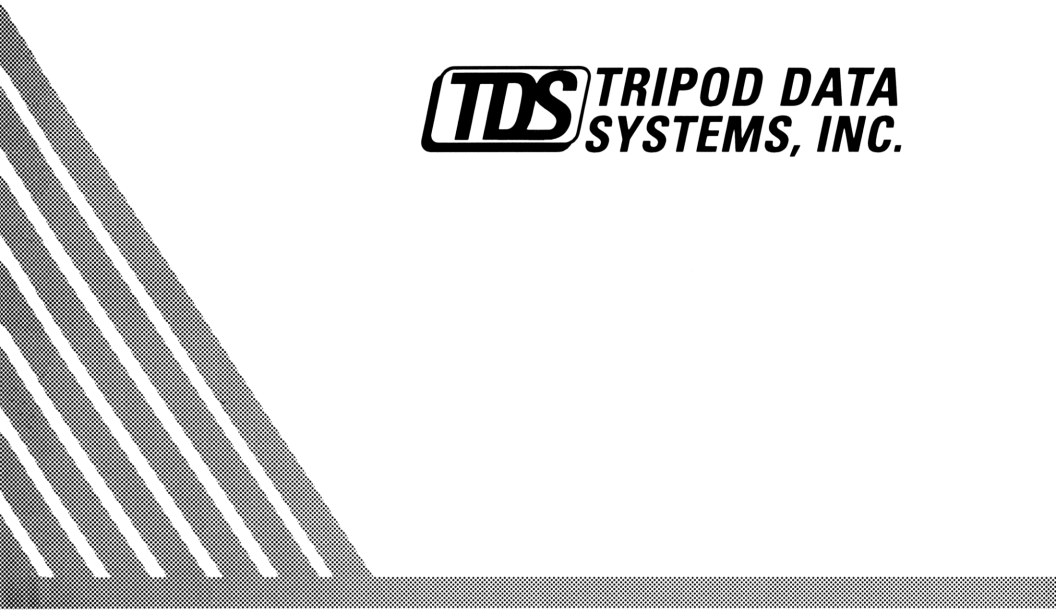
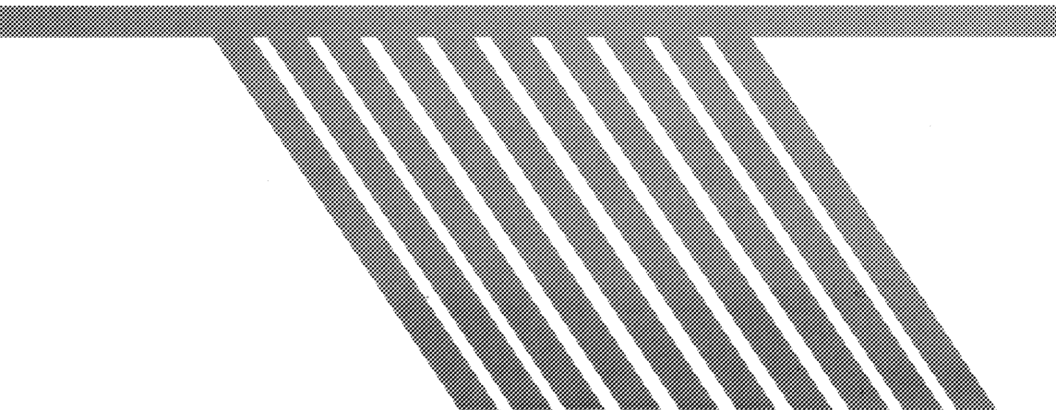


TRIPOD DATA SYSTEMS, INC.

TDS-COG048

User's Manual



TDS-COGO48

COGO Card

User's Manual

For use with the HP-48

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1. INTRODUCTION

In this chapter, you will become familiar with the TDS-COGO48 Card; you will install the card in your HP-48SX/GX Handheld Computer; you will learn about its general features and capabilities; and you will be introduced to the organization and content of this manual.

WELCOME TO THE TDS-COGO48

The TDS-COGO48 is an IC (Integrated Circuit) Card for the HP-48 Scientific Expandable Handheld Calculator. The program is stored in Read Only Memory (ROM) and therefore has no need for a backup battery. With normal use, the user cannot delete, change or damage the program that is stored on this card.

The HP-48 has significantly more computational capability than previous HP scientific calculator products. Indeed, it is unlikely that any single user will require or need to learn all of the features of the machine. This is true for the typical land surveyor. By using the TDS-COGO48 Card in conjunction with your HP-48, you will be able to take advantage of all of the hardware features of the HP-48 in your day-to-day surveying work without having to open the HP-48 manuals. This TDS-COGO48 Manual contains all of the information you need to gain the productivity in your work, that this technology offers. The TDS-COGO48 converts your HP-48 into a powerful COGO computer that provides several basic functions needed by the student or professional land surveyor:

1) The TDS-COGO48 may be used to manually collect data observations in the field by keying them in. These observations are converted to three dimensional coordinates as they are obtained.

2) Since the coordinates of your points are always available, you may apply a wide variety of built-in CO-GO functions to the coordinates to analyze and adjust your job, as well as to add design points to your data file.

3) In the office, you can use TDS's companion TFR software to upload and/or download your coordinates and raw data to or from an office PC. The TFR programs also give you the ability to convert your coordinate data into formats that can be used by a wide variety of CO-GO, CAD and other survey- related software.

SYSTEM CONFIGURATION

The minimum configuration required for the TDS-COGO48 is the following:

1) 1 HP-48SX or GX Scientific Expandable Calculator.

2) 1 TDS-COGO48 Card.

3) 1 TDS-COGO48 Keyboard Overlay.

In addition, if you want to connect your TDS-COGO48 to your office PC, you will need:

4) 1 TDS PC to HP-48 cable or HP-82208A opt.1AW Cable.

5) 1 TDS TFR PC Program (see note below).

The TDS TFR PC Program will provide for data communication between your PC and your TDS-COGO48. It also serves as a file conversion capability to convert your surveying data files into files that are compatible with approximately 20 different brands of PC Surveying and Civil Engineering Software. The TDS TFR PC Program is included as a part of TDS's EASY SURVEY Office Software.

A 32k-byte or 128k-byte RAM Card can be added to the system and merged with main memory to increase the storage capacity:

INSTALLING YOUR TDS-COGO48 CARD

Installation of your TDS-COGO48 Card is simple and straight-forward. However, you should follow these installation instructions exactly as they are presented here:

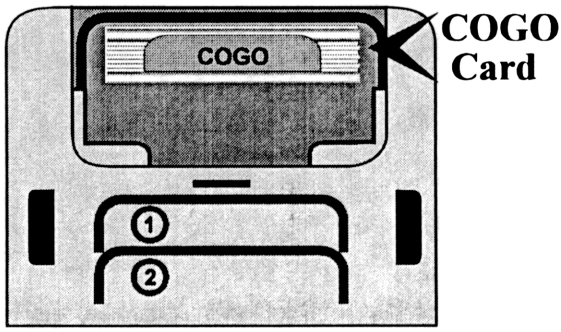
Be certain that you have three AAA alkaline battery cells properly installed in your HP-48 before you begin the card installation process. If you have no cards plugged into your HP-48, you may go to step 3.

Step 1: Turn your HP-48 OFF: [ON]

Step 2: Remove any IC cards that you will not be needing with the TDS-COGO48. **Do not remove your RAM if it is configured as part of the main system RAM. This will cause a system memory loss.** Save any data that is needed if the RAM card is to be removed.

Step 3: Turn your HP-48 **[ON]** and then OFF again: [ON].

Step 4: Insert your **TDS-COGO48 Card** into **Port 1** if you have an HP-48SX or **Port 2** if you have an HP-48GX. Ports 1 & 2 may be identified by the graphic on the back of the HP-48. Cards are installed with the card graphics facing up when the 48 is inverted (keyboard down).



Step 5: Turn the 48 **[ON]** & enter α α T D S C O G O**[Enter]**.

Step 6: Place the TDS-COGO48 Keyboard Overlay on the HP-48's keyboard. The small tabs on the edges of the overlay fit into slots on the keyboard.

You will need to repeat this installation procedure whenever your HP-48 experiences a memory loss. Perform steps 3 through 8.

Step 7: When you insert a RAM card for the first time, you *may* get an **"WARNING Invalid Card Data"** error message. This is normal. Ignore this error message and proceed with running your TDS-COGO48.

For the remainder of this manual, we will adopt the convention of using the term TDS-COGO48 to refer to the combination of a TDS-COGO48 Card installed in an HP-48SX or GX.

EXPANDING THE TDS-COGO48 MEMORY

Before you install the TDS-COGO48 you may want to determine the memory configuration the you want to use. The HP-48SX has about 32k-bytes of RAM memory available for the TDS-COGO48 to use to store coordinate data. This will accommodate up to about 1000 three dimensional points. The HP-48GX has about 128k-bytes of RAM memory for coordinate data. It will accommodate up to about 4000 points. Two sizes of RAM cards are available to expand the TDS-COGO48: 32k-bytes and 128k-bytes. These cards will add room for up to 1000 or 4000 points, respectively.

In addition the HP-48SX can use a RAM card as a backup or storage device. When used in this manner you cannot merge the memory card with the main memory. The following table should be of use in determining the HP-48 port in which to insert the TDS-COGO card and the RAM card for the various configurations.

Memory Configuration:	HP-48SX		HP-48GX	
	Insert card in specified port			
	COGO	RAM	COGO	RAM
No Memory card	Port 1		Port 1 or 2	
32k or 128k card merged with main memory	Port 1	Port 2	Port 2	Port 1
RAM card used as backup disk	Port 1	Port 2	N/A	N/A

RUNNING THE TDS-COGO48

Turn the TDS-COGO48 **[ON]**. When you first turn on your TDS-COGO48, you are presented with the standard HP-48 operational stack in the display. The keyboard will respond as a standard HP-48. It is beyond the scope of this manual to describe the operations of the standard HP-48. To learn how to use your system as a standard HP-48, consult the HP-48 Operator's Manuals that came with your unit.

When the TDS-COGO48 Card software is running, the Card takes over the control of the operation of the unit and the machine will *not* behave as a standard 48. To use the unit as an HP-48, it is necessary for you to EXIT the program (see below).

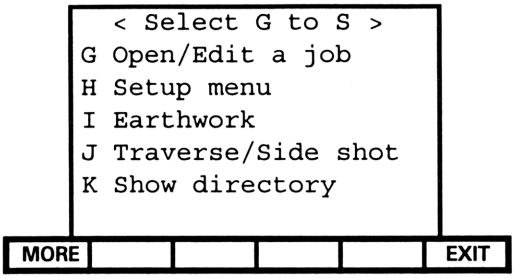
To run the Surveying Card Software, first press the alpha key **[α]** **[α]** twice.

This manual uses the convention of showing keystrokes in **[BOLDFACE]** enclosed in square brackets **[ ]**. This convention is used whether the key is primary, shifted or a "soft" key. The alpha key is the one directly above the *purple* left shift key and is depicted in this manual as it is on the keyboard as **[α]**. In the standard HP-48, pressing **[α]** once will enable the alpha key definitions for the next keystroke. Pressing **[α]** twice will lock the system in alpha mode. You will learn more about the keyboard and display of the TDS-COGO48 in the next chapter: Getting Started.

Now, in alpha mode, type **[T]** **[D]** **[S]** **[C]** **[O]** **[G]** **[O]**[**ENTER**].
Use of the **[ENTER]** key will clear alpha mode.

INTRODUCTION

You should now see the Main Menu of the TDS-COGO48.



Once you have activated the TDS-COGO48 software, the TDS-COGO48 will remain in control of the system until you intentionally return to the standard HP-48 operating system. Turning the unit OFF and then ON again should return you to the same screen that was active when the unit was turned OFF.

EXITING THE TDS-COGO48

If you wish to exit from the TDS-COGO48 and return control of the system to the standard HP-48 operating system, press the **[EXIT]** softkey, from the Main Menu. You will be asked "**Exit program? [Y/N]**". Pressing the **[Y]** key will return you the HP-48 stack; entering **[N]** will return you to the TDS-COGO48 main menu. If you exit the program, you may return by repeating the instructions on running the TDS-COGO48, given in the previous section.

NOTE

For a more detailed description of "soft" keys and their use, see Chapter 2 - Getting Started.

HOW TO LEARN THE SYSTEM AND HOW TO USE THIS MANUAL

The best way to learn the TDS-COGO48 System is to sit down and use it. You will find the user interface to be very intuitive and easy to master. This is due primarily to the consistency within the TDS-COGO48 which has been widely accepted within the surveying community. The TDS-COGO48 utilizes a combined "Menu"-and-"Screen" user interface. Screens make appropriate use of the HP-48's "softkeys". These six keys across the top of the keyboard are defined as is appropriate to each job. A one word explanation of these keys are always shown in the bottom row of the 48's screen. After you've learned a few "rules of the road" (Chapter 2), the most effective way to master any feature of the TDS-COGO48 is to go ahead and press some keys. See what happens. You can't hurt the TDS-COGO48.

This User's Manual is organized into two major sections. The Tutorial consists of introductory material and a series of examples which teach the various features of the TDS-COGO48 system in a step-by-step fashion. The second section consists of a detailed Reference Manual which describes all of the functions of the TDS-COGO48. It is organized by class of function. Use the Tutorial to master the basic operation of the TDS-COGO48, at that time, learning the "rules of the road" and working through the example problems. Then you should need to use the Reference Manual only to answer specific questions about detailed operations of a particular function.

The tutorial will not cover every screen or routine in the TDS-COGO48; however, it will explain in detail each type of procedure. It will have several examples of CO-GO and curve routines. TDS software products are all very consistent in their layout and use. If you learn one CO-GO calculation, you have a good idea how to use them all. The more you use a part of your product the more familiar you are with that product as a whole. If you are familiar with a routine in one product, you already know how to use that routine in an other product. So dig in and get dirty. Using the TDS-COGO48 is the best way to learn it.

INTRODUCTION

For TDS-COGO48 users who find that they would like to maximize the use of their COGO computer by using a companion software in a PC, Tripod Data Systems offers **Easy Survey**. **Easy Survey** looks and acts as your TDS-COGO48 program would if it ran on a PC. Many of the menus and screens with which you are familiar, are used throughout Easy Survey. Other new and more powerful functions like automated mapping and contouring, use a menu and screen user interface, which you are already familiar and will find to be instinctively comfortable. You can take a notebook PC to the job site and **see** your work before you leave.

Easy Survey provides real time graphics throughout. When you perform an inverse on two points, a line connecting the two points is drawn on the screen. Perform an area solution and a boundary appears defining the property. If you use automated mapping, the descriptor codes you used when locating points on curb lines, center lines, easements, etc. are automatically drawn as lines, arcs, points, symbols, annotation, etc., by Easy Survey. You can overlay a contour map; perform a Least Squares adjustment; export your graphic map from the display of your monitor as an Autocad DXF drawing file or a MicroStation DGN file; or use your printer or plotter to make a fast and easy hard copy.

If you like the way your TDS-COGO48 card works, you'll find TDS **Easy Survey** is the perfect match on your PC.

2. GETTING STARTED

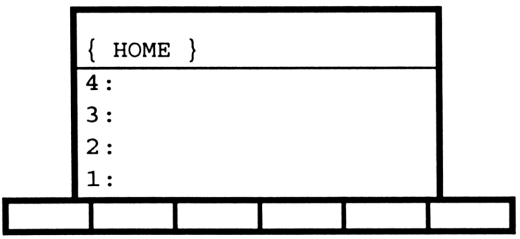
In this chapter, you will start to use your TDS-COGO48. You will initialize the unit by selecting the various setting for your TDS-COGO48. You will learn how the features and functions in the TDS-COGO48 are organized and how the various kinds of data are stored. Finally, you will create your first job.

BEFORE YOU START

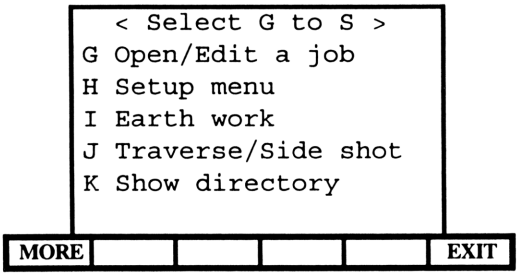
Before you start, you should be certain that you have installed in your HP-48 your batteries and have installed your TDS-COGO48 Card. For installation instructions see Chapter 1 - Introduction.

RUNNING YOUR TDS-COGO48

Now, press the **[ON]** key. You will see the operational stack of the standard HP-48 operating system displayed as:



Now press [α] [α] [T] [D] [S] [C] [O] [G] [O][ENTER]. The TDS-COGO48 Card has now taken over control of the machine. You will see the MAIN MENU of the system which looks like:



GETTING STARTED

To turn off the unit, press the [↩] and **[ON]** keys. Now, press **[ON]** again. Notice that you return to the Main Menu. This is where you were when you turned the unit OFF. This is the *first Rule of the Road:* **When you turn the TDS-COGO48 ON, you will return to the screen or menu location occupied when you turned the machine OFF.**

The six boxes at the bottom of the display screen are called *"soft"* key labels. They identify the functions of the six keys in the top row of the keyboard. Pressing any one of these keys will activate the function shown in the box above that key in the bottom row of the screen. The functions will change depending on the particular screen that you are using and the problem that you are solving.

MENUS VS. SCREENS - WHAT'S THE DIFFERENCE?

The TDS-COGO48 is an intuitive-use software. Much progress can be made in mastering its system by pressing keys and seeing what happens in response. However, full understanding of the machine requires that a few simple concepts be well understood. One of these is the difference between a MENU and a SCREEN.

MENUS

A MENU is a display that is characterized by a list of functions or operations which may be selected by choosing one of the alphabetic keys listed down the left hand column of the display. See Main Menu above. Except for the **[EXIT]** and **[MORE]** keys, MENUS do not use active "soft" keys. The **[EXIT]** key is always displayed above the **[F]** key on the right. The **[MORE]** key will be labeled above the **[A]** key if there are more menu choices than will fit on one display. Pressing one of the alpha keys shown in the MENU display will present you with either another MENU, with more alpha choices and an **[EXIT]** key, or a SCREEN.

