next point number is put on the stack. This makes it possible to step through the points sequentially by pressing* PRCL .

AREA *used to view the current area traversed. The area is cleared whenever a point is occupied and updated whenever a traverse is made. The precision is based on the difference between the last occupied point and the last point traversed.*

OCPT *used to view the current occupied point information.*

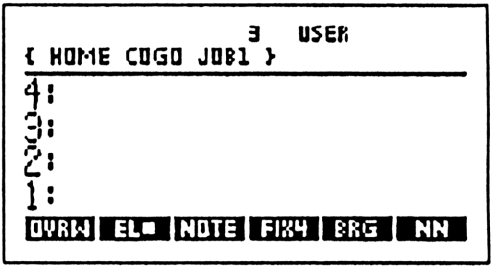
BKAZ *used to view the current back azimuth.*

LSTPT *used to view the last point stored.*

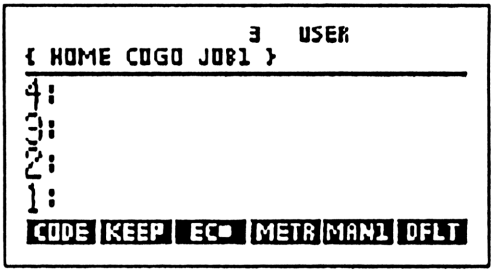
(Change Options Menu)

Purpose: To allow changing the default settings of the calculator.

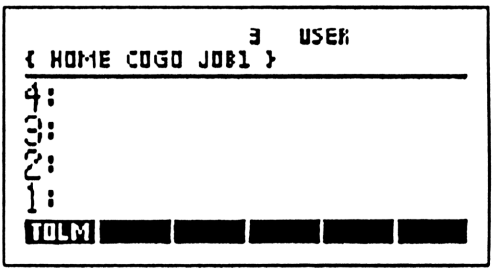
Keystrokes: CHG



Press NXT



Press NXT



Explanation of OPT Soft Keys:

OVRW / OVW■ *used to toggle automatic overwriting*

of previously stored points.

OVRW *if the point about to be stored will replace a previously stored point, the calculator will ask you if you are sure you want to overwrite it.*

OVW■ *the calculator will automatically overwrite points if there is a conflict.*

EL■ / **EL** *used to select storage of elevations.*

EL■ *store elevations.*

EL *won't store elevations.*

NTE■ / **NOTE** *used to select prompting for a note.*

NTE■ *will prompt for note whenever a point is stored.*

NOTE *will not prompt for note. If a note is to be stored, use* **NOTE** *in the* **SIDS** , **TRAV** , **SETUP** , *or* **SC** .

FIX4 *used to change the fix point of numbers on the display and stack. The number shown after FIX is the*

current fix point.

ΔFT / BRG / AZ use this key as a toggle between the three methods of displaying angles.

NN■ / NN used to select next number prompting.

NN■ you will be prompted for the point number of the point about to be stored.

NN The point about to be stored is automatically stored at the next number value. The next number is changed with ↵ NEXTNO and incremented each time a point is stored.

CDE■ / CODE used to select prompting for a code.

CDE■ will prompt for code whenever a point is stored.

CODE will not prompt for code. If a code is to be stored, store the code with the note before a comma. EX: code,note

---

ADD / KEEP *used to select adding to the list of codes and notes as they are entered. See the explanation of notes to learn how to use these lists.*

ADD *as notes and codes are entered to be stored with points, they will be added to the list of codes or notes to select from if they are not stored in the list already.*

KEEP *the code and note lists will not be increased. The most frequently used codes and notes will still be put at the bottom of the stack for easy access.*

EC■ / EC *used to toggle earth's curvature adjustment.*

EC■ *earth's curvature adjustment will be applied.*

EC *earth's curvature adjustment will not be applied.*

MTR■ / METR *toggles converting meters to feet. The only routines that assume feet are those involving acreage.*

MTR■ *horizontal and slope distances will be converted from meters to feet.*

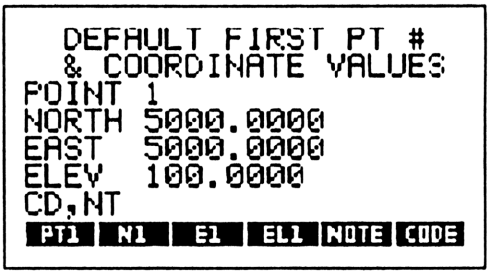
METR *no conversion of distances will occur.*

MAN1 / MAN2 *toggles between using menus or prompting for side shot and traverse collection.*