The **[EXIT]** key will always return to the SCREEN or MENU location occupied prior to a current SCREEN or MENU. Thus, MENUS in the TDS-COGO48 are arranged like a "tree". By selecting a sequence of alpha keys, you make progress from the MAIN MENU (the trunk of the tree) to the large branches (additional menus) to the small branches (sub-menus or screens) and then to the twigs and leaves (screens). By pressing **[EXIT]** successively, you can progress back through the branches to the trunk (the MAIN MENU).

If a menu has **[MORE]** displayed above the **[A]** key, there are other choices that can be made from this menu. Pressing the **[MORE]** key will display the remaining options. The **[EXIT]** key will then return you to the original set of options.

As an example of how this works, consider the Curve Menu. The MAIN MENU is large enough to require two displays. You may access the second display by pressing **[MORE]** from the MAIN MENU and viewing the choices M through S. As you become familiar with the TDS-COGO48, you will learn the frequently used letters in the MAIN MENU. You can access the choices in the second screen from the first screen by pressing the appropriate letter directly. The Curve Menu is choice **[Q]**. Press **[Q]** and see the Curve Menu. Arbitrarily choose **[G]:** Horizontal Curve. This presents you with the Solving Horiz Curve Screen in the display. This is the screen where you will solve your horizontal curve problems. You will practice with this screen in the next section. Now, press the **[EXIT]** softkey three times. Pause each time to notice how the TDS-COGO48 returns to the previous MENU in the MENU "tree". Finally, you arrive back at the first display of the MAIN MENU.

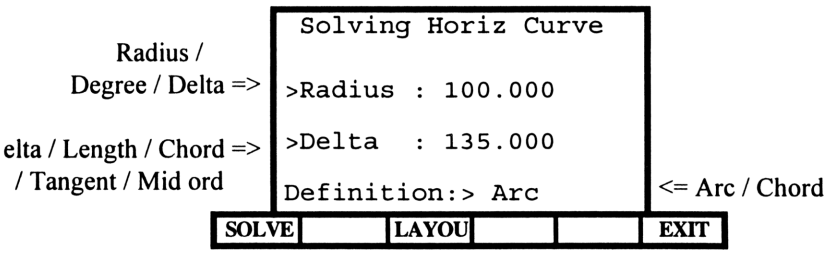
In the HP-48, the top row of keys are used for the alpha keys A - F, as well as for the softkeys. For this reason, all Menu labels in the TDS-COGO48 will begin with the letter **[G]**. Since there is no ambiguity in MENUS between menu selection keys and softkeys, it is *not* necessary to press the **[α]** key prior to making a menu screen selection.

GETTING STARTED

SCREENS

From the MAIN MENU, return to the Solving Horiz Curve Screen. As you recall, the key-strokes are **[Q] [G]**. As you can now see, a SCREEN is characterized by labels and data on each of the lines of the display separated by colons. They also have a variety of "soft" key labels at the bottom. These "soft" keys give you choices of one or more functions to perform. **It is in the SCREENS where you will enter your data and solve your surveying problems.** *You don't solve problems* in the MENUS. The MENUS are an aid to help you navigate the various Screens. While the user interface among the various SCREENS is consistent, each SCREEN solves a different kind of problem. Each SCREEN is explained in detail in the Reference Manual.

The Horizontal Curve Screen appears as:



You will use this screen to solve your first surveying problem and, at the same time, learn some very important concepts or *Rules of the Road.* The first has to do with the uses of the vertical cursor keys **[↑]** and **[↓]**. When you first enter this screen, the value of the radius is highlighted by a *scroll bar.* By pressing one of these vertical cursor keys, you will move the scroll bar to the next data entry field. The **[↑]** key moves the scroll bar up in the screen. The **[↓]** key moves the scroll bar down in the screen. When the arrow key moves to the bottom of a screen, scrolling again will wrap to the top of that screen (or from the top to the bottom). Since this particular screen has only two data entry fields, the action of the two vertical cursor keys is the same.

Thus, the procedure for solving a screen is to place the scroll bar at each data entry field as defined in the screen; key in the appropriate value; and press the proper solution softkey. In this case, suppose you want to know the curve parameters (solve the curve) for a horizontal curve of 100 ft. radius and a delta angle of 135°.

Step 1: With the scroll bar at the radius line, key in 100. Then, press **[↓]**. (The **[ENTER]** key will also move the scroll bar to the "next" data entry line.)

Step 2: Now, key in 135 at the Delta prompt.

Step 3: Leaving the curve definition as Arc press **[SOLVE]** (softkey **[A]**). The screen will now display the solution curve parameters for the curve you have solved.

```
Radius   : 100.000
Length   : 235.619
Chord    : 184.776
Degree   : 57.1745
Delta    : 135.0000
Tangent  : 241.421
External : 161.313
```

MORE					EXIT

NOTE

All angles in the TDS-COGO48 are entered and displayed in degree-minutes-and-seconds format and are resolved to the nearest second. The format is DDD.MMSS, where DDD indicates degrees; MM is the minutes; SS the seconds.

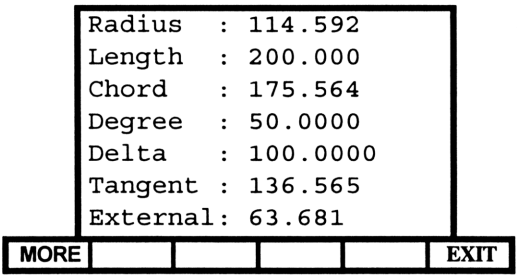
Now, pressing **[MORE]** will show you the remainder of the curve parameters, the Mid-ordinate (61.732), Segment (8245.439) and Sector (11780.972). Press **[EXIT]** twice to return to the Solving Horizontal Curve Screen.

This time you will solve a horizontal curve with different known curve parameters and, at the same time, learn the special function of the horizontal cursor keys **[←]** and **[→]**. Suppose that instead of the radius and delta angle of the curve, you know the degree of curvature and the arc length. In this case, it is a curve of 50 degrees of curvature and an arc length of 200 ft. Notice that both data input labels in this screen have a ">" symbol on the screen in front of the label. This symbol is called the *scrolling prompt* symbol. It indicates that you may change the input label prompt by use of the horizontal cursor keys **[←]** and **[→]**.

Step 1: With the scroll bar on the Radius input line, press the **[➔]** key. The prompt will change to "Degree". Key in 50 and press **[↓]** (or **[ENTER]**).

Step 2: Now press **[➔]** multiple times to see the selections for the second curve parameter. With the label on "Length", key in 200.

Step 3: Press **[SOLVE]**. The solution screen will display the parameters of this new curve.



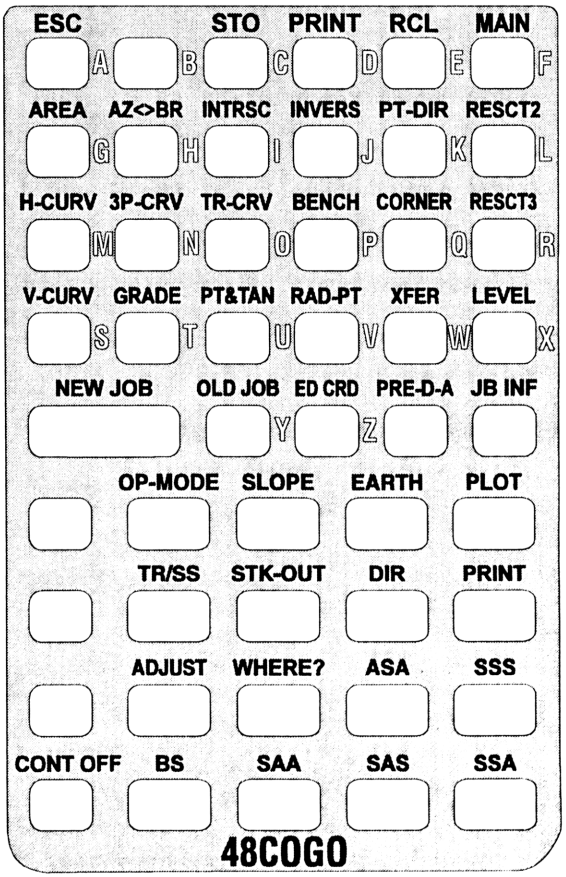
NOTE

A ">" character in front of any prompt in a TDS-COGO48 screen allows you to change the prompt to another option by scrolling through options with the horizontal cursor keys.

THE KEYBOARD OVERLAY

Your TDS-COGO48 Card comes with an overlay which you may install on your HP-48's keyboard to help you locate the alpha keys more easily and to mask the shifted function on the 48 which are not used by the TDS-COGO48. The overlay also displays the shifted function of each key (in purple) for direct access to many of TDS-COGO48's most-used routines. The overlay appears as shown:

Overlay for TDS-COGO48:



GETTING STARTED

Note that the alpha keys, printed in white, are positioned to the right of the associated key. The **[CONT]** and **[OFF]** functions, printed in purple and green respectively, are positioned above the **[ON]** key with which they are associated. All functions on the overlay can be accessed by pressing the purple or green shift key, and then the appropriate function key. The Top-Row of shifted keys perform a function and return to where you left off. The remainder of the shifted function keys send you to a screen or menu within the TDS-COGO48 program's tree structure. When you **[EXIT]** from that screen, you will return to the screen from which you pressed the direct access key. With the exception of the top row keys, all direct access functions can be accessed from the menu tree in the normal manner. Below is a table listing each Direct Access key used by TDS-COGO48 and a simple description of what each does:

Key	Function	Description
A	ESC	Escape temporarily from the TDS-COGO48 program and return to the main operating system of the HP-48. See the **ON** or **CONT** key to return to the TDS-COGO48
B		
C	STO	Store a value to the Clipboard register.
D	PRINT	Print the current screen to an Infrared Printer.
E	RCL	Recall a value from the Clipboard.
F	MAIN	Return to the Main Menu from wherever you are in the TDS-COGO48.
G	AREA	Compute the area of a parcel of land.
H	AZ<>BR	Converts Azimuths to Bearings or visa-versa.
I	INTRSC	Find a point at the intersection of two lines.
J	INVERS	Compute the Inverse between two points or a point and a line.
K	PT-DIR	Compute the coordinates of a new point by specifying a known point, a direction and distance.
L	RESCT2	Determine the coordinates of an unknown occupied point by field measurements (angles and distances) to two known points.
M	H-CURV	Solve for the properties of a horizontal curve.

N	3P-CRV	Solve for a curve that will pass through three known points.
O	TR-CRV	Include a horizontal curve in a traverse.
P	BENCH	Compute the elevation of the occupied point given the known elevation of the foresight.
Q	CORNER	Compute the angle made by two lines that meet at a common (corner) point.
R	RESCT3	Determine the coordinates of an occupied point by field measurements (angles) to three known points.
S	V-CURV	Compute the elevations at various stations along a vertical curve.
T	GRADE	Solve for the elevation at various stations along a straight grade.
U	PI&TAN	Solve for the PC and PT with known PI, tangents and radius.
V	RAD-PT	Calculate the radius point of a curve with two points and one other parameter known.
W	XFER	Will transfer you to the Transfer Screen.
X	LEVEL	Provide access to the Trig-leveling and Differential leveling routines.
Y	OLDJOB	Allow you to select an existing job to be opened.
Z	ED CRD	Provide a way to review and edit coordinate data.
ENTER	NEW JOB	Allow for the creation of a new job file.
DEL	PRE-D-A	Lets you set a point to form a parcel of a specified size.
←	JB INF	Provide for a way of reviewing many of the important parameters of the currently active job.
9	EARTH	Will transfer you to the Earthwork Menu.
8	SLOPE	Converts Zenith and Slope distance to horizontal and vertical distances.
7	OP-MODE	Set the operating modes.
6	DIR	Displays the job files stored in the TDS-COGO48.
5	STK-OUT	Calculate the Direction and distance needed to performing a point stake.
4	TR/SS	Will transfer you to the Traverse/Sideshot Screen.
3	ASA	Bring up the Angle-Side-Angle Triangle routines.

2	WHERE?	Help the rod man to quickly find the next point, relative to his own point of view, during a point stake.
1	ADJUST	Will transfer you to the Adjustment Menu.
0	BS	Bring up the Backsight Screen.
÷	PLOT	View a plot of a block of points in the TDS-COGO48 screen display.
*	PRINT	Bring up the Print Menu.
-	SSS	Provide access to the Side-Side-Side Triangle routines.
+	SSA	Bring up the Side-Side-Angle Triangle routines.
ON	CONT	Return to the TDS-COGO48 program after ESC to the operating system of the HP-48.
.	SAA	Bring up the Side-Angle-Angle Triangle routines.
SPC	SAS	Provide access to the Side-Angle-Side Triangle routines.

TOP-ROW SHIFTED FUNCTION KEYS

The five direct access keys on the top row are in some ways different from the rest of the direct access keys. They perform a specific function rather than bring up a screen or menu. The functions they perform are **[ESC]**, **[STO]**, **[PRINT]**, **[RCL]** and **[MAIN]** respectively. These functions are described in more detail below:

[ESC] -  **[A]** The **[ESC]**, Escape, function allows you to escape temporarily from the TDS-COGO48 program and return to the main operating system of the HP-48. This function will also "bring with it" the value of the field at the current cursor location and loads this value into the HP-48 operational stack at level 1. Then you can perform any calculation that you want on this value, including running your own software. When you return to the TDS-COGO48, the system will return to the screen that you were in prior to the escape; and, whatever is in level 1 of the stack when you return will be loaded at the cursor location in the screen that you were in prior to the escape. The keystrokes required to execute the Escape function are **[A]**. The details of the operation of the function are given below.

The **[ESC]** (Escape) functions may only be executed from a SCREEN. When you are in a screen and you press **[ESC]** - (◀ **[A]**), control of the system is passed temporarily from the TDS-COGO48 to the operating system of the HP-48. In addition, the numerical value in the screen at the current cursor location is loaded in the operational stack of the 48 at level 1. The word "HALT" appears in the annunciator line at the top of the screen to indicate that a running program has been halted. Thus, it is now possible for you to perform any calculations that you want in the stack, including calculations on the value that has been returned. This can be done either manually from the keyboard or via other software routines which you may have written and loaded into the system memory. When you are finished and wish to return to the TDS-COGO48, press **[CONT]** or ◀ **[ON]**. **[CONT]** is the purple shifted function above the **[ON]** key. You will return to the screen you were in before executing **[ESC]**. When you return, the value at the cursor location is replaced by the value from level 1 of the 48's stack.

If you find yourself at the HP-48 system stack and do not know why or how you got there, you may have inadvertently pressed the **[ESC]** key. Check and see if **HALT** is displayed on the top of the screen. If it is, then press the **[CONT]** or ◀ **[ON]** keys. If **HALT** is not displayed, you must have accidentally **[EXIT**ed] the program; Rerun the TDS-COGO48 program by entering α α T D S 4 8 and press **[ENTER]**.

[STO] - ◀ **[C]** The **[STO]** key will take any numeric value from an input field and store it to a temporary register. To save a numeric value, first highlight the field that you want stored and then press the ◀ and **[STO]** or **[C]** keys. The value can be moved to another field using the **[RCL]** key (see below). This function is useful in transferring data from one screen to another. However, some values in a screen are display only and therefore you cannot highlight them with the cursor. thus you can't store them to the **[STO]** register.

GETTING STARTED

[PRINT] - [↩] **[D]** The **[PRINT]** function will allow you to print the current contents of the screen onto the HP-82240B Infrared Printer. This function may be accessed from any screen or menu in the TDS-COGO48 at any time that you want a hard copy of your work.

[RCL] - [↩] **[E]** The **[RCL]** key will copy the numeric value from the register to the currently highlighted input field. To copy a numeric value, first, highlight the field that you want to move it to, then, press the [↩] and **[RCL]** or **[E]** keys.

[MAIN] - [↩] **[F]** The **[MAIN]** function will allow you to return to the MAIN MENU from any other menu or screen in the TDS-COGO48. It is a shortcut method of returning to the Main Menu "home base" without pressing **[EXIT]** repeatedly as described above.

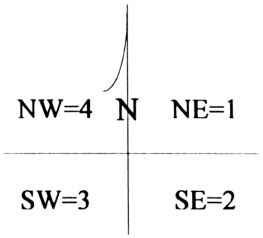
If you would like to see the complete MENU "tree" for the TDS-COGO48 and identify the kinds of surveying problems that can be solved with the TDS-COGO48, turn to pages R-8 to R-10 in the Reference Manual. Just to be sure that you understand this concept, practice moving around the various MENUS and SCREENS using the alpha and **[EXIT]** keys. Use the Menu "tree" in the Reference Manual as a guide.

DATA ENTRY TIPS

Throughout the TDS-COGO48 program you can use a short-cut method for entering Directions, Angles or Distances. If the highlighted input field is expecting a Direction, Angle or Distance and the desired value is defined by points in your current job, you can enter those points separated by a "-". e. g. If in the previous Horizontal Curve Solution example, the radius desired was defined by points 53 and 147 and the delta was defined by 147, 53 and 204 then you could enter "53-147" in the Radius field and "147-53-204" in the Delta field. The TDS-COGO48 program will calculate the distance of the radius and the angle of the delta for you.

When entering a bearing, you can press [α] to put the HP-48 in the alpha mode; then, type "N" or "S", the bearing and an "E" or "W". A faster way to enter this is to use quadrants. Type the quadrant number followed by the bearing.

Quadrants



As an example, if you had a bearing of S47.3627W it could be entered as 347.3627; and N47.3627E it could be entered as 147.3627.

Each of these entry tips will be explained in greater detail via the example in the chapters that follow.

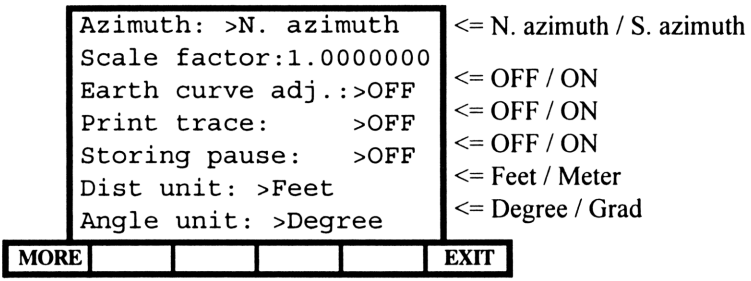
INTERACTIVE USE OF THE MENUS AND SCREENS - THE SETUP MENU

One of the first things that you will want to do after you get familiar with your TDS-COGO48 is to set it up for the kinds of jobs and surveys that you do. In addition, you need to become familiar with the interactive nature of the various menus and screens of the TDS-COGO48 as soon as possible. The present section of the manual will illustrate the use of the menus and screens by taking you through the setup routine. At the end of this section, you should have the unit set up for your particular needs. Just as importantly, you should be familiar with the way menus and screens in the TDS-COGO48 interact.

Path:	From the Main Menu, press **[H]** to access the Setup Screen.

GETTING STARTED

You should now see the Setup Screen which appears as:



Step 1: Set the Azimuth: This indicates the assumed direction of a zero azimuth, either North or South.

Step 2: In this screen, you can set a Scale factor which is the factor by which all distances entered in the field will be multiplied before coordinate values are computed.

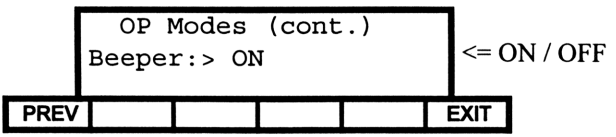
Step 3: Earth curve adjust, when set ON, will include calculations to compensate for earth curvature and refraction in the computation of coordinates.

Step 4: When Print Trace is set ON, it will send the computed data to the I/R printer port as each screen is solved.

Step 5: Storing pause, when set ON, will pause and display the computed coordinates as each point is shot.

Step 6: The Distance unit and Angle unit set the units that the internal calculations will use. These can be Feet or Meters and Degrees or Grads. These settings differ from the unit settings in the Device Setup screen in that there they set the unit that the data is collected in. You can set the TDS-COGO48 to any combination you need. e.g. your gun reads in feet but you want it stored in meters.

Step 7: Pressing **[MORE]** will bring up the following screen. Here you can turn the HP-48's beep on or off.

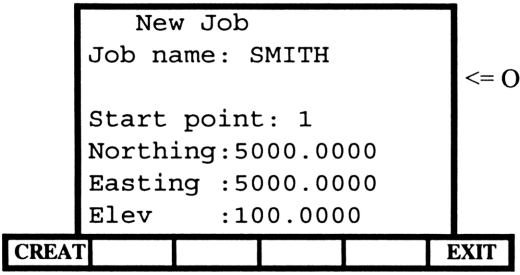


CREATING YOUR FIRST JOB

The TDS-COGO48 is now set up so that it is compatible with your equipment. You are ready to do your FIRST JOB. Return to the Main Menu. Since you have not established a job in the machine, you must begin by pressing **[G]**.

Path: Press **[G]** to see the Open/Edit a Job Menu.

This will present the New Job screen:



Step 1: The scroll bar is highlighting the Job name field. You may now press the **[α]** once and key in the name of your job. The name may be any combination of up to *eight* alpha, numeric or special characters. The first character must be alpha.

NOTE

Unlike *Menus* where you may key in the alpha menu selections without using the **[α]** key, alpha data fields in *Screens* require you to press the **[α]** key in order to put the TDS-COGO48 into alpha mode. Pressing **[α]** once will lock the keyboard into alpha mode and pressing the purple shift key ↵ while in alpha mode will lock in lower case characters. Since the cursor keys are used to input alpha characters in alpha mode, you must press **[α]** again to take the unit out of alpha mode. However, pressing **[ENTER]** will clear alpha mode as well as cause the scroll bar to move to the next data input line in the screen.

You should also realize that you may key in alpha characters in either upper or lower case. The TDS-COGO48 *will* maintain a distinction between them. For example, name this job **SMITH.** The TDS-COGO48 will treat it as distinct from a job named **Smith**. Care should be taken when using jobs with the same name and only upper or lower case differences. If both files are down-loaded to a PC, they will no longer be unique. *Only* the second one down loaded will exist on the PC.

Step 2: In the next field in the New Job Screen, you will key in the *starting point number*. Most often this number will be 1. However, it may be any number. This number will also become the smallest point number that the TDS-COGO48 will accept for this particular job. **If your starting point is not the smallest point number that you plan to use in a job, you should key in the smallest point number in this field.**

Step 3: Next, provide the coordinates of the starting point: northing, easting, and elevation. The default values are shown in the display as 5000.0000 ft. for both northing and easting and 100.0000 ft. for elevation.

Step 4: When a coordinate point is stored, a descriptor or note of up to sixteen characters may be saved with it. The default descriptor for the staring point is "START".

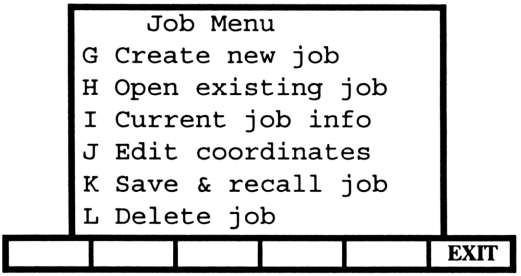
Step 5: Once you have the New Job screen properly configured, press **[CREAT]**. This command instructs the TDS-COGO48 to create the SMITH job as you have specified it in the screen.

This is another general *"rule of the road"* . While you are moving the scroll bar around the screen keying in information in response to prompts, the TDS-COGO48 does not take any direct action. If you make a mistake, you may reposition the scroll bar over the erroneous entry and key in the correct information. The TDS-COGO48 takes its action for any particular screen only in response to a direct command from you. These commands are usually issued by pressing one of the "soft" keys labeled in the bottom row of the display.

After you have pressed **[CREAT]**, the TDS-COGO48 will establish the job SMITH. The TDS-COGO48 will display the Current Job Info Screen so that you may review the status of the current job. Press **[EXIT]** from this screen to return to the Jobs Menu.

OTHER JOB RELATED FUNCTIONS

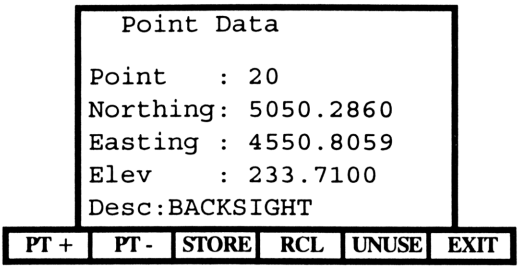
Within the Job Menu there is the ability to handle a number of other job file related tasks.



The number of jobs that you can store in your TDS-COGO48 at one time is limited only by the total memory of the machine. You can establish any number of jobs exactly as you have established SMITH. To switch between jobs that have already been created, use the **[H] Open existing job** key from the Jobs Menu.

You have seen the **Current job info** screen already, after you created the Smith job. By pressing **[I] Current job info** you can recall this screen to view information about the current job.

At this time, let us enter a second set of coordinates for practice. Press **[J] Edit coordinates** from the Jobs Menu. You will see the coordinates for point 1 of the SMITH job that you established earlier. Lets create a point 20:



Enter "20" in the Point: field for point number 20 and press **[ENTER]**. Now input "5050.2860" as the Northing; "4550.8059" as the Easting and "233.71" as the Elevation. Enter "BACKSIGHT" as a descriptor, pressing **[ENTER]** between each field entry. The screen should be filled out as displayed above. Now, press **[STORE]** to generate point 20 in our SMITH job.

The **[K] Save & recall job** option brings up a menu that allows you to Store or unload a job that has been save to a RAM card. This function is only available on the HP-48SX.

The **[L] Delete job** lets you select the file to delete.

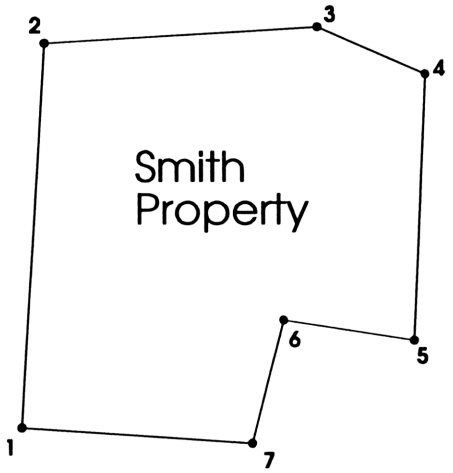
3. FIRST JOB:

Practice with COGO

In this chapter you will begin working with the coordinates of the SMITH job which you established in chapter 2, "Getting Started". You will:

- **Enter the corner Coordinates of the Smith property into the TDS-COGO48.**
- **Work with these Coordinates using the Coordinate Geometry (COGO) screens.**
- **Create new points using various COGO routines.**

You are now familiar with the TDS-COGO48. The software is installed and setup for your needs. In this chapter, you will work on the SMITH job. Make sure that the SMITH file is the currently active job. If you have not created the SMITH job from chapter 2 or no longer have the it available, return to the last couple of section of chapter 2 and create it. As you recall point 1of this job has a northing of 5000.0000, an easting of 5000.0000 and an elevation of 100.0000. Below is a picture of Mr. Smiths property and a table of the coordinates for each corner.

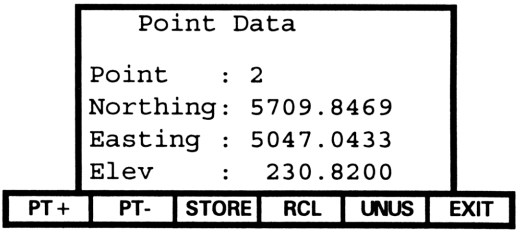


CO-GO

PT NUM	NORTHING	EASTING	ELEV.	NOTE
1	5000.0000	5000.0000	227.53	START
2	5709.8469	5047.0433	230.82	PT2
3	5736.1695	5504.0370	233.90	PT3
4	5649.0185	5685.4911	235.75	PT4
5	5152.6326	5660.0409	244.89	PT5
6	5194.3888	5439.9992	242.32	PT6
7	4966.9177	5385.6510	239.83	PT7

We will use the Edit Coordinates screen to enter the coordinates.

Path: From the Main Menu, press **[G]** to get the **Job Menu** and then **[J]** for the **Edit Coordinated Screen**. This screen should look like:



To key in the coordinates, move the scroll bar to each of the data fields and enter the proper values. For point 2 move the scroll bar to the first field and enter 2. Next press **[ENTER]** or the **[↓]** key and enter the northing, etc. When you have built the screen as displayed above, press **[STORE]**. Continue entering each of the corner points and press **[STORE]** to enter them into the coordinate file. The **[PT+]** and **[PT-]** keys can be used to review the coordinate that have been stored. You can edit any point by simply making the changes to this screen and pressing **[STORE]**. A message will ask:

```
"Storing Pt: 3
 Point used!!
 Overwrite? [Y/N]_"
```

Answer **[Y]** if you want to save the changes.

Coordinates in the TDS-COGO48 may have come from several sources:

- computed by the COGO functions in the TDS-COGO48.
- up loaded from a PC.
- keyed into the coordinate editor.

No matter how a point's coordinates get into the TDS- COGO48, they can be used by any of the functions of this COGO computer. In addition, you can review them at any time by pressing **[ED CRD] or** ⮌ **[Z]** (Edit Coordinates) to access the Point Data Screen.

PRACTICE WITH COGO

To illustrate this point, take a few minutes now to practice with some of the COGO functions on the SMITH job. From the Main Menu, press **[M].** The COGO Menu is displayed. You'll see 12 different coordinate geometry functions in the menu: 6 in the first screen and 6 after pressing **[MORE]**. In this chapter, we will cover the following seven functions:

- **Inverse**
- **Intersect**
- **Point in dir.**
- **Area**
- **Predetermined areas:**
  Hinged line method
  Parallel line method
- **Corner angle**

In addition, **Two Point Resection** and **Benchmark** are covered in chapter 6, Field Work.

Assume that the first thing that you want to do is inverse, compute the bearing and distance, between points 1 and 2 in the SMITH job.

INVERSE BETWEEN POINTS

Path:	From the COGO Menu, press **[J]** to get the **Inverse Screen**. That screen should look like:

```
  Inverse by Points
Begin point: 1
End point  : 2
Bearing    : N3.4730E
Azimuth    : 3.4730
Horiz dist: 711.404
Vert dist  : 3.286
```

SOLVE		BYCRD	BYLIN		EXIT

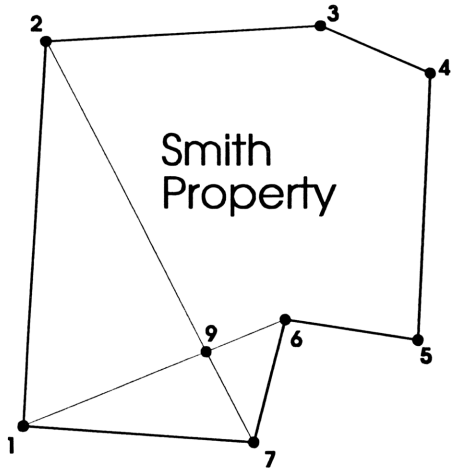
Like all of the screens in the TDS-COGO48, the use of this one is straight-forward. Move the scroll bar to the field in which you want to enter data and key in the data. Then move the scroll bar to another field, key in that data, etc. When you have built the screen to represent the problem that you are trying to solve, press **[SOLVE]**.

Step 1: In the case of the *inverse* function, specify 1 as the beginning point; 2 as the ending point; and press **[SOLVE]**. The azimuth, bearing, horizontal distance, and vertical distance between points 1 and 2 will be displayed as above:

Notice also that, by pressing **[BYCRD]** or **[C]**, you will see a screen that will let you inverse by coordinates rather than by point number; and, by pressing **[BYLIN]** or **[D]**, you will be able to inverse between a point and a line defined by two other points. These inverse routines simply display the results. The data in your job file is not modified in any way. You may wish to practice with the other inverse screens at this time. **[BYPTS]** key will return you to the inverse between two point numbers.

INTERSECTION

As the next exercise in this chapter, suppose that you want to find the point that represents the intersection of a line connecting point 1 and point 6 with a line connecting point 2 and point 7. This problem is shown pictorially as:



Path: From the COGO Menu, select **[I]** for the **Intersection** Screen.

Azimuth / Bearing / Distance =>

Azimuth / Bearing / Distance =>

```
   Intersection
 Point 1 : 1
>Azimuth : 66.0952
 Point 2 : 2
>Azimuth : 155.2952
 Store pt: 9
```

SOLVE	DFDIR				EXIT

NOTE

The third and fifth lines of the display have the ">" scrolling prompt character. When you move the prompt to one of these lines and press a horizontal cursor key (**[←]** or **[→]**), both the **value** of the data in that line and the **prompt label** will change. In this case, the Azimuth prompt will change to a Bearing or a Distance. You can use any combination of direction or distance to calculate an intersection.

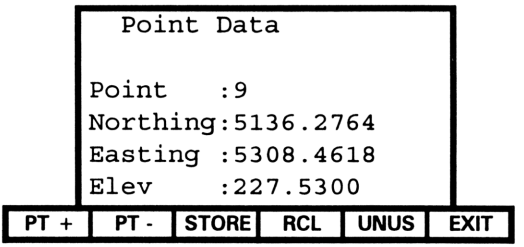
Step 1: Into this screen, you enter the parameters of this problem. The first point is point 1. Next you could use the **[INVERS]** or **[J]** key or invoke the command **[DFDIR]** or **[B]**, **Define Direction**, to specify the azimuth between points 1 and 6, but the TDS-COGO48 will compute the inverse for you. Simply enter "1-6" and press **[ENTER]** or **[↓]** to move to the next field. The TDS-COGO48 will compute the azimuth of the line and enter it in the Azimuth field. This process may be repeated for the line connecting points 2 and 7. Use point 9 as the stored point. When the screen has been properly filled out, it should appear as displayed above:

NOTE

If you had set the prompt for bearing, 1-6 would have resulted in a bearing. If a prompt is expecting a distance as its input data, the TDS-COGO48 will calculate a distance. If the field is expecting an angle, you can enter three point numbers separated by hyphens. The TDS-COGO48 will calculate the angle starting from the first point number, through the middle point and turning angle right to the last point.

Step 2: Now press **[SOLVE]**. The TDS-COGO48 will give you an opportunity to specify an elevation before adding point 9 to the job file.

You may review the coordinate values of point 9 by pressing **[ED CRD]** or **[Z]**. Press **[RCL]** and key in 9 for the point number in response to the prompt. The coordinates are shown as:

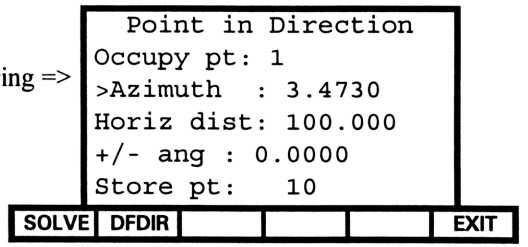


POINT IN DIRECTION

From the previous inverse example, you know that the horizontal distance between points 1 and 2 is 711.404 ft. Assume that you want to create 7 new points at 100 ft intervals along the line between points 1 and 2. You can do this with the Point-In-Direction function.

Path:	From the COGO Menu, press **[K]** to access the **Pt-in-Dir** screen. You should see:

Azimuth / Bearing =>



As in the Inverse or intersection Screen, the procedure to solve this problem is to build the appropriate screen and then press **[SOLVE]** to calculate new coordinates and store them.

Step 1: You should key in 1 as the occupied point.