MAN1 *when* SIDS *or* TRAV *is pressed, a menu for entry of the data will be activated.*

MAN2 *when* SIDS *or* TRAV *is pressed, the user is prompted to enter the slope distance, zenith angle and angle right.*

DFLT *creates a submenu for changing the default first point number and coordinate values. These are the values that will be shown when* JOB *is pressed.*



Explanation of DFLT Soft Keys:

PT1 *used to change the point number of the first point in jobs created in the future.*

N1 *used to change the north coordinate of the first point in jobs created in the future.*

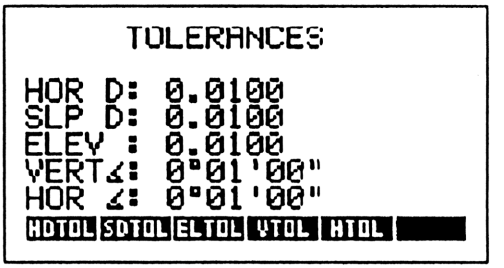
E1 *used to change the east coordinate of the first point in jobs created in the future.*

EL1 *used to change the elevation of the first point in jobs created in the future.*

NOTE *used to change the note of the first point in jobs created in the future.*

CODE *used to change the code of the first point in the jobs created in the future.*

TOLM *creates a submenu to change the current tolerance values.*



Whenever a tolerance is exceeded, the calculator will beep to let you know.

Explanation of TOLM Soft Keys:

HDTO *used to change the horizontal distance tolerance.*

SDTO *used to change the slope distance tolerance.*

ELTO *used to change the elevation tolerance.*

VTOL *used to change the vertical angle tolerance.*

HTOL *used to change the horizontal angle tolerance.*

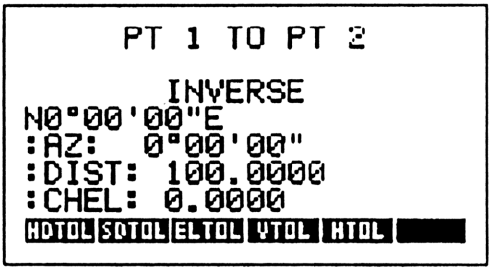
P-P

(Point to Point Inverse)

Purpose: *To display the inverse between two points.*

Keystrokes: *1* **SPC** *2* **P-P**
or 1 **ENTER** *2* **P-P** *to inverse between points 1 and 2.*

The inverse is displayed without changing the current menu.



FAP

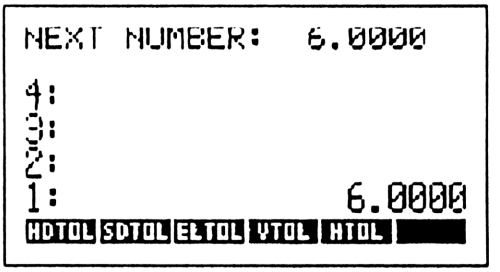
(First Available Point)

Purpose: *To search for a point number in the job that has not been used.*

Keystrokes: ↰ **FAP**

If there are no point numbers on the stack, **FAP** *searches from the beginning of the job for the first point number that has not been used and assigns it to be the next number to be stored. If there is a point number on the stack, the search begins from that point. If that*

point has been used, the search goes toward the higher point numbers until an unused point number has been found. If the point number has not been used, the search goes downward until the point after the highest used point is found.

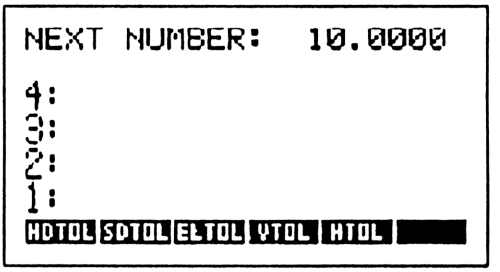


NEXTNO
(Next Number To Be Stored)

Purpose: *To assign the next number to be stored.*

Keystrokes: *10 ↵ NEXTNO to make 10 the next number to be stored.*

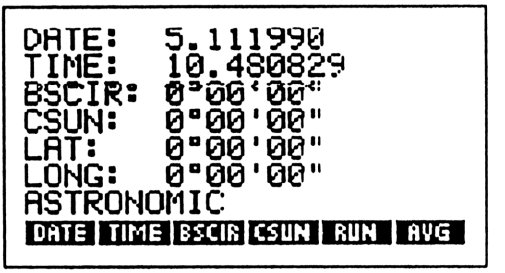
The number shown as the next number will be the point number of the next point stored.