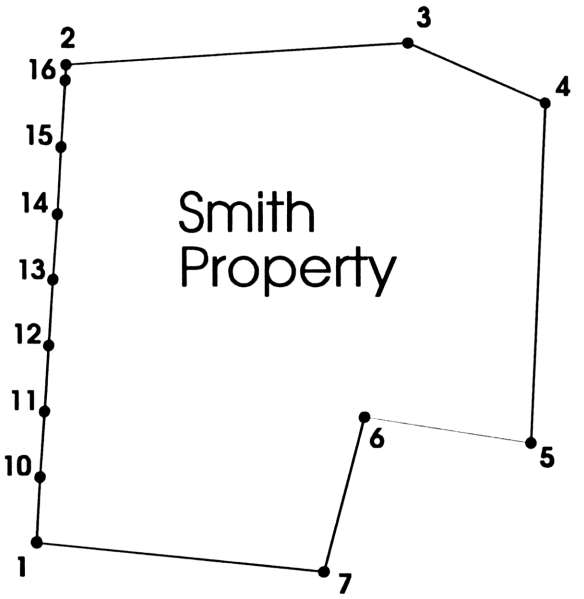
Step 2: Enter "1-2" in the Azimuth field and press **[ENTER]** to move to the next field. The TDS-COGO48 will compute the azimuth of the line and enter it in the Azimuth field. Enter "100" as the Horiz dist and 10 for the Store pt. The Point In Dir Screen should be filled out as displayed above.

Step 3: Now, press **[SOLVE]** to get the coordinates of your first point that is 100 ft from point 1. This will be stored as point 10. A new screen will prompt you for an elevation. You can enter an elevation here, but, let's use the one displayed for you (227.53 ft in this case) by pressing **[ENTER]**.

Step 4: The machine will return to the Point in Direction screen set up to solve for the next point, point 11 and can be calculated by simple pressing **[SOLVE]**. This procedure may be repeated six more times to obtain the coordinates of the rest of the points at 100 ft intervals along the line from 1 to 2. The last point stored will be point 16.

You do not have to solve for the azimuth each time because it will not change. In fact, there are no changes that need to be made to the screen between each solution. The TDS-COGO48 automatically increments the occupied point number and store point number for you, All other data remains the same.

After you've created points 10 through 16 at 100 ft intervals along the line from point 1 to point 2 in the SMITH job, your picture of the SMITH property should look like:



ACREAGE AND THE POINT LIST

For your next task, you want to find the area of the SMITH property in acres.

Path:	From the COGO Menu, press **[G]** to select the Area Screen. The Acreage Screen appears as:

From point - To point /Using point list =>

```
   Acreage
>From point: 1
To point    : 7
Acreage :   9.789
Perimeter: 2712.401
Square ft: 426396.03
```

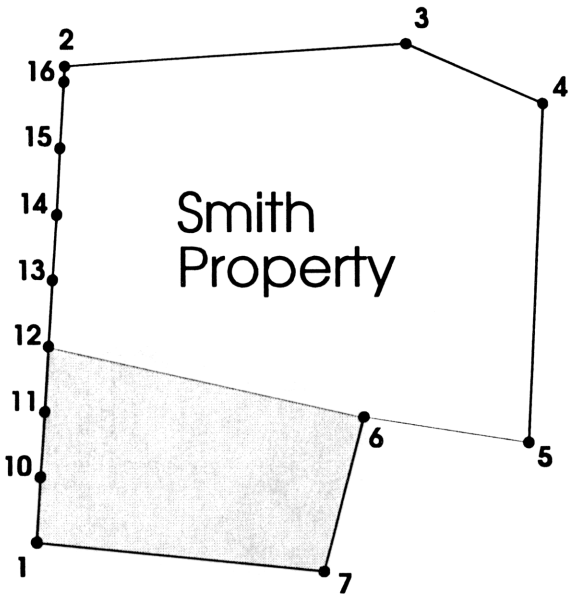
SOLVE	PTLST				EXIT

Step 1: Load the first and last corners of the survey into the "From point" and "To point" fields of the screen: 1 and 7. To compute the acreage in acres and square feet and the perimeter in feet, press **[SOLVE].**

When you use the "From point" and "To point" fields, the TDS-COGO48 assumes that the acreage that you want to compute is bounded by lines connecting all of the points in sequence from the first point to the last point and then closing back to the first point again. In this case, that means lines connecting from point 1 to 2 to 3 to 4 to 5 to 6 to 7 and back to 1. If you have done this correctly, you should see an area of 9.789 acres, 426396.03 sq. ft, and a perimeter of 2712.401 ft.

When the distance units of the TDS-COGO48 are set to ***feet***, the area is reported in both acres and square feet and the perimeter is in feet. When the units are set to ***meters***, the screen is called the Area Screen; the area is in square meters; and, the perimeter is in meters.

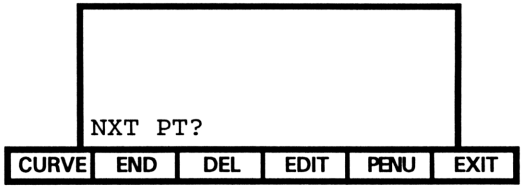
This process works well for those areas that are bounded by lines between points which are numbered *consecutively*. However, suppose you want to compute some other area. Take as an example the area bounded by lines that go from point 1 to 12 to 6 to 7 and back to 1.



To solve this problem, it is necessary for you to be familiar with the concept of the **"Point List"**. In its simplest form, the Point List is merely a way to define a sequence of point numbers that are not consecutive. In reality, it is a special kind of file in the machine that consists of a list of point numbers. To solve this particular acreage problem, you must do three things. First, you set up the Acreage Screen to compute area using that Point List. Next, you must specify the sequence of point numbers for the TDS-COGO48 to use. Finally, press **[SOLVE]**.

Step 2: Note that the "From point" line in the Acreage Screen has the scrolling prompt symbol ">" at the beginning of the line. By pressing one of the horizontal cursor keys, either **[<]** or **[>]**, you will switch the expected boundary format from sequential to: * Using Point List *.

Step 3: Next, you must create the proper Point List file. To do this, press **[PTLST].** You will see the Point List Menu. Choose **[G]** to see the Point List Screen:



NOTE

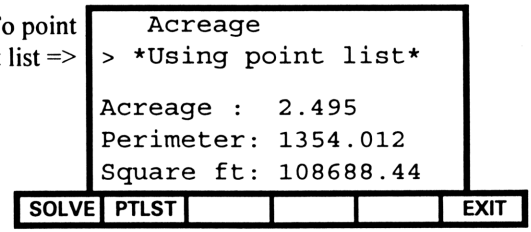
If your Point List is not empty, either press **[DEL]** repeatedly until it is empty; or, return to the Point List menu by pressing **[EXIT]**; press **[H] Clear Point List;** and finally, press **[G]** again to return to the Point List Screen.

The NXT PT? line is where you key in the points that you want; in this case, 1. Key in "1" and press **[ENTER]**; then "12" **[ENTER];** and so on, through points 6, 7 and back to 1. Notice how the point numbers are displayed in the screen as you key them in. The point list should look like:

PT 1
PT 12
PT 6
PT 7
PT 1
NXT PT?

Step 4: You may now exit from the Point List Screen by pressing **[EXIT]**. Press **[EXIT]** again to return to the Acreage Screen. Finally, press **[SOLVE]** to compute the area of this portion of the SMITH property. The correct acreage is 2.495 acres.

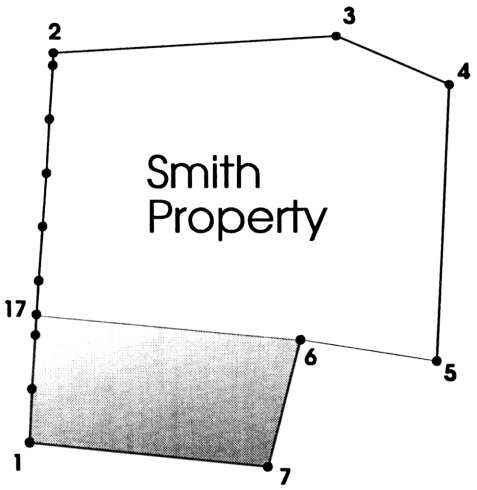
From point - To point
/Using point list =>



The Point List is used throughout the TDS-COGO48 to specify points to be used in a variety of functions. For example, the Screen Plot Screen may use the point list to select only those points that you want to have shown in the display. To get the most out of your TDS-COGO48, be certain that you thoroughly understand the concept of the Point List. It is described in greater detail in the Reference section. You should practice using the Point List, with several functions.

Calculate Pre-Determined Areas

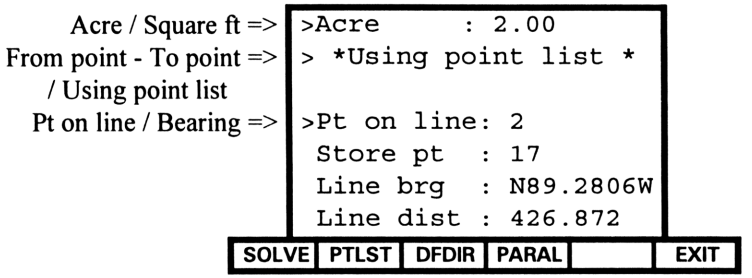
Let's assume Mr. Smith wants to section off a two-acre parcel from the lower notch of his property. To do this, you will need to find the point on line 1-2 that, when connected back to point 6, will section off exactly two acres of land. It is not a trivial task to calculate the boundary point that will provide a two-acre region. But, TDS-COGO48 will calculate this for you using the **Swing Hinge Line** Approach. With this method, you can find this boundary point that will provide a pre-determined area; which in this exercise is two acres. This is graphically displayed in the drawing below:



The two-acre parcel will be bounded by the points 1, 7, 6, and a new point along line 1-2. For the new point, use point 17.

To solve this particular problem, you need the Predetermined Area w/ Hinge Line screen to locate the point that will create a 2.0 acre parcel.

Path: From the COGO Menu, select **[Q]: Pre-Determined Area.**



Using this screen, you can swing the hinge line 6-17 about the hinge point (6) along the known directional line 1-2 until it finds the unknown point 17. All of this information is entered into the Polygon w/ Hinge Line screen as follows:

Step 1: Enter "2" in the Acres field to define the area to be sectioned off. Press **[ENTER]** or **[↓]**.

Step 2: Define the boundary points of the polygon. This requires that you use the Point List screen again. Press **[PTLST]** to display the Point List Menu.

On the Point List Menu, clear the existing point list by selecting **[H] Clear Current List; [Y]** in response to the "Are you sure?" prompt; and then, **[G] Edit Current List**.

Step 3: Enter the points bounding the lower notch of the property, starting with the break point 1 and ending with the hinge point 6. Enter "1, 7, 6" and press **[ENTER]** after each number.

PT 1
PT 7
PT 6
NXT PT?

The boundary for a Polygon with Hinge Line can have as many points as you desire, but the list ***must begin*** with the break point (the starting point of the fixed line that the hinge line intersects with) and ***end*** with the hinge point (the point that the hinge line rotates about).

Press **[EXIT]** twice to leave the Point List screen and return to the Polygon W/Hinge Line screen.

Step 4: To define the fixed intersection line (the line that will be intersected by the swing line at the unknown point), enter "2".

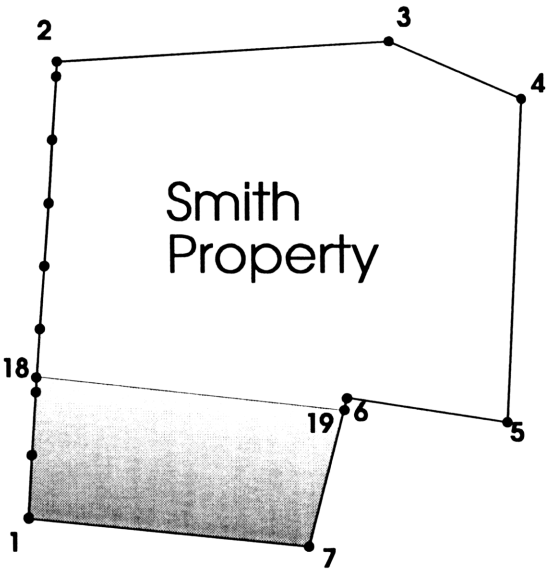
Step 5: Enter "17" as the point number whose coordinates are to be calculated and stored in the SMITH job file.

Step 6: Press **[SOLVE]** or **[G]** to do the actual computation. Again, TDS-COGO48 will prompt you for an elevation. The coordinates of point 17 will now be added to the SMITH job file.

You can plot point 17 if desired, and you can check that the area is indeed 2.0 acres by returning to the Compute Area screen. Press **[AREA]** or **[G] Compute Area**. Use a new Point List that contains points 1, 7, 6, 17, 1.

The Moving Parallel Line Approach

Another way to calculate the points that bound a pre-determined area is the Moving Parallel Line method. With this method, you section off a pre-determined area by sliding a line (up or down) parallel to a known line of a four sided figure as shown below.



Path:	From the COGO Menu, select **[P] Pre-Determined Area** . Then press **[PARAL]** or **[D]** to bring up the Parallel screen

Acre / Square ft =>

pt 2 / Bearing =>

pt 2 / Bearing =>

```
>Acre      : 2.00
Side 1: pt 1:1
>       pt 2:2
Side 2: pt 1:7
>       pt 2:6
Store 1st pt:18
      2nd pt:19
```

SOLVE		DFDIR			EXIT

In order to set up a parallel predetermined area calculation, you must define three lines or sides of the area. The TDS-COGO48 will determine the fourth side. The middle line is the one that will be parallel to the side that is moved to obtain the predetermined area. The two sides are entered into the screen. The first point (Pt 1:) of these two lines defines the middle or parallel line.

Step 1: In the Parallel Moving Line screen, define the left and right sides of the 2.0 acre parcel by naming two points for each side of the property. The first point of each side must be the point that is in common with the line of the boundary that will be parallel with the moving line; in this case, line 1 to 7. Enter the values as shown in the screen above:

Step 2: Press **[SOLVE]** or **[G]**. You will be prompted for an elevation for each new point. Input the data and press **[ENTER]** for each point.

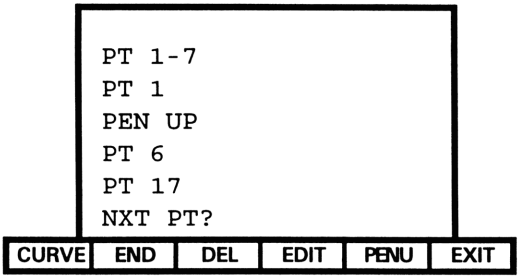
TDS-COGO48 will compute the coordinates for new points 18 and 19 and then add them to the SMITH job file. You can check that you have indeed created a 2.0-acre parcel by using the Compute Area screen and the appropriate Point List: 1, 18, 19, 7.

PLOTTING

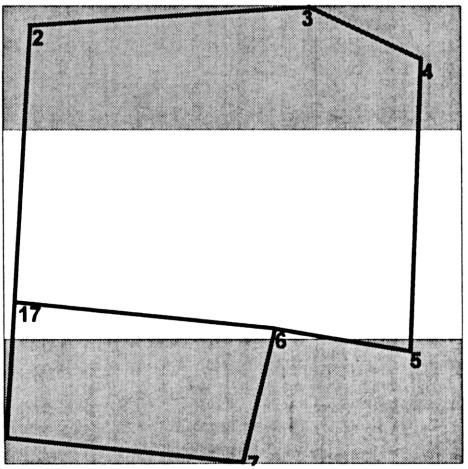
As a finale exercise, let's redo the screen plot of the boundary of the SMITH job and include a line 6 to 17. This will illustrate the feature of inserting a **[PENU]** command in the Point List that controls the screen plot.

Press **[PLOT]** or  **[÷]** and then **[PTLST]**. Press **[H]** to clear the existing list and then press **[G]** to edit a new one. You may connect points 1 to 7 in sequence by keying in "1-7" in the first NXT PT? line of the list. In a Point List, 1-7 means a range of points (from one to seven) and not the azimuth or distance between 1 and 7. Press **[ENTER]** to enter this line. Then key in "1" again. Press **[ENTER]** again. This will design the plot to connect points 1-2-3-4-5-6-7 in sequence and then close back to point 1.

Next, you want to connect from point 6 to point 17, but you do not want a line between 1 and 6. Press **[PENU]** - pen up key. This command will "lift the pen" before moving to the next point. Now press "6" **[ENTER]** and "17" **[ENTER]**. Properly filled out, your Point List should look like:



Press **[EXIT]** twice to return to the Screen Plot Screen; set the scrolling prompt to read *Using point list*; and press **[LINES]**.



You should see a portion of the desired plot in the screen. Remember to use the **[↑]** and **[↓]** keys to see the rest of the plot. Don't forget to press the **[ON]** key to return back to the Screen Plot screen.

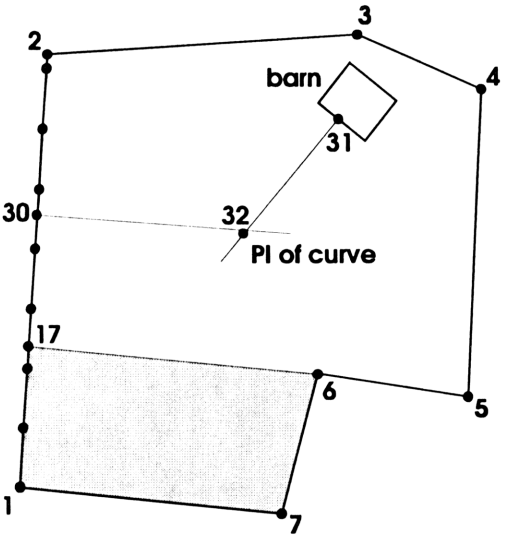
4. CURVES

In this Chapter be introduced to the Curve Menu. Working with the coordinates of the SMITH job you will explore various Curve Screens of the TDS-COGO48 and practice integrating the curve capabilities into the COGO routines.

HORIZONTAL CURVE ROUTINES

Mr. Smith wants to sell the two-acre parcel of land that you previously created with the addition of point 17. Unfortunately, the existing gravel driveway to his barn runs across this parcel. Mr. Smith would like you to design a new 20 ft wide driveway from his barn to a new access-point along the western boundary of his remaining property. He would like you to prepare a map of his property showing the barn and the driveway. In addition, you are to measure the area of the driveway so that he can determine how much gravel he will need for it. To make things interesting, Mr. Smith wants the driveway to meet the road along the western boundary of his property as well as the front of the barn at right angles. He also wants a 150 ft radius curve built into his driveway where these two sections intersect. From a previous survey of this property, you have located the center of the driveway in front of the barn (pt. 31) and the desired access point for the center of the driveway at the western boundary of his property (pt. 30). You have also established the bearings of the straight sections of the driveway and the point where they intersect. This is the PI of the curve (pt. 32). These points are shown on the figure below.

CURVES



The coordinates of the relevant points are given in this table.

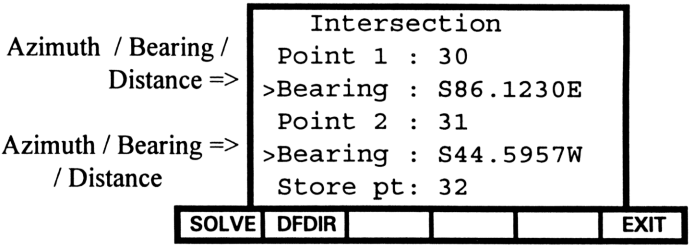
PT NUM	NORTHING	EASTING	ELE.	NOTE
30	5449.0151	5029.7574	229.74	WEST END
31	5553.3876	5488.3254	235.31	FRT. OF BARN

Next, calculate the PI or the intersection of the two sections of driveway.

Path:	Press **[INTRSC]** or [↵] **[I]** to jump to the Intersection screen.

The bearing of line 30 - 32 is S 86 12' 30" E; the bearing of line 31 - 32 is S 44 59' 57" W

Step 1: With these coordinates and line bearings, you should be able to compute the coordinates of the intersection of the lines, which is also the PI of the curve. Use the Bearing-Bearing option in the Intersection Screen, fill out the screen as follows:



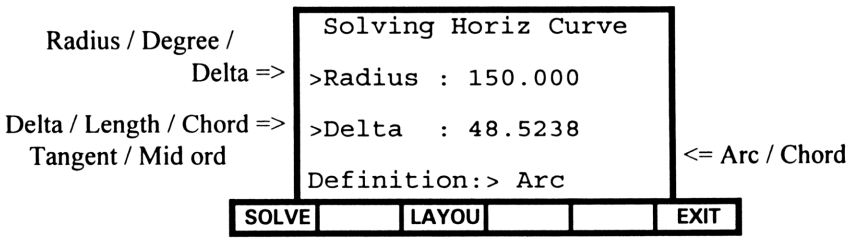
Store this intersection point as point 32. Enter an elevation of 227.53 ft. Its coordinates are:

PT NUM	NORTHING	EASTING	ELE.	NOTE
32	5427.0004	5361.9419	227.53	PI OF CURVE

HORIZONTAL CURVE SOLUTION

Your next task is to put a 150 ft radius curve on this center line.

Path:	Select **[Q]** from the Main Menu. Press **[G]** for the Solving Horizontal Curve Screen.



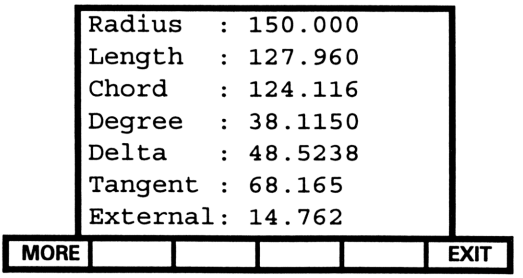
To define a curve, you need at least two of its parameters: one that relates to its curvature and one that relates to its length. The Solving Horizontal Curve Screen has two data input lines that relate to these two properties. You may use the horizontal cursor keys (**[←]** or **[→]**) to set the prompt to the quantities you know.

Step 2: In this case, the **radius** is given as 150 ft.

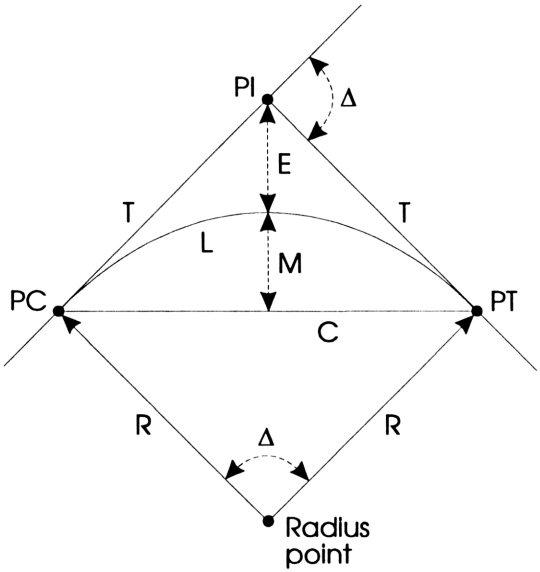
Step 3: The **delta angle** may be computed from the bearings of the center lines of the driveway which are the tangent lines of the curve. However, the TDS-COGO48 will compute the angle of the PC-PI-PT by entering "30-32-31" and pressing **[ENTER]**.

Next, you need to subtract this result from 180°. Highlight the Delta angle field and press **[ESC]** or [←] **[A]**. You should now be in the HP-48GX stack with "131.1227" in line 1. Press the **[+/-]** key. Now, enter "180" and press **[+]**. The result is the delta in decimal form. To convert to Degree, Minute, Second form press **[α][α]** to put the 48 in the alpha mode. Next enter [→] **[0]** to display "→" on the stack. Now type **[H] [M] [S]** and **[ENTER]**. The delta angle of 48.5238 should now be displayed in the #1 stack position. Press **[CONT]** or [←] **[ON]** to return to the TDS-COGO48 program with this result. With the screen filled out as above, press **[SOLVE]**.

The seven computed curve parameters will appear in the solution screen as:



These parameters are defined in the figure below:



PC - Point of Curvature
PT - Point of Tangency
PI - Point of Intersection
P - Radius Point

R - Radius
L - Length (Arc Length)
C - Chord Length
T - Tangent Length
E - External
M - Mid-ordinate
Δ - Internal angle from cent to tangent points
Degree of Curvature - Internal angle equivalent to a 100 arc length
Degree of Curvature = (18,000) / (R x p) Expressed in degrees, minutes, and seconds.

Step 4: Press **[MORE]** to see the values:

Mid-ordinate: 13.439
Segment : 1122.376
Sector : 9597.030

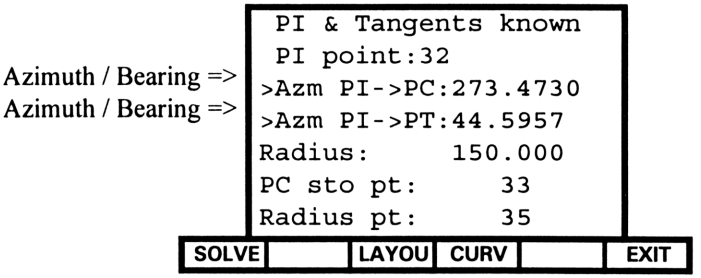
NOTE

These values will be automatically placed into any other curve screen where they are needed. For example, if you access the Traverse On A Curve screen now, the radius and length will **already** be entered in the appropriate data fields.

FINDING THE PC AND PT

To complete the curve, you need to compute the coordinates of the Point of Curvature (PC) and Point of Tangency (PT) of the curved portion of the driveway. You could do this from the curve parameters and the COGO functions, but TDS-COGO48 provides a special PI and Tangents Known screen that makes finding the PC and PT very simple.

Path: From the Curve Menu, select **[H] Known PI and Tangent.**



Step 4: Enter the following:

- "32" as the PI.
- "32-30" in the Azm PI->PC field.
- "32-31" in the Azm PI->PT field.
- the radius as "150."
- the PC Store Pt as "33"

The PT will be stored in the next consecutive number.

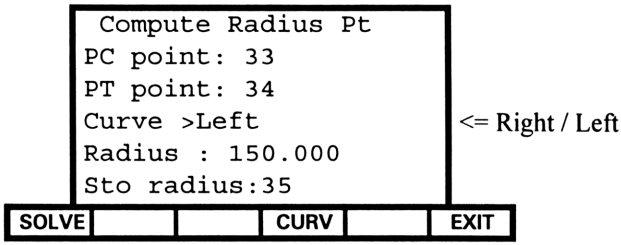
- "35" as the radius point.

Step 5: Press **[SOLVE]**. TDS-COGO48 will display the results of the radius, PI and tangent. Then, it will prompt you to give an elevation for the next three store points. Press **[ENTER]** to accept the default elevations. TDS-COGO48 will add these points to the job file.

Compute Radius Point

You previously generated the radius point (pt 35) in the PI & Tangent routine above. This is presented here, so that you are aware of its availability.

Path: From the Curve Menu, select **[J] Compute radius pt.**

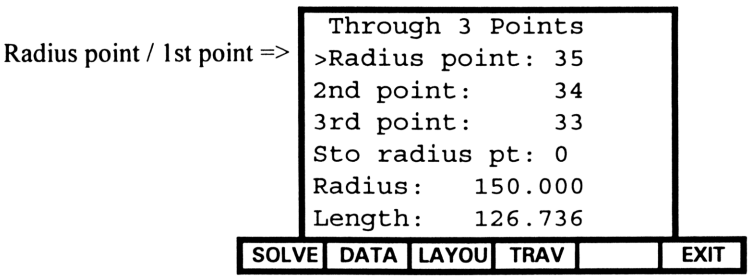


Filled out the screen as desired and press **[SOLVE].** This routine computes and stores the radius point.

Curve Through Three Points

Just for practice with another curve routine, let's use the Through Three Points function to compute the curve we just created. You will solve for the curve that lies between points 33 and 34, using point 35 as the radius point.

Path: From the Curve Menu, select **[I] Through 3 Points.**



The Curve Through 3 Points screen operates in two modes: one allows you to solve for the curve using three points on the curve itself; beginning point, ending point and one other point on the curve. The other solves for the curve using a known radius point and the begin and end points of the curve.

CURVES

Step 1: Use the **[←]** or **[→]** on the scrolling prompt of the first line to select the Radius Point option.

Step 2: Enter the Radius Point as "35."
Enter the 2nd Point as "33"
Enter the 3rd Point as "34"

In order to determine the curve you want solved, the points must be entered in clockwise order.

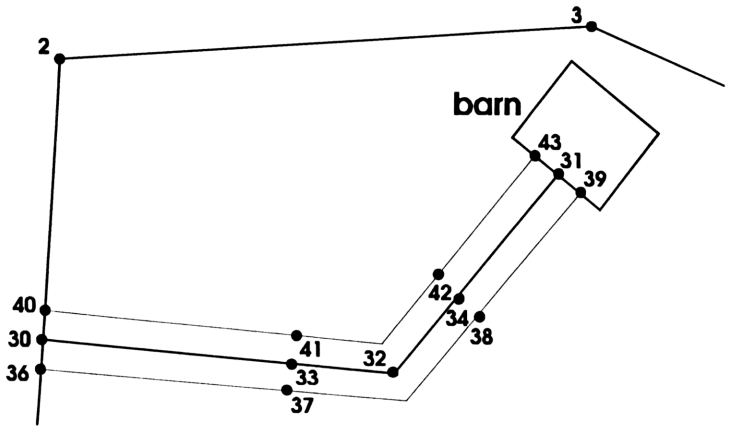
Enter "0" as the Sto radius pt:

With "0" in the Sto radius pt: field, this routine will not store a radius point.

Step 3: Press **[SOLVE]** or **[A]**. TDS-COGO48 will solve for the curve and respond by displaying the radius and length. Press **[DATA]** to display the results. You have just verified that you have the correct curve in the driveway.

Offsets of the driveway

Next, let us set offset points at the ends of each segment of the center line so that we can calculate the area of the drive.



The boundary points of the driveway, points 36 through 43 in the figure above, may be located using the Point-in-Direction Screen in the COGO Menu. Points 36 and 40 may be determined directly since they lie on a line with known end-points. The other points may be found by specifying a + or - 90° rotation of the direction line in the Point-In-Direction Screen. We will set point 37 as an example:

Path:	Press **[PT-DIR]** or [↩] **[K]** from wherever you are to bring up the Point-In-Direction Screen. .

Azimuth / Bearing =>

```
  Point in Direction
Occupy pt: 33
>Azimuth   : 93.4730
Horiz dist: 10
+/- ang :    90.0000
Store pt: 37
```

SOLVE	DFDIR				EXIT

Step 1: Enter "33" as the Occupy pt:, enter "30-33" to compute the Azimuth; and, enter "10" in the Horiz dist: field.

Step 2: Now, we want point 37 set at a 90° angle to the line 30-33; so, we enter "90.0000" in the +/- ang: field. The store point is "37". With this screen completed as above, press **[SOLVE]**.

Determine the coordinates of the other points along the boundary of the driveway in like manner. When setting a point to the *left* of a line enter "-90.0000" in the +/- ang: field. Also note that when you are using the +/- field, the Azimuth field is modified between each calculations. It will need to be re-entered when you are doing several calculations from the same point.

AREA AND INSERTING A CURVE IN A POINT LIST

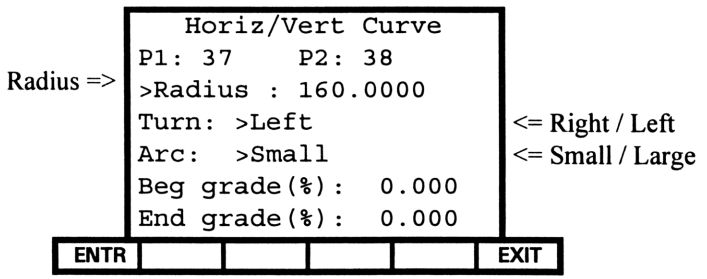
You have now solved for the coordinates of all of the points that will make up the boundary of the driveway. You have the end-points of the driveway with 10 ft offsets; the PCs, PIs, and PTs of the center line; and the boundary lines. All that remains is to use the Acreage Screen to compute the area of the driveway. However, to do this properly, you should specify that there is a curve between points 37 and 38 and another one between points 41 and 42. Thereby, the Acreage Screen will compute the area based on the curved sides. The Point List allows you to place a curve rather than a straight line between any two points in the list. The procedure for doing this is: key in a point on one end of the curve; then press the **[CURVE]** "soft" key. The Screen will prompt for information about the curve which you should fill in.

Path: Press **[AREA]** or [↩] **[G]** from wherever you are to bring up the Area Screen. Press **[PTLST]** or **[B]** for the Point list menu. Press **[H] Clear Point List** and **[G] Edit point list**.

Step 1: The Point List sequence for this job is:

36 **[ENTER]**
37 **[ENTER]**

Step 2: Press **[CURVE]** and fill out the Horiz/Vert Curve Screen as shown below; then, press **[ENTER]**.



NOTE Even though the values of Pt 1 and Pt 2 in this screen are on the same line, you still use the *vertical* cursor keys to move the scroll bar between them. The horizontal cursor keys are reserved for scrolling prompts.

Step 3: Enter: 39 **[ENTER]**
43 **[ENTER]**
42 **[ENTER]**

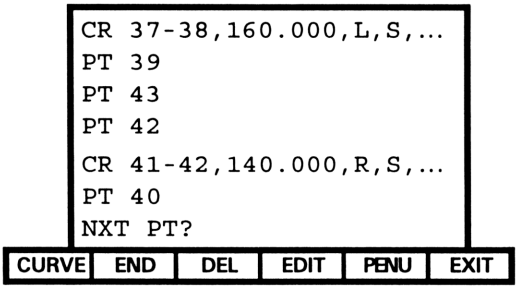
Step 4: Press **[CURVE]** and fill out the Horiz/Vert Curve Screen with:

P1 = 42 P2 = 41
Radius = 140
Turn = Right
Arc = Small

Press **[ENTER].**

Step 5: Input 40 and press **[ENTER].**

The Point List Screen will look a follows before you press **[EXIT]**.



The first two points in the point list, PT 36 and PT 37 have scrolled off the top of the display.

Step 6: Press **[EXIT]** twice to return to the area screen and press **[SOLVE]**.

By computing the acreage in the Acreage Screen based on this Point List, you may determine the area of the driveway with the curve included. You should compute 0.231 acres or 10066.507 sq. ft. as the area.

That completes the curve section of this tutorial. You should be able to use the various routines to solve your own surveying needs. If there are fields or keys in a screen that you need more information on, please refer to the reference section for a complete description of every routine in the TDS-COGO48.

5. TRIANGLE SOLUTIONS

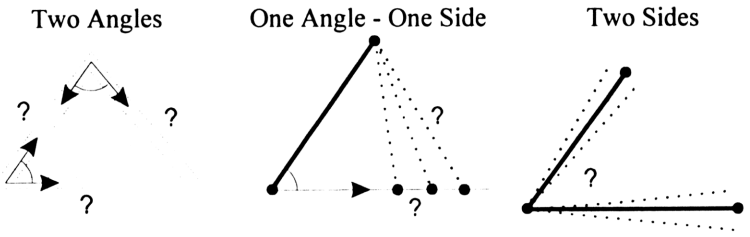
With Trig and Differential Leveling

In this chapter, you will learn about triangle and leveling functions of the TDS-COGO48. There are 5 triangle routines as well as Differential and Trig leveling.

TRIANGLE SOLUTIONS

This chapter is about the triangle solutions with in the TDS-COGO48. This is a set of routines that allow you to enter what you know about a triangle and the program will solve for what you do not know. The first thing to determine then is what you know.