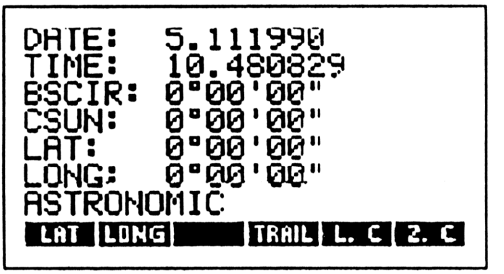
(Sun Shots)

Purpose: *To take a sunshot or to calculate a sun shot previously done.*

Keystrokes: ↱ SUN



Press NXT



Explanation of Sun Shot Soft Keys:

DATE *used to enter a date. The format is MM.DDYYYY . If a date isn't on the stack, the current date in the calculator will be used.*

TIME *used to enter the time. The format is HH.MMSS . If a number isn't on the stack, the time when the key was pressed will be used.*

BSCIR used to enter the backsight circle reading.

CSUN used to enter the circle to the sun.

RUN / REP used to perform the calculation using the values already stored. If one or more sunshots have already been made, REP is on the key instead of RUN . The resulting average circle to the sun is put on the stack.

AVG press to see the average circle reading to the sun calculated from the sun shots made since SUN was pressed. The average is also put on the stack.

LAT used to enter the latitude.

LONG used to enter the longitude.

TRAIL / CNTR used to select the trailing edge or the

center of the sun for pointing.

TRAIL *point at the trailing edge of the sun.*

CNTR *point at the center of the sun.*

L.C *used to enter the longitude constant.*

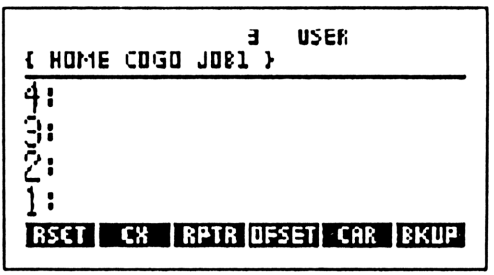
Z.C *used to enter the zone constant.*

(More Routines Menu)

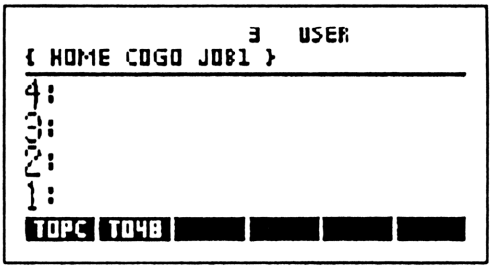
Purpose: To allow access to:

- RSCT *Resections*
- CX *Transformations*
- RPTR *Random Point Traverse*
- OFSE *Offsets*
- CAR *Compute Angle Right*
- BKUP *Back Up Job*
- TOPC *Transfer to Computer*
- TO48 *Transfer to HP 48SX*

Keystrokes: MORE



Press NXT



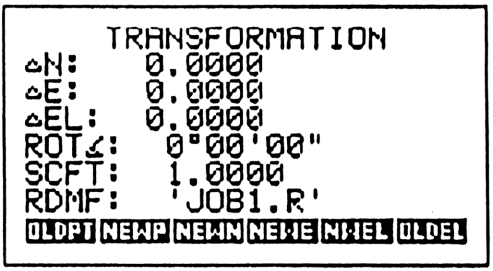
Explanation of MORE Soft Keys:

(Resection)

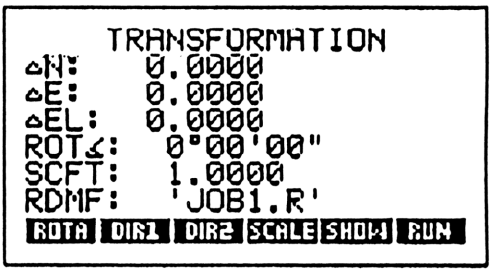
RSCT *used to enter the point number of the first shot. After getting the point number, the shot will be taken electronically or the information will be prompted for.*

SHOT *used to enter the point number of the second shot. After getting the point number, the shot will be taken electronically or the information will be prompted for. The occupied point will then be calculated and stored.*

MORE CX



Press NXT



CX *used to display the transformation menu. The values shown on the screen show what changes will be made to the points in the current random point file when* RUN *is pressed. The rotation angle will be made around the point entered into* OLDP .

Explanation of CX Soft Keys:

OLDP *used to enter the point to translate from and rotate around. If there is not a point to translate to, this same point should be entered as the new point.*

NEWP *used to enter the point to translate.*

NEWN *used to enter the new north of the rotation point (* OLDP *).*

NEWE *used to enter the new east of the rotation point (* OLDP *).*

NWEL *used to enter the new elevation of the rotation point (* OLDP *).*

OLDE *used to enter an old elevation to compare with the new elevation.*

ROTA *used to enter the rotation angle.*

DIR1 *used to enter the direction the rotation angle is turning from. If two points are on the stack, the inverse between the points will be used. DIR1 will be subtracted from DIR2 to get the rotation angle.*

DIR2 *used to enter the direction the rotation angle is turning to. If two points are on the stack, the inverse between the points will be used. DIR1 will be subtracted from DIR2 to get the rotation angle.*

SCAL *used to enter a scale factor. Scale factors greater than 1 increase the distance between points while scale factors less than 1 decrease the distance between points.*

SHOW *used to show the changes that will be made to points in the random point file when* RUN *is pressed.*

RUN *used to perform the transformation based on the values shown when* SHOW *is pressed.*

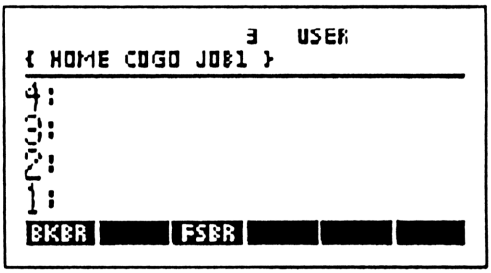
RPTR *press to perform a random point traverse. The current random point file is used. The last point in the random point file should be the point that the second to last point will be compared to for a precision value.*

EX: JOB1 2.5 10 2

This example random point file shows how to make a closed traverse from 2 to 10 and compare point 10 to point 2 for a precision value.

OFSET *used to perform an offset from a list of points and curves in the current random point file. After prompting for an offset distance, points will be stored to create a width of that distance away from the curves and points in the random point file. The point numbers used to store the points created will start at the current next number value unless next number prompting is on (changed in the CHG menu). How to enter curves and point numbers is listed in the description of how to use* RPTS *(Random Points Store).*

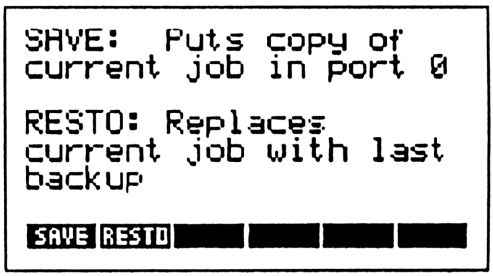
CAR *used to compute the angle right from the back bearing and the foresight bearing.*



BKBR *used to enter the back bearing.*

FSBR *used to enter the foresight bearing.*

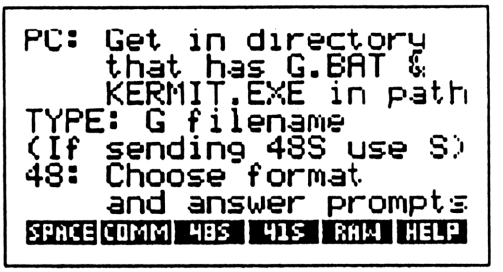
BKUP *used to save a backup copy of the current job in port 0. This may be done to prepare to free a memory card that is currently merged or to save an old copy for later use.*



SAVE *makes a copy of the current job and puts it in port 0. If an old copy of the job is already in port 0, it is replaced.*

REST *replaces the current job with the copy that is in port 0. The copy in port 0 remains as it was.*

TOPC *used to send data to a computer.*



REQUIRED TO INTERFACE WITH A COMPUTER

Hardware: *A computer with a serial port.*
A cable from the HP 48SX to the serial port.

Software: *Transfer software that supports Kermit protocol. How to use the version included on the HP Interface Kit disk (called KERMIT.EXE) for IBM compatible computers is explained in this manual.*

BEFORE INTERFACING WITH THE COMPUTER

You first need to store the transfer software in the directory where you will be sending and receiving files to and from the HP 48SX. If you have the HP Interface Kit, it is the KERMIT.EXE file.