The triangle solutions deal with the angles and the length of the sides or six values. In order to uniquely define a triangle you must have three of these. If you have four values, you have one value more than is needed. Two values will not allow us to determine the other values:

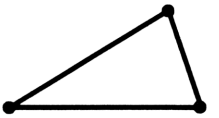


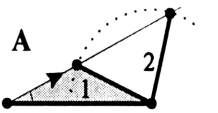
Given the fact that we have two choices (angles or sides) and three needed pieces of information, there are eight possible combinations (2^3). Two of these are redundant or mathematically the same, which leave six combinations:

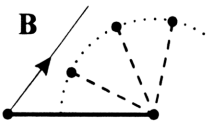
TRIANGLES

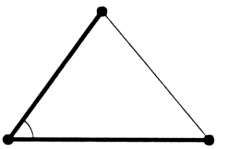
Menu
Key

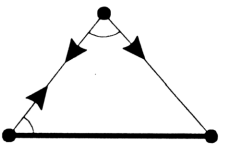
A	SSS ➢ Side - Side - Side Does uniquely define a triangle Will take 3 sides of a triangle and calculate the 3 angles and the area.
E	SSA ➢ Side - Side - Angle Will not always uniquely define a triangle If the side with an unknown length will intersect an arc formed by swinging the free known side, then we can solve for 2 possible triangle (A). Other wise there is no solution (B See example below:
D	SAS ➢ Side - Angle- Side Does uniquely define a triangle Input 2 sides with an angle between them and calculate the other 2 angles, the last side and the area.
C	SAA ➢ Side - Angle- Angle Does uniquely define a triangle Input 2 angles with an opposite side (not between them) and calculate the other 2 sides, the last angle and the area.
	ASS ➢ Is the same as SSA



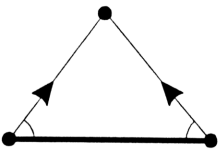


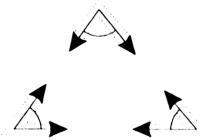






B	ASA ➢ Angle - Side - Angle Does uniquely define a triangle Input 2 angles with the side between them and calculate the other 2 sides, the last angle and the area.
	AAS ➢ Is the same as SAA
B	AAA ➢ Will not uniquely define a triangle The 3 corners can be moved in or out as far as you would like. Nothing fixes the length of the sides.



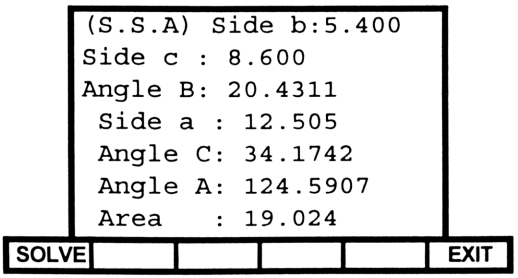


As you can see from the above table, two of the choices do not define a unique triangle which leaves 4 triangle routines. The TDS-COGO48 also uses the fact the SSA will define two possible triangle given the right information (more on this, later). So the first step is to determine what data you know about the triangle and if that information matches one of the routines.

Side - Side - Angle

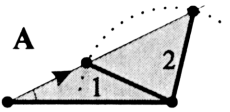
Let us solve a Side - Side - Angle problem as an example.

Path:	From the Main Menu press **[O]** to display the **Triangle Solutions Menu**. Select **[K]** for the **2 S's & opposite A Screen**.

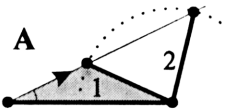


TRIANGLES

Step 1: Fill out the screen as above and press **[SOLVE]**. The following triangle is defined by the first results.

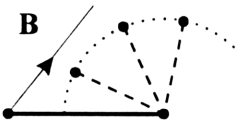


Step 2: Press **[MORE]** to display the other possibility.




```
Side a : 3.583
Angle C: 145.422
Angle A: 13.3431
Area   : 5.450
```

Step 3: Now try entering "68.3512" as Angle C:. There is no solution for this combination of Side - Side - Angle.

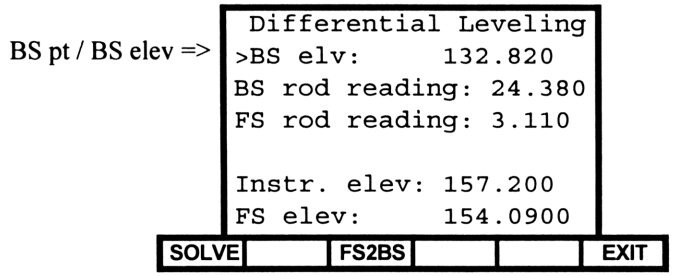


That completes the CO-GO and curve section of this tutorial. You should be able to use the various routines to solve your own surveying needs. If there are fields or keys in a screen that you need more information on, please refer to the reference section for a complete description of every routine in the TDS-COGO48.

DIFFERENTIAL LEVELING

The Differential Leveling routine allows you to use a graduated rod and a level to determine the elevation of a point from another point with a known elevation.

Path:	From the Main Menu, press **[O] Triangle Solutions Menu**; then, **[L] Differential Leveling** to bring up the following display:



Step 1: Set up your instrument on a point where you can read your graduated rod on both the Backsight and the foresight. Enter the elevation or point number of the backsight point. In our example, enter 132.82.

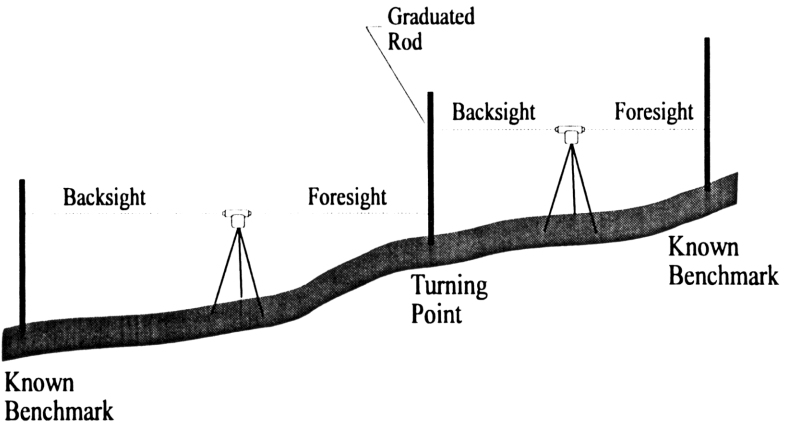
Step 2: Observe the rod reading on the backsight and enter it in the BS rod reading: 24.38.

Step 3: Observe the rod reading on the foresight and enter it in the FS rod reading: 3.11

Step 4: Press **[SOLVE]** to calculate the elevation of the instrument and foresight. They will be displayed on the last two lines of the screen, as shown above:

The **[FS2BS]** key will transfer the elevation in the FS elev: field to the BS elev: field, in preparation for your next positioning and observations.

TRIANGLES



NOTE

The Differential Leveling routine does not support any electronic interface due to the fact that you view a graduated rod and not a prism.

TRIGONOMETRIC LEVELING

The Trig leveling routine allows you to compute the vertical distance between a point on a vertical plane and the horizontal plane of the instrument.

Path:	From the Main Menu, press **[O] Triangle Solutions Menu**; then **[M] Trig Leveling** to display the following .

Station elv / Station pt =>

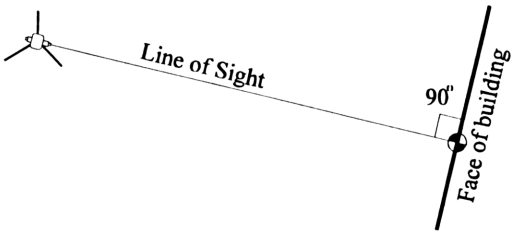
Zenith / Vert ang =>

```
    Trig. Leveling
>Station elv:253.91
HI: 5.26
Horiz dist:  147.620
>Zenith:      86.5822
Target elv:  162.026
VD +- hor plan:2.676
```

SOLVE		HD			EXIT

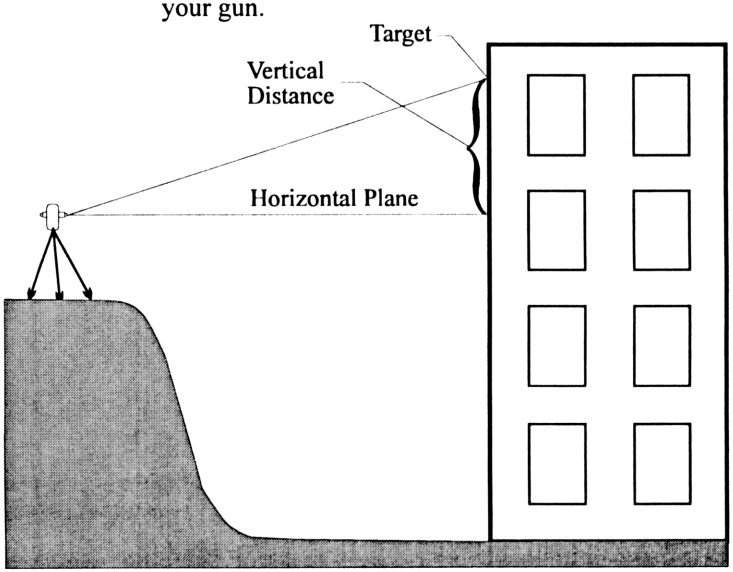
Step 1: Start by entering Station elv as 253.91 and the HI as 5.26.

Step 2: If you were connected to an instrument, you could set a prism against the vertical plane at a point that is perpendicular to the instrument's line of sight and the face of the vertical plane. Then, you could press **[HD]** to fire the gun and read the slope distance. The TDS-COGO48 would then calculate the horizontal distance for you.



For our example, enter 147.62 in the Horiz dist field.

Step 3: Now enter "89.2419" in the Zenith field. Press **[SOLVE]** to calculate the Target elevation and the Vertical distance to the horizontal plane. If you were doing this electronically, pressing the **[SOLVE]** key would read the zenith angle from your gun.



6. SURVEY FIELD WORK

The first section of this chapter is designed to introduce you to the use of your TDS-COGO48 to collect field data. You will enter the traverse of the SMITH property using manual input. You will learn how to do a resection in the field. You will see how a topographic survey can be entered with the TDS-COGO48.

INTRODUCTION

This chapter is designed as a introduction to the field use of the TDS-COGO48. It assumes that you understand and have a working knowledge of your particular surveying instrument. This Manual will cover how to use the TDS-COGO48 to enter field data from a total station. The specific button to press on your total station to perform an operation, like zeroing the circle, is left up to you to determine. We will try to mention any difficulties or special differences a total station may have, but you should be familiar with the operation of your instrument.

There are a couple of concepts related to the use of TDS-COGO48 that you should be aware of. First, the TDS-COGO48 is a 3-dimensional, coordinate geometry field computer. It dose not have the option of storing Raw Data, but stores only the coordinate data.

Second, when entering field data you have a number of optional formats in which the data can be entered; e.g. Angle right or left; Azimuth or Bearing; Deflection right or left;. Zenith or Vertical angle and Slope distance or Horizontal distance and Change in elevation.

TRAVERSING THE BOUNDARY OF THE SMITH PROPERTY

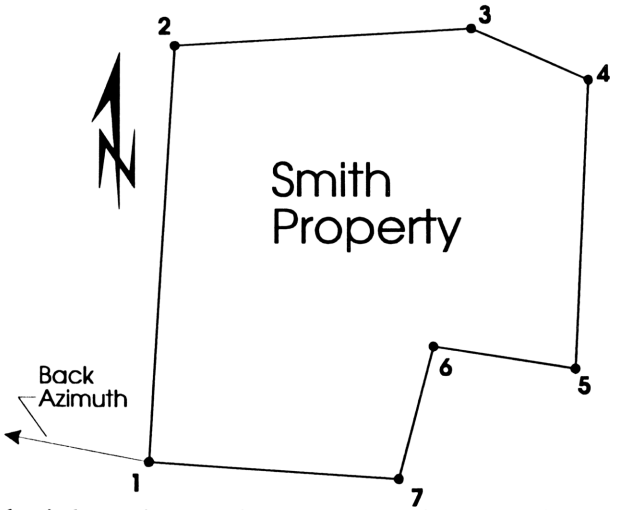
This chapter covers several examples of the use of the TDS-COGO48 in the field. As with other sections of this Manual, the general approach is to cover some basic material and deal with both the theory of the operation of the TDS-COGO48 and its practice. It is presumed that the material contained in this section of the Manual will be read and practiced while in an office setting.

FIELD WORK

In order to provide realistic examples, it is assumed that you will be keying in the field data manually from field notes provided in this chapter.

You are now somewhat familiar with the TDS-COGO48. It's time to enter the field data for the sample job called SMITH. It's the same one that you created in the Chapter 2: "Getting Started". Since you already have coordinates for the property corners you may want to **[CREATe]** a new job for this field data(Perhaps **SMITH2**). As you recall, you established the **SMITH** job with the starting point at 1 using the default coordinates of northing and easting, each equal to 5000.0000 ft., and an elevation of 100 ft. If you do not wish to save the coordinates entered in chapter 3 simply answer **[Y]** when prompted to overwrite each point.

Your first task is to enter the boundary survey of the Smith property, a plot that you will work with throughout this Manual. A sketch of the property is shown here for reference:



You begin by setting your instrument on point 1. You have found a point on the adjacent property to the west which has a known azimuth from point 1. You choose this point as a back sight and set the known azimuth as the back azimuth. You then traverse the boundary clockwise closing back on point 1. The following table represents the field notes from the survey:

Back Sight [BS]	Occupied Point [OC]	Fore Sight [FS]	Height of Instru. [HI]	Height of Rod [HR]	Horizontal Angle (angle right) [HA]	Zenith Angle [ZA]	Slope Dist. [SD]
0*	1	2	5.32	6.0	86.5412	89.4050	711.42
1	2	3	5.43	6.0	262.5448	89.3236	457.76
2	3	4	5.40	6.0	208.5710	89.1803	201.31
3	4	5	5.39	6.0	247.1657	88.5235	497.13
4	5	6	5.35	6.0	277.4835	90.2926	223.98
5	6	7	5.40	6.0	92.4143	90.2746	233.88
6	7	8	5.42	6.0	261.2756	91.4405	387.25

*The known *back azimuth* is 276° 23' 15".

The screen that you will use to enter this data is the Traverse/Sideshot Screen.

Path: From the Main Menu, press **[J] Traverse/Sideshot** Screen.

Ang right / Azimuth / Bearing /
Ang left / Def right /Def left =>
Zenith ang / Vert ang / Chng elev =>
Slope dist / Slope dist / Horiz dist

```
OC:1          FS:2
BS pt:         0
>Ang right :     0.0000
>Zenith ang:     0.0000
 Slope dist:      0.000
HI:  0.000 HR:   0.000
```

SIDES		BACK	TRAV		EXIT

This screen is designed for you to key in data directly from your field notes.

Step 1: To begin: from the Traverse/Sideshot Screen, set the occupied point (OC) as 1; the foresight point (FS) as 2; and press the **[BACK]** key. This will allow you to set the back azimuth for your first shot. Filled out the Backsight azimuth with 276.2315 and press **[SOLVE].** You will be prompted for a new HI and the Screen will appear as:

BS point / BS azm /
BS brg =>

```
    Backsight
>BS azm:   276.2315
 Circle:   0.0000

BS Azm:    276.2315
BS Brg:    N83.3645W
```

SOLVE					EXIT

NOTE

Remember to use the **[←]** or **[→]** key to change the first line prompt to "BS azm" before keying in the back azimuth. The BS Circle field, is the horizontal circle (angle) reading in the instrument while sighting on the backsight. This is customarily zero, but may be any value. **In this example, it should always be 0.**

Step 2: Pressing **[EXIT]** will return you to the Traverse / Sideshot Scre Finish filling out this screen with:

- **Angle Right: 86.5412**
- **Zenith Angle: 89.4050**
- **Slope Distance: 711.420**
- **HI: 5.320**
- **HR: 6.000**

taken from the table above.

The screen appear as show below:

Ang right / Azimuth / Bearing /
Ang left / Def right /Def left =>
Zenith ang / Vert ang / Chng elev =>
Slope dist / Slope dist / Horiz dist

```
OC:1        FS:2
BS pt:0
>Ang right  :86.5412
>Zenith ang:89.4050
 Slope dist:711.420
HI:  5.320 HR:  6.000
```

SIDES		BACK	TRAV		EXIT

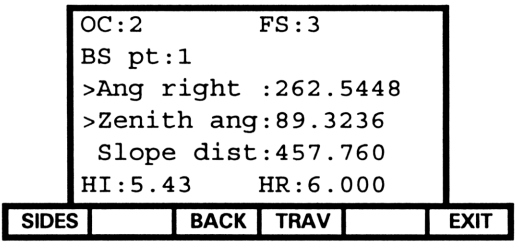
Step 3: Press **[TRAV]** to take this shot.

By filling out the screen and pressing **[TRAV]**, the TDS-COGO48 will do several things. First, it will compute the coordinates of your foresight point; in this case, point 2. If you have the "storing pause" set "ON" in the Operating Modes Screen of the Setup Menu, the TDS-COGO48 will also display the coordinates for you.

Next, the TDS-COGO48 will add these coordinates, along with the point descriptor, to the SMITH coordinate file. The machine will then increment the occupied point and foresight point and set the backsight point to be the old occupied point. The result: OC=2; FS=3 and BS=1. Finally, it will also change the back azimuth to reflect the new backsight point. If you have a

point with known coordinates specified as the backsight point in the Traverse / Sideshot Screen, it is not necessary to use the **[BACK]** key. You need to use the **[BACK]** key only if you wish to set a back azimuth or back bearing or change the circle angle to your backsight. For the rest of the traverse, you will backsight the previously occupied point. The TDS-COGO48 assumes that this is the continuing mode of operation and will build the screen after each shot accordingly.

Step 4: Fill out the Traverse \ Sideshot screen for the next point. The data for point 3 should appear as shown below prior to pressing **[TRAV]**. Again you will be prompted for the HI.



NOTE

From the standpoint of the TDS-COGO48, the only difference between the **[TRAV]** and **[SIDES]** keys is that, after a sideshot, the TDS-COGO48 will not change the occupied point or the backsight point. Of course, it will increment the foresight point to the next point number as it does for a traverse.

Step 5: In the same manner, you should enter the data from the table for the remaining corners into the SMITH job file. This will complete FS. Points 2 to 8.

FIELD WORK

SCREEN GRAPHICS

At this point, you may wonder if those coordinates resemble the SMITH property. One way to tell is to look at these coordinates and try to figure out where they are in relation to the corners of the Smith property. However, there's an easier and faster way. You can use the Screen Plot capability of the TDS-COGO48 to show the points of the SMITH job graphically in the display.

Path:	From where you are, press **[PLOT]** or [↵] **[÷]** for the Screen Plot Screen. It is shown below:

From point - To point / Using point list =>

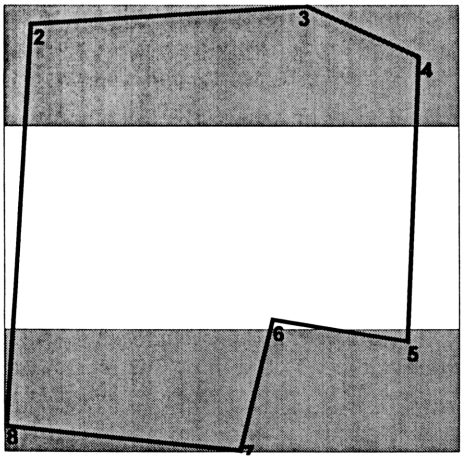
```
   Screen Plot
>From point: 1
To point   : 8

Plot pt number: >Yes
```

<= Yes / No

POINT	PTLST	LINES	SCALE	PRINT	EXIT

Step 1: Specify points from point 1 to point 8.

Step 2: Then press **[LINES]**.



Use the **[↑]** and **[↓]** keys to scroll to the "hidden" portions of the plot.

Step 3: You should now see a partial plot of the SMITH job in the display. Use the **[↓]** and **[↑]** keys to view the rest of the plot.

Step 4: Press the **[ON]** key to return to the Screen Plot Screen.

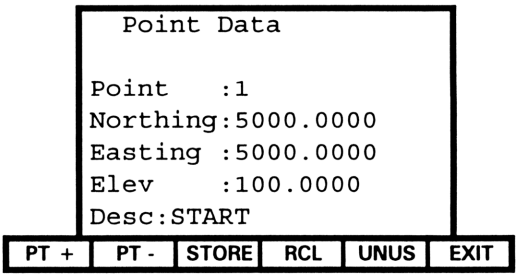
The Plot pt number field allows you to turn ON or OFF, the plotting of point numbers . You may also want to see what happens when you press **[POINT]**.

NOTE

The first time that you do a screen plot after you have opened a job, the TDS-COGO48 will automatically set the scale for all screen plots for that job. The TDS-COGO48 will search the coordinate file and select a scale that will plot all of the *specified* points in such a way that they will completely fill the virtual display as shown in the above figure. If you subsequently add new points that enlarge the area of your plot, the scale and location of the points will not change for this job unless you press **[SCALE]**. Pressing **[SCALE]** in the Screen Plot Screen will re-compute the scale and location of the plotted points based upon the *new* group of selected points.

VIEW COORDINATE

As you learned, in Chapter 2, you can view your coordinates in the Edit coordinate screen (**[ED CRD]** or **[Z]**). The screen for point 1 is displayed below:



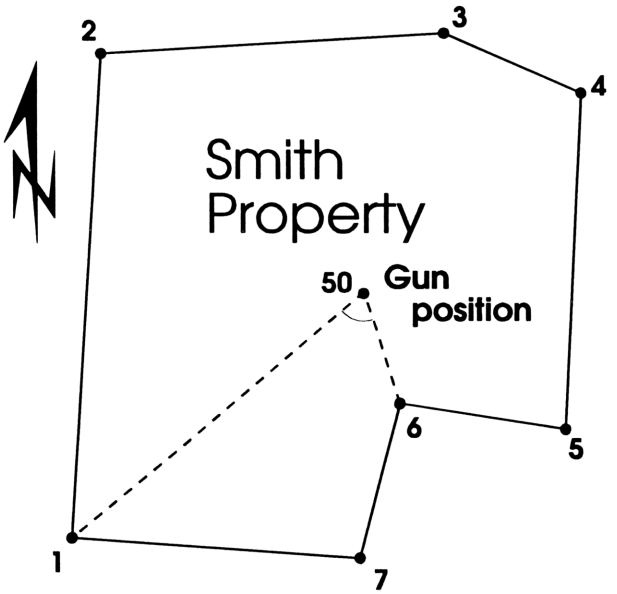
You can use the **[PT +]** **PT +** and **[PT -]** **PT -** keys to review coordinates. The **[RCL]** key can be used to jump directly to a specified point number and the **[UNUS]** key will find the next larger unused point number.

FIELD WORK

TWO POINT RESECTION

The next segment of the job is to perform a topographic survey of the Smith property. However, none of the known boundary points provide an adequate vantage point to the entire parcel. Therefore, you decide to move the instrument to a position near the center of the property from which you have a good line of sight to the rest of the parcel. In this section, you will learn to establish the coordinates of the new instrument position using a two-point resection technique. To learn about the Three-Point Resection screen, consult the appropriate section in the Reference Manual.

Let us call this new (unknown) instrument position *point 50.* The two point resection requires the rod man to move to two appropriate points that have known coordinates in the SMITH job file. For this example, use points 6 and 1. From point 50, you need to determine the zenith angle and slope distance to both points and the horizontal angle between them. From this information, the TDS-COGO48 can determine the coordinates of the instrument position and store this information in the SMITH coordinate file. The figure below depicts the situation.



The field notes for this resection problem are shown in the table below:

Back Sight [BS]	Occu-pied Point [OC]	Fore Sight [FS]	Height of Instru. [HI]	Height of Rod [HR]	Horizontal Angle (circular) [HA]	Zenith Angle [ZA]	Slope Dist. [SD]	Note
6	50	6	5.42	6.0	0.0000	88.1347	162.19	PT 6
6	50	1	5.42	6.0	74.1810	91.0713	498.91	PT 1

This data is entered in the Two-Point Resection screen.

Path: Press the direct access key **[RESCT2]** or [↩] **[L]**. As with all direct access keys, it can also be found from the Main Menu; then **[M] CO-GO menu;** and, then **[L] Resect (2P).**

Step 1: Enter the data for this example as shown in the screen below:

```
  Resection from 2 Pts
Option: >Direct only
First pt:    6
HI:5.420    HR:6.000
Circular:    0.0000
Zenith ang: 88.1347
Slope dist: 162.190
SOLVE                  EXIT
```

<= Direct & Rev / Direct only

Step 2: Press **[SOLVE]** and the TDS-COGO48 will go on to the second point. The next screen will appear. Fill it out as shown below:

```
  Resection 2nd Pt
Second pt:   1
            HR:6.000
Store pt:    50
Circular :   74.1810
Zenith ang: 91.0713
Slope dist: 498.910
SOLVE                  EXIT
```

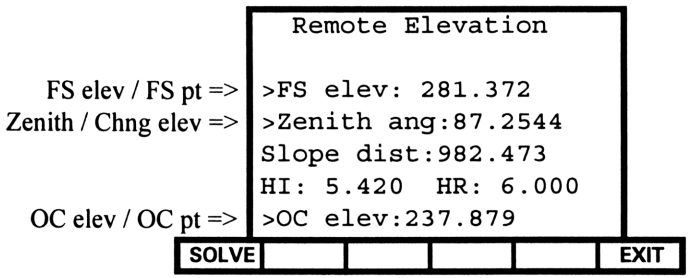
FIELD WORK

Step 3: Again, press **[SOLVE]** from this screen. The TDS-COGO48 will compute the coordinates of the new instrument position: point 50. It will also compute the horizontal distance between the two known points calculated in this resection. It will compare this distance with the distance between these points as determined from the known coordinates of these points stored in the SMITH coordinate file: points 6 and 1. This measurement is expressed as a precision number for the resection. In this example, the precision of the resection to establish point 50 is reported as 191,199, which is approximately 1 in 191,199. You are prompted for a descriptor for the new point.

BENCHMARK

Since doing the boundary traverse, you have found a benchmark from which we can establish our true elevation. Before you begin the topo, you will want to have an accurate elevation for your occupied point. The Benchmark routine allows us to compute the elevation of an occupied point from the elevation of a foresighted point.

Path:	Press the direct access key, **[BENCH]** or [↩] **[P]**. Or, from the Main Menu; press **[M] CO-GO;** then, **[O] Benchmark**.



Step 1: Fill out the screen with the field data as shown above and press **[SOLVE]**. The OC elev: is 237.88. The elevation determined by the 2-Pt resection was 110.35 with a difference of 127.53. This will be used later in Chapter 4.

Step 2: Now, change the OC elev: to OC pt: and enter "50". Press **[SOLVE]**. This time you will be asked if you want to overwrite point 50. Answer "Y" for yes. The elevation of point 50 is now adjusted relative to the foresighted benchmark.

If the **OC pt** is selected, the Benchmark routine will replace the existing elevation of the occupied point with the elevation, calculated from the foresight. When the **OC elev** prompt is chosen, this routine will only display the calculated elevation.

TOPOGRAPHIC SURVEY OF THE SMITH PROPERTY

From your position at point 50, you may now complete a topographic survey of the Smith property. A normal topographic survey would include sideshots taken for all of the features of the property. In the interest of brevity, the data for this example is restricted to the 9 points listed as points 51 to 59 in the table below. The *elevations* of these points are of prime importance. Since you did your resection with the horizontal angle zeroed while sighting point 6 as a backsight, you may as well continue to use point 6 as a backsight for the topographic survey.

FIELD WORK

Back Sight [BS]	Occupied Point [OC]	Fore Sight [FS]	Height of Instru. [HI]	Height of Rod [HR]	Horizontal Angle (angle right) [HA]	Zenith Angle [ZA]	Slope Dist. [SD]
6	50	51	5.42	6.0	77.2701	91.0638	350.43
6	50	52	5.42	6.0	98.3511	90.2829	106.23
6	50	53	5.42	6.0	166.4557	90.4605	378.20
6	50	54	5.42	6.0	221.0823	90.2225	237.72
6	50	55	5.42	6.0	252.4512	90.4518	55.39
6	50	56	5.42	6.0	319.5833	88.5442	287.43
6	50	57	5.42	6.0	4.1315	88.3356	99.02
6	50	58	5.42	6.0	25.0702	89.3258	253.09
6	50	59	5.42	6.0	56.4200	90.2459	182.14

With one exception, the procedure for entering sideshot data is exactly the same as that for a traverse. The exception is that you must press the **[SIDES]** key instead of **[TRAV]**.

Step 1: As an illustration, the Traverse/Sideshot Screen shown below is properly filled out for the first shot prior to pressing **[SIDES]**.

Ang right / Azimuth / Bearing /
Ang left / Def right /Def left =>
Zenith ang / Vert ang / Chng elev =>
Slope dist / Slope dist / Horiz dist

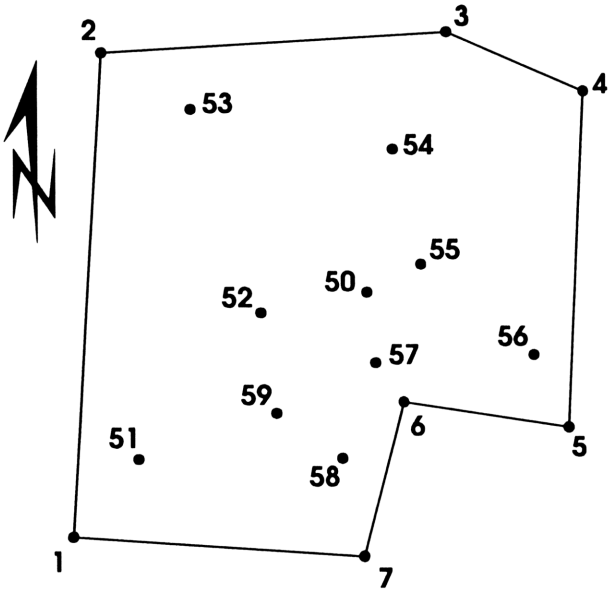
```
OC:50        FS:51
BS pt:6
>Ang right  :77.2701
>Zenith ang:91.0638
 Slope dist:350.430
HI:5.420    HR:6.000
```

SIDES		BACK	TRAV		EXIT

Step 2: In like manner, the other sideshots may be added to the file. The figure below shows the relative locations of these points. You may use the Screen Plot Screen feature to get a rough idea of the location of the points you have added to the file.

NOTE

Traverse shots and sideshots can be taken intermixed. There is not a limit to the number of sideshots that can be taken from any one occupied point. Be mindful, if you use the **[TRAV]** key, that the point to be occupied next is shot last on each setup. When the **[TRAV]** key is pressed, the foresight point will be used to replace the occupy pt. If your next occupied point is not to be your last shot from this setup, then use the **[SIDES]** key and manually change the occupied point field when you move ahead.



7. ADJUSTMENTS

In this chapter, you will learn several ways you can adjust your coordinates under various constraints. You can scale your job or translate blocks of coordinates in any direction, including elevation. You can rotate blocks of coordinates about any point in the file through any specified angle. You can also adjust a traverse using Angle Adjustment and then the Compass Rule.

This chapter is an introduction to TDS-COGO48's various adjustment routines. You will be using the coordinates that were computed as a result of the SMITH survey. Be certain that you have the SMITH job as the active job. If you have not done the Field Work from Chapter 3 or no longer have the SMITH job available, you can create a new job file and enter the coordinates from the table below. Your coordinate file should look as follows:

PT NUM	NORTHING	EASTING	ELEV.	NOTE
1	5000.0000	5000.0000	100.00	START
2	5710.2358	5040.8379	103.29	PT2
3	5740.5392	5497.5792	106.37	PT3
4	5654.9688	5679.7808	108.22	PT4
5	5158.3849	5658.6252	117.36	PT5
6	5198.2397	5438.2280	114.79	PT6
7	4970.3105	5385.8397	112.30	PT7
8	5000.0783	4999.9135	100.00	Close to pt1
50	5341.9353	5363.1789	237.88	PT50
51	5116.1320	5095.2835	230.51	PT51
52	5307.3676	5262.7343	236.42	PT52
53	5628.1565	5115.0212	232.23	PT53
54	5573.0213	5418.9250	235.75	PT54
55	5380.9779	5402.4624	236.57	PT55
56	5232.4298	5628.8757	242.76	PT56
57	5251.0577	5402.4228	239.78	PT57
58	5089.0863	5374.0411	239.29	PT58
59	5182.8260	5274.5365	235.98	PT59

This first thing you may wish to do is to compute the precision of the survey. You can determine the precision of a survey from the Compass Rule Screen.

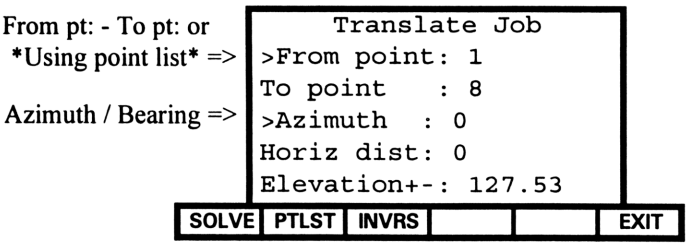
Path:	From the Main Menu, select **[N] Survey adjustment**; then, **[K] Compass Rule** Screen.

Step 1: Enter From point: as "1" and To point: as "8". Then press **[PRECI]**. The precision is displayed as: 23,245, which should be read as 1 in 23,245. The precision may vary slightly if you have typed in your coordinates. Press **[EXIT]** to return to the Survey Adjustment Menu.

TRANSLATION

To acquire some practice with the adjustment features of the TDS-COGO48, let us assume that selecting your beginning elevation as 100 ft was simply for arbitrary convenience. However, In Chapter 3 while doing your Benchmark calculation of point 50, you discovered that, you must add 127.53 to the elevation of each boundary point in the file. You would like to bring all of the boundary points of your survey into line with the elevations of the topo.

Path:	From the survey adjustment Menu, select **[H] Translate job**. The Translate Job Screen is shown below:



Step 1: The elevation of only the boundary points, in the SMITH job, should be adjusted; so, enter "1" in the From point and "8" in the To point: field. In this example there is no need to change the position of the survey only its elevation so set the Azimuth: and Horiz dist: to "0". Enter 127.53 in the Elevation+- field. When your screen is filled out with the same values as displayed above, press **[SOLVE]**.

ADJUSTMENTS

After pressing **[SOLVE]**, the TDS-COGO48 will adjust the elevations by the amount specified. You may return to the Point Data Screen to confirm this.

NOTE

Since you were adding an elevation, you simply keyed in the amount to add. To **subtract** an elevation, key in a **negative** value for the amount to subtracted. The translation of the coordinates' positions can be done at the same time as changing its elevation. Simply enter the proper values in the Azimuth and Distance Fields.

The **[INVRS]** key will bring up the Inverse screen from the CO-GO menu allowing you to inverse between two known points. Entering your 2 points, press **[SOLVE]** and **[EXIT]** from the inverse screen. The inverse results will be stored in the bottom three lines of the Translate Job screen.

ROTATE JOB

Let us also assume we learn that our backsight was entered in error and should have been 276.5315. A simple rotation will correct this problem.