To make the transfers between your HP 48SX and your computer more automatic, we suggest that you write two batch files that we call G.BAT and S.BAT. If you don't know what batch files are, don't worry, you don't need to know what they are to use them. You can even make batch files without knowing what they are. To make the G.BAT batch file, get in the directory in your computer that you want to transfer files from and type at the DOS

prompt:

COPY CON G.BAT (Enter)
KERMIT SET PORT 1,SET BAUD 9600,LOG SES %1,C
(Ctrl Z) (Enter)

Make the other batch file by typing:

COPY CON S.BAT (Enter)
KERMIT SET PORT 1,SET BAUD 9600, SERVER
(Ctrl Z) (Enter)

These batch files assume you are using port 1 for your transfers to and from the HP 48SX. If you want to use a different port, substitute the desired port number where the 1 after PORT occurs.

Using batch files saves you from having to type the commands to get Kermit properly set up each time you want to do a transfer.

If you want to learn more about KERMIT.EXE, read the KERMIT.TXT file that came with the HP Interface Kit.

When Ready To Send Data To The Computer

To prepare the computer to receive a file from the HP 48SX, type:

G filename

After the file has been transferred, it will be stored under the filename given after G.

Explanation of TOPC Soft Keys:

SPACE *used to send the current job as a space delimited ascii file to a computer.*

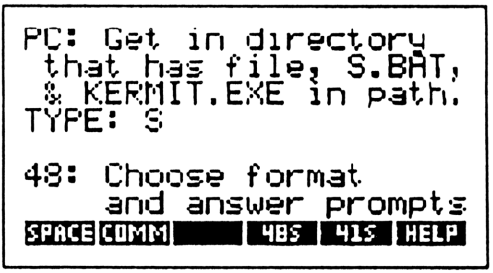
COMM *used to send the current job as a comma delimited ascii file to a computer.*

48S *used to send the current job to a computer for a quick backup. This is the fastest transfer protocol. Note that instead of typing G on the computer, S is used when sending 48S format.*

41S *used to send the current job in 41S format to a computer.*

RAW *used to send the current raw data file to the computer.*

HELP *reminds you of what needs to be in the G.BAT file to send a file to the computer.*



TO48 used to send data from a computer to the HP 48SX. Read the information on TOPC to learn the preliminary requirements for data transfer.

When Ready To Send Data To The HP 48SX

On the computer type:

S

The computer will now wait until the file has been transferred. To abort the transfer, type (Ctrl C) on .

On the HP 48SX, choose the format below that describes the type of file that is to be sent. You will be prompted for the name of the file to load into the HP 48SX. When the transfer is done, type (Ctrl C) on the computer to return to the DOS prompt.

Explanation of TO48 Soft Keys:

SPACE used to receive a file in space delimited format. Will prompt you for the lowest and highest points in the file before asking for the name of the file.

COMM used to receive a file in comma delimited format. Will prompt you for the lowest and highest

points in the file before asking for the name of the file.

48S *used to receive a file in 48S format. This is the quickest way to receive a file.*

41S *used to receive a file in 41S format.*

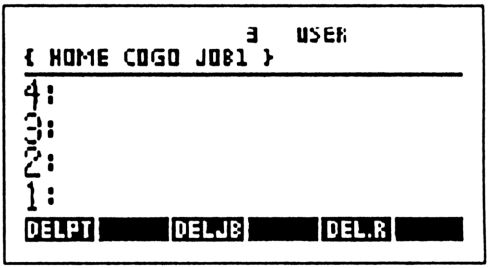
HELP *reminds you of what needs to be in the S.BAT file.*

DEL

(Delete Menu)

Purpose: To delete a point, a job, or a random point file.

Keystrokes: DEL



Explanation of DEL Soft Keys:

DELP *used to delete a point out of the current job.*

DELJ *used to delete a job.*

DEL.R *used to delete a random point file.*

DROP
(Drop First Level)

Purpose: *To drop the object on the first level of the stack.*

Keystrokes: ↰ **DROP** *(shift is not necessary)*

Explanation: ↰ *2 will restore the stack.*

CLEAR
(Clear Stack)

Purpose: *To clear everything from the stack.*

Keystrokes: ↱ **CLEAR**

Explanation: ↰ *2 will restore the stack.*

USER
(User Toggle)

Purpose: *To turn user mode off and on.*

Keystrokes: ↰ **USER**

Explanation: *The K program sets a system flag that makes* **USER** *a two-way toggle instead of a three-way toggle. User mode is on when USER is displayed in the normal stack display. For the functions on the overlay to be active, User mode must be on.*

[△RT]
(Angle Right)

Purpose: *Convert an angle right to an azimuth.*

Keystrokes: [↱] [△RT]

Explanation: *Expects a number on the stack and returns an azimuth based on the current back azimuth.*

[DEF-LT]
(Deflection Left)