Path: From the survey adjustment Menu, select **[I] Rotate job**. The Rotate Job Screen will be displayed:

From pt: - To pt: or
Using point list =>

```
        Rotate Job
>From point: 1
To point   : 59

Rotation pt: 1
Old bearing: N83.3645W
New bearing: N83.0645W
```

SOLVE	PTLST	DFDIR			EXIT

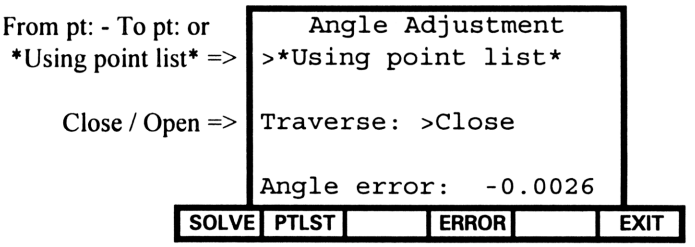
Step 1: The position of all the points in the SMITH job including the topo should be rotated, so enter "59" in the To point: field. Enter "1" as the Rotation pt: and N83.3645W and N83.0645W as the Old and New Bearings. The screen should look like the display above. Press **[SOLVE]**.

After you press **[SOLVE]**, the TDS-COGO48 will rotate all of the coordinates around point "1" by the difference between the two bearings.

ANGLE ADJUSTMENT

For practice with traverse adjustments, let us perform an angle adjustment and then the Compass Rule adjustment on the SMITH job.

Path:	Select **[J]** from the Adjustment Menu. The Angle Adjustm Screen appears as:



Step 1: Again you want to adjust all the points in the SMITH job, but simply entering "From pt 1 To point 59" will treat every point as a traversed point. Points 50 to 59 need to be adjusted as sideshots. In order to differentiate between Traverse points and Sideshots, we must use a Point List.

Press **[PTLST]** to bring up the Point List Menu; then **[H]** to clear any current list; then **[G]** to display the Point List Screen.

At the NXT PT prompt, enter:

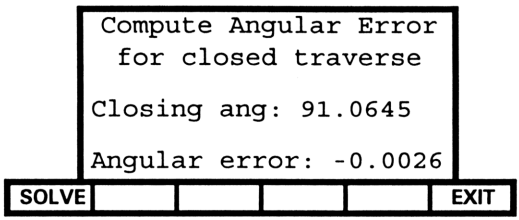
1-6	**[ENTER]**
SS 50-59	**[ENTER]**
7-8	**[ENTER]**

This has defined a Point List that will treat 1 to 6 as traverse points; 50 to 59 as sideshots of point 6; and, 7 to 8 again as traverse points. Press **[EXIT]** twice to return to the Angle Adjustment screen. Now, change the From pt. prompt to display, *Using point list*.

NOTE

The Point List is used throughout the TDS-COGO48 to specify points to be used in a variety of functions. For example, a Screen Plot may use the point list to select those points that you want to display. To get the most out of your TDS-COGO48, be certain that you understand the concept of the Point List. It is described in greater detail in the Reference section.

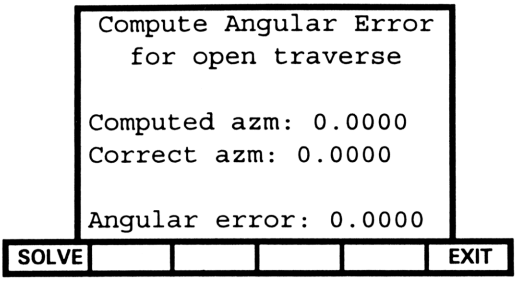
Step 2: Now you need to determine the angular error of your traverse. Press **[ERROR]** and the following screen is displayed:



When adjusting a closed traverse there are two methods that the TDS-COGO48 can use to calculate the angular error. If you have measured the closing angle you can enter that angle in the Closing ang field. The closing angle is the circle angle from a backsight of the next to the last traverse point, while occupying the closing point/starting point and turning to the second point of the traverse.

The second method is to let the TDS-COGO48 calculate the closing angle using the next to the last point, the last point and the second point in the point list. If the closing angle field equals zero then the closing angle will be calculated other wise the value in this field will be used as the closing angle. Both methods calculate the angular error by adding together the internal angles at each traverse point. The sum is then compared to **N-2*180** where **N** equals the number of traverse points. The difference is the angular error.

If you are adjusting an **OPEN** traverse you must enter both the observed or computed closing azimuth and the correct closing azimuth. The Error Routine will calculate the difference between these to azimuths to determine the error. The Compute Angular Error for open traverse screen is displayed below:



We will let the routine calculate the closing angle. Make sure the closing angle is 0 and press the **[SOLVE]** key to compute the angular error.

Step 3: You can now view the angular error as -0.0026 and decide if the closure is acceptable. If so, press **[EXIT]** to return to the Angle Adjust screen and press **[SOLVE]** to adjust the traverse angles. The angular error is divided by one less than the number of traverse points. The internal angle at each traverse point is adjusted by this fraction of the total error, starting from the third point in the traverse.

At this point, the traverse has the correct sum of internal angles for a 7 sided polygon. Points 1 and 8 do not yet close, but the internal angles are adjusted.

NOTE

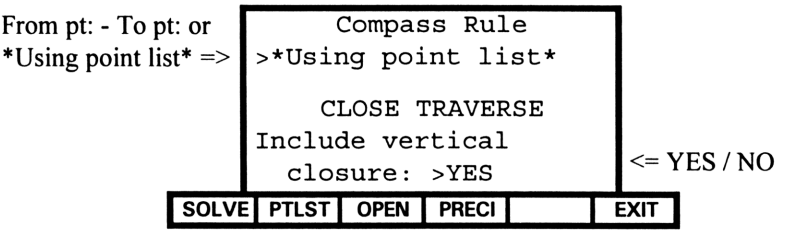
It is not necessary for the traverse points to be in numerical order in order to perform an adjustment. If they are not in numerical order, use the Point List to specify the order of the *traverse points*. If sideshots were taken from the occupied points during the traverse, they may be included in an adjustment, as sideshots. In the Point List, following the occupied point from which the sideshot was taken, keying in **[S] [S] [SPACE]** and the point number (SS ##). By including your sideshots in the Point List, your sideshots as well as your traverse point coordinates will be adjusted when you solve for the various adjustments in the Adjustment Menu.

ADJUSTMENTS

COMPASS RULE

The last exercise is to adjust the closure of the coordinates with the Compass Rule routine.

Path:	From the Adjustment Menu, select **[K] Compass Rule** Screen. This screen is displayed below:



Step 1: The Point List you created for the angular adjustment is correct for this closure also. Be sure the screen says **CLOSE TRAVERSE** on the center line. If not then press **[CLOSE]** or **[C]** to change the display.

NOTE

If you want to calculate the precision again, do so at this time. The precision, and the angular error as well, are determinations made from the errors in the traverse. Once the adjustments are made, these values cannot be recalculated without returning the coordinated to their original values.

Step 2: Press the **[SOLVE]** or **[A]** key to adjust the traverse.

NOTE

Open traverses may also be adjusted. Select the OPEN TRAVERSE version of the Compass Rule Screen by pressing **[OPEN]**. You will have to key in the true northing and easting coordinate values that the last point in the traverse will close to before pressing **[SOLVE]**.

The Compass Rule routine can be set to adjust or not adjust the elevations. Just set the "**Include Vertical Closure:**" field to "Yes" or "No", depending on whether or not you want the elevations included.

CHANGE SCALE

Within the Survey Adjustment selections there is also the ability to change the scale of your job. This routine is useful either to convert a set of coordinates to or from the state plane grid; or, for modifying a job from feet to meters or from meters to feet. This routine functions like the other adjustments; you simply enter the range of point you want scaled; a base point (a point whose coordinates will not be changed); and, a scale factor. You then press solve to adjust the scale.

Path:	From the Adjustment Menu, select **[G] Change scale** Screen. This screen is displayed below:

From pt: - To pt: or
Using point list =>

```
      Change Scale
>From point: 1
To point   : 60

Base point  : 1
Scale factor:1.0000
Scale elevation:> Yes
```

<= Yes / No

SOLVE	PTLST				EXIT

The scale routine can be set to adjust or not adjust the elevations. When converting to state plane coordinates, you would typically not want the elevations changed. However, when changing the distance units, you would. You will not be changing the scale of this job. It is presented here simply for reference.

NOTE

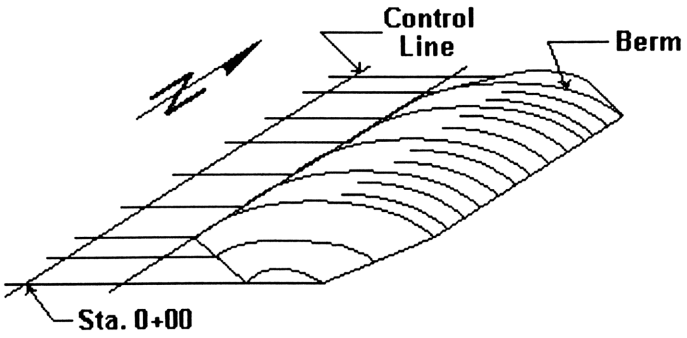
The Change Scale routine changes the coordinates of your job. It should not be used to adjust the size of your plotted or printed output as it will change calls, inverses and other distance-related calculations.

8. EARTH WORK

In this chapter, you will learn how to use TDS-COGO48 to compute volumes of earth from field and coordinate data. TDS-COGO48 uses the average end-area method of computing the volume of a berm or a gully. This technique may be extended to compute the volumes of cuts or fills required for road construction. Finally, you will learn how TDS-COGO48 can compute the volume of a mound or borrow pit.

VOLUME OF A BERM OR GULLY

In this section, you will learn how to gather data in the field from a berm or gully and how to use TDS-COGO48 to compute the volume of the amount of earth in the berm or the amount that has to be added to fill the gully. The average end-area method is used to compute volumes. For this example, assume that you are to compute the volume of earth in a berm. The sketch below indicates the procedure to follow.



EARTH WORK

First, establish a control line parallel to the long axis of the berm. Designate one end of the control line as station 0 + 00. Position your gun at a location that will give you a good line of sight to all of the points on the berm that you want to shoot. Shoot at least two points on the control line to establish the control line azimuth.

The earthwork calculations in the TDS-COGO48 require that the control line run in a north-south direction. If the actual control line is in some other direction, you should *rotate the job* after the data is collected so that the actual control line azimuth is 0^{o}. Job rotation is described in Chapter 7 - Adjustments.

Now, have your rod man move across the berm along lines perpendicular to the control line. He should stop at each "break" in the contour of the berm to take a shot. In this way, you will collect points along a series of cross-sections across the berm. The coordinates of these points will be used to compute the cross-sectional areas of each section. Then, these areas will be used in the average end-area method for computing volumes.

Assume that you have collected the data for the berm illustrated above and have rotated the job such that the azimuth of the control line is 0^{o}. The coordinate values are shown below.

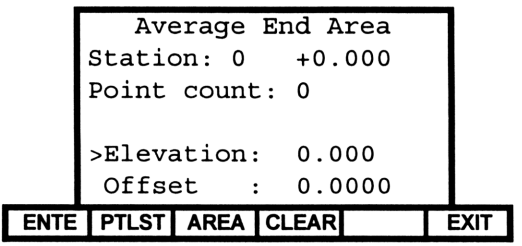
STATION	POINT NUMBER	NORTHING	EASTING	ELEVATION
0 + 00	1	5000.00	5045.00	100.00
	2	5000.00	5060.00	108.00
	3	5000.00	5075.00	100.00

STATION	POINT NUMBER	NORTHING	EASTING	ELEVATION
0 + 20	4	5020.00	5040.00	100.00
	5	5020.00	5050.00	107.00
	6	5020.00	5070.00	106.50
	7	5020.00	5080.00	100.00
0 + 30	8	5030.00	5030.00	100.00
	9	5030.00	5040.00	102.00
	10	5030.00	5060.00	112.00
	11	5030.00	5080.00	103.00
	12	5030.00	5090.00	100.00
0 + 55	13	5055.00	5030.00	100.00
	14	5055.00	5040.00	104.00
	15	5055.00	5060.00	111.00
	16	5055.00	5080.00	105.00
	17	5055.00	5090.00	100.00
0 + 80	18	5080.00	5030.00	100.00
	19	5080.00	5040.00	102.50
	20	5080.00	5060.00	113.50
	21	5080.00	5080.00	104.00
	22	5080.00	5090.00	100.00
1+05	23	5105.00	5030.00	100.00
	24	5105.00	5040.00	105.00
	25	5105.00	5060.00	113.50
	26	5105.00	5080.00	102.50
	27	5105.00	5090.00	100.00
1 + 20	28	5120.00	5030.00	100.00
	29	5120.00	5040.00	107.00
	30	5120.00	5060.00	114.00
	31	5120.00	5080.00	105.50
	32	5120.00	5090.00	100.00
1 + 40	33	5140.00	5040.00	100.00
	34	5140.00	5050.00	107.00
	35	5140.00	5070.00	109.00
	36	5140.00	5080.00	100.00
1 + 45	37	5145.00	5045.00	100.00
	38	5145.00	5060.00	104.50
	39	5145.00	5075.00	100.00

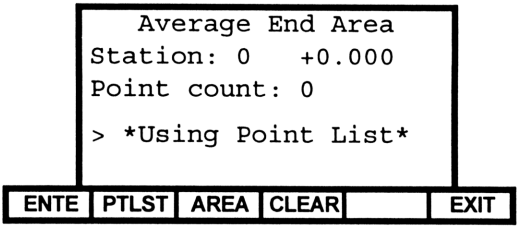
Obviously, this data is contrived in order to simplify the task of keying them into the system. For example, actual field data will not have the northings of all of the points for a given station exactly the same. However, it is important that these northings be close in value. The amount of variation in the northing value of cross-section points for a given station is a measure of how far your rod man wandered from a true perpendicular to the control line. The actual value of the northings of these points is ignored by TDS-COGO48 in doing earthwork calculations.

The earthwork screens allow you to key in the easting offsets and elevations from you field notes; or, you can use the Point List to set up the points along the respective cross sections. In preparation for this, you should key in the data given above, at least for the first several stations. It will be a new job. Set up a job called BERM. Key in the data using the Point Data Screen ([↩] [Z]).

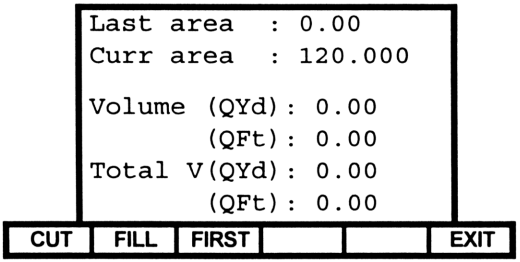
Once you have the data keyed in, from the Main Menu, select **[I]** for **Earthwork**. At this point it is wise to use the **[I] Clear earth work data** to clear any left over data from a previous calculation. Then, select **[G]** for the **Average End-Area** method. This will present you with the following screen :



You could now key in the elevation and offset (easting) of the points along the cross-section for station 0 + 00. However, since you have this data already stored as points 1, 2, and 3 of the BERM job, you should press one of the horizontal arrow keys with the scroll bar on the elevation line. This will allow you to use the point-list method of specifying the data.



You should now press the **[PTLST]** softkey and set up a point list with points 1, 2, and 3. A single point list entry can specify points 1-3. These are the three points on the cross-section for station 0 + 00. Now, press the **[EXIT]** softkey twice to return to the Average End Area Screen. Then, press the **[AREA]** softkey. This command will compute the cross-section area and store it in the Last area. Volumes are computed by pressing the **[CUT]** and **[FILL]** keys. After pressing the **[AREA]** key, you should see the screen below.



NOTE

Pressing **[EXIT]** before pressing **[CUT]**, **[FILL]** or **[FIRST]** will return you to the Average End Area Screen. There you can make any correction to the data defining the current cross section and press **[AREA]** again to return to the Volume screen

Since this is the first cross section, you cannot compute a volume yet. Press **[FIRST]** to enter this area as the first cross section. Now, **[EXIT]** back to the AVERAGE End Area screen. Set the station to 0 + 20 and redefine the point list to include the points on the cross section at station 0 + 20. These points are 4, 5, 6, and 7. Press the **[ENTER]** key and **[EXIT]** twice to return to the Average End Area Screen.

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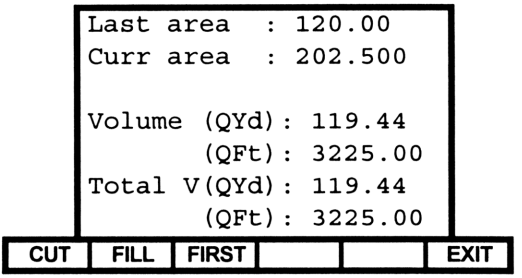
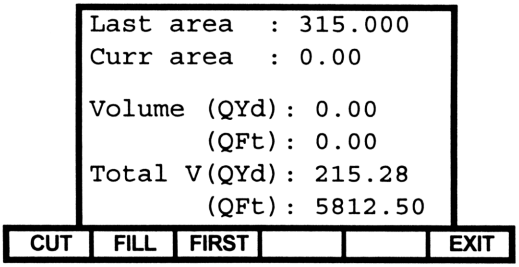
Now, press the **[AREA]** softkey again to compute the cross-section area. If the cross section area displayed on the "Current area" line is correct, press the **[CUT]** softkey. In our example, you will always press **[CUT]** because we are determining the volume of a berm being "cut". If you were determining the volume of a gully to "fill", you would press the **[FILL]** softkey. Pressing **[CUT]** will compute the volume and update the "Last area" value. This will also clear the "Current area" value.



If the area is not correct, you should press the **[CLEAR]** softkey. Then, enter the correct data points. Use either the correct point list or the elevation and offset from the screen. Then, press the **[AREA]** softkey to compute the area at the cross section and the **[CUT]** softkey to add the current volume to the total. After correctly computing the volume of this segment, you should see the following screen :

The volume between stations 0 + 00 and 0 + 20 is shown in both cubic yards (QYd) and cubic feet (QFt). The cumulative volume is also shown in cubic yards and cubic feet.. Key in the new interval