Purpose: *Convert a deflection left to an azimuth.*

Keystrokes: [↱] [DEF-LT]

Explanation: *Expects a number on the stack and returns an azimuth based on the current back azimuth.*

[DEF-RT]
(Deflection Right)

Purpose: *Convert a deflection right to an azimuth.*

Keystrokes: [↱] [DEF-RT]

Explanation: *Expects a number on the stack and returns an azimuth based on the current back azimuth.*

[→HMS]
(Convert to HMS)

Purpose: *To convert a decimal number to degrees, minutes, and seconds format.*

Keystrokes: [↱] [→HMS]

Explanation: *Expects a decimal number on the stack and converts it to HMS format. The answer is tagged as HMS.*

[↰]
(Shift Left)

Purpose: *To access the functions in orange on the keyboard and overlay.*

Keystrokes: [↰]

Explanation: *After pressing it the next key pressed will execute the function in orange beside that key. Pressing* [↱] *or* [↰] *will deactivate* [↰] *if it was active.*

N-W

(North West Bearing)

Purpose: *To convert a northwest bearing to an azimuth.*

Keystrokes: [↱] **N-W**

Explanation: *Expects a bearing on the stack and returns an azimuth.*

ATB

(Azimuth to Bearing)

Purpose: *To convert an azimuth to a bearing.*

Keystrokes: [↱] **ATB**

Explanation: *Expects an azimuth on the stack and returns the bearing tagged with the appropriate quadrant.*

∠LT

(Angle Left)

Purpose: *To convert an angle left to an azimuth.*

Keystrokes: [↱] **∠LT**

Explanation: *Expects an angle left on the stack and returns the azimuth.*

[→HR]

(Convert to Decimal Hours)

Purpose: *To convert an angle in degrees, minutes, and seconds format to decimal degrees.*

Keystrokes: [↱] [→HR]

Explanation: *Expects an angle in HMS format on the stack and returns the decimal value. The answer is tagged with DEC to indicate decimal format.*

[↱]

(Shift Right)

Purpose: *To access the functions in blue on the keyboard and overlay.*

Keystrokes: [↱]

Explanation: *After pressing it the next key pressed will execute the function in blue beside that key. Pressing* [↰] *or* [↱] *will deactivate* [↱] *if it was active.*

[N-E]
(North East Bearing)

Purpose: *To convert a northeast bearing to an azimuth.*

Keystrokes: [↱] [N-E]

Explanation: *Expects a bearing on the stack and returns an azimuth.*

[S-E]
(South East Bearing)

Purpose: *To convert a southeast bearing to an azimuth.*

Keystrokes: [↱] [S-E]

Explanation: *Expects a bearing on the stack and returns an azimuth.*

[N-E]
(North East Bearing)

Purpose: *To convert a northeast bearing to an azimuth.*

Keystrokes: [↱] [N-E]

Explanation: *Expects a bearing on the stack and*

returns an azimuth.

[HMS-]
(HMS Subtract)

Purpose: To subtract two numbers in HMS format.

Keystrokes: [↱] [HMS-]

Explanation: Expects two numbers on the stack in HMS format. The result is tagged with HMS to indicate the format.

[ON]
(On or ATTN)

Purpose: To turn the calculator on, to clear the command line or stack, or to stop program execution.

Keystrokes: [ON]

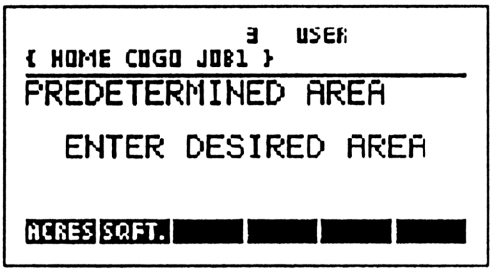
Explanation: If the calculator is off, [ON] *turns it on. If user mode is on, the stack is cleared. If pressed when answering a prompt and the stack is not visible, the command line is cleared.*

PREA

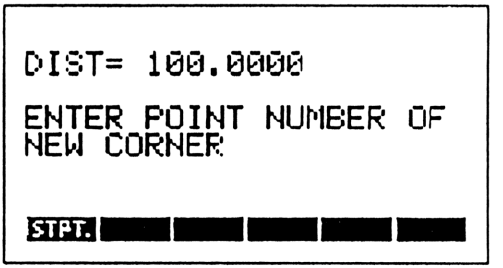
(Predetermined Area)

Purpose: *To store a point that finishes a boundary of a desired area using the pivot method.*

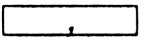
Keystrokes: ↱ **PREA**



Enter the area and press either **ACRE** *for acres or* **SQFT** *for square feet. The current random point file will now be used to compute the point. The random point file should begin with the pivot point and end with the two points defining the line along which the calculated point will be stored. See the explanation of* **RPTS** *to learn how to enter points and curves in a random point file.*

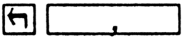


The distance shown is the distance from the second to last point in the random point file along the line defined by the last point. To store the point at a point number other than the next number, enter the point number and press **STPT**



(Comma)

Purpose: *To precede a note with a code.*

Keystrokes: 

Explanation: *If a code is to be associated with a point, it can be stored with the note by putting in the code, typing in a comma and if desired, a note. This is not necessary if code prompting is turned on in*  *.*

(Return ↵)

Purpose: *To allow text to continue on the next line.*

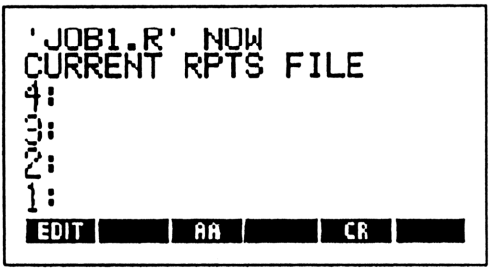
Keystrokes: 

Explanation: *While typing in a note or random point file, it may make reading them on the screen easier if a return is inserted into the text when the characters get to the right edge of the screen.*

(Compass Rule and Angle Adjustments)

Purpose: To perform compass rule and angle adjustment operations on points in the current random point file.

Keystrokes: ↱ COMPAS



Explanation of COMPAS Soft Keys:

EDIT *used to edit the current random point file. A full explanation of* EDIT *is given with the explanation of the* RPTS *menu.*

AA *used to perform an angle adjustment using the current random point file. The last two traverse points in the file should define the direction assumed to be correct and the second to last two traverse points should define the error direction.*

EX: JOB1 1.7 10 1 2

In the above example, the angle adjustment is to be performed on a closed traverse. The 1.7 shown

indicates a range of points from point 1 to point 7. Points 7 and 10 were shot at the same place as 1 and 2 after traversing around the property. The difference in the direction between points 1 and 2 and points 7 and 10 will be averaged among all the angles turned. The points will be adjusted and stored in place of their old values.

To adjust the side shots along with the traverse points, enter them as negative numbers or negative ranges of numbers. They should occur in the random point file after the traverse point they were shot from.

EX: JOB1 1.7 -8 -9 10 1 2

This random point file accomplishes the same adjustment as the one above except that side shots 8 and 9 are adjusted along with their traverse point 7.

CR *used to perform a compass rule adjustment using the current random point file. The last point in the random point file should be the accepted point. The second to last traverse point should be the point shot to the accepted point at the end of the traverse.*

EX: JOB1 1 5.10 15 201

In the example above, the compass rule adjustment is to be performed on an open traverse. Point 15 was shot to the same place as point 201. The direction and distance of error between point 15 and point 201 will be spread proportionally through the whole traverse to

result in point 15 getting the same coordinates as point 201.

To adjust the side shots along with the traverse points, enter them as negative numbers or negative ranges of numbers. They should occur in the random point file after the traverse point they were shot from.

EX: JOB1 1 -2.4 5.10 15 201

This random point file accomplishes the same adjustment as the one above except that side shots 2 through 4 are adjusted along with their traverse point 1.

[HMS+]
(HMS Add)

Purpose: To add two numbers in HMS format.

Keystrokes: [↱] [HMS+]

Explanation: Expects two numbers on the stack in HMS format. The result is tagged with HMS to indicate the format.

APPENDIX B
Lambert Zones
Central Meridians and Zone Constants for State Plane Coordinates

STATE	ZONE	CENTRAL LONGITUDE	LATITUDINAL CONSTANT
Arkansas	North	92 00	0.581899
	South	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	North	105 30	0.646133
	Central	105 30	0.630690
	South	105 30	0.613378
Connecticut		72 45	0.663059
Florida	North	84 30	0.502526
Iowa	North	93 30	0.677745
	South	93 30	0.658701
Kansas	North	98 00	0.632715
	South	98 30	0.614528
Kentucky	North	84 15	0.622067
	South	85 45	0.606462

STATE	ZONE	CENTRAL LONGITUDE	LATITUDINAL CONSTANT
Louisiana	North	92 30	0.528701
	South	91 20	0.500013
	Offshore	91 20	0.454007
Maryland		77 00	0.627634
Massachusetts	Mainland	71 30	0.671729
	Island	70 30	0.661095
Michigan	North	87 00	0.722790
	Central	84 20	0.706407
	South	84 20	0.680529
Minnesota	North	93 06	0.741220
	Central	94 15	0.723388
	South	94 00	0.700928
Montana	North	109 30	0.746452
	Central	109 30	0.733354
	South	109 30	0.714901
Nebraska	North	100 00	0.673451
	South	99 30	0.656076
New York	Long Island	74 00	0.654082
North Carolina		79 00	0.577171
North Dakota	North	100 30	0.744133
	South	100 30	0.729383

STATE	ZONE	CENTRAL LONGITUDE	LATITUDINAL CONSTANT
Ohio	North	82 30	0.656950
	South	82 30	0.634520
Oklahoma	North	98 00	0.590147
	South	98 00	0.567617
Oregon	North	120 30	0.709186
	South	120 30	0.684147
Pennsylvania	North	77 45	0.661540
	South	77 45	0.648793
South Carolina	North	81 00	0.564497
	South	81 00	0.544652
South Dakota	North	100 00	0.707738
	South	100 20	0.689852
Tennessee		86 00	0.585440
Texas	North	101 30	0.579536
	North Central	97 30	0.545394
	Central	100 20	0.515059
	South Central	99 00	0.489913
	South	98 30	0.454007
Utah	North	111 30	0.659355
	Central	111 30	0.640579
	South	111 30	0.612687
Virginia	North	78 30	0.624118
	South	78 30	0.606925

STATE	ZONE	CENTRAL LONGITUDE	LATITUDINAL CONSTANT
Washington	North	120 50	0.744520
	South	120 30	0.726396
West Virginia	North	79 30	0.637773
	South	81 00	0.618195
Wisconsin	North	90 00	0.721371
	Central	90 00	0.705577
	South	90 00	0.687103

APPENDIX C
Transverse Mercator Zones

Central Meridians of State Plane Coordinates

E = East
W = West
C = Central

STATE	ZONE	C.M.	STATE	ZONE	C.M.
Alabama	E	85 50	Hawaii	1	155 30
	W	87 30		2	156 40
				3	158 00
Alaska	2	142 00		4	159 30
	3	146 00		5	160 10
	4	150 00			
	5	154 00	Idaho	E	112 10
	6	158 00		C	114 00
	7	162 00		W	115 45
	8	166 00			
	9	170 00	Illinois	E	88 20
Arizona	E	110 10		W	90 10
	C	111 55			
	W	113 45	Indiana	E	85 40
				W	87 05
Delaware		75 25			
Florida	E	81 00	Maine	E	68 30
	W	82 00		W	70 10

STATE	ZONE	C.M.	STATE	ZONE	C.M.
Georgia	E	82 10	Michigan	E	83 40
	W	84 10	(1934)	C	85 45
				W	88 45
Mississippi	E	88 50	New Mexico	E	104 20
	W	90 20		C	106 15
				W	107 50
Missouri	E	90 30			
	C	92 30	New York	E	74 20
	W	94 30		C	76 35
				W	78 35
Nevada	E	115 35	Rhode Island		71 30
	C	116 40	Vermont		72 30
	W	118 35			
			Wyoming	1	105 10
New Hampshire		71 40		2	107 20
				3	108 45
New Jersey		74 40		4	110 05

Other Surveying Cards Available:

48BC Basic Coordinate Geometry Surveying Card

- Stores 1200 points by point number without additional memory.
- Compute curves and intersections.
- Translate, rotate and scale any set of points.
- Compute perpendicular offset from a line.
- Compass rule adjustment.
- Compute acres, square feet, and perimeter by point number.

48SC Standard Coordinate Geometry Surveying Card

Contains all of the features of the 48BC plus the following features:

- Built in sunshot program that develops its own ephemeris.
- Store elevations as well as coordinates.
- The stake program gives GO and COME values. If elevations are on it gives CUT and FILL.
- Pre-determined area by hinge and slide method.
- ASCII data to PC.

48DC Data Collection for Land Surveyors

Includes hardware and software. Contains all of the features of the 48AC plus the following features:

- Both manual and electronic data collection.
- Electronically collects data from Lietz, Nikon's Top Gun, Topcon, Wild and Zeiss Electronic Total Stations.
- Hardware included: HP 48SX, tripod mount, environmental case, cable to PC, cable to Instrument. Video training tape, overlay and manuals.

Surveyor's Module, Inc.
250 West New Street, Kingsport, TN 37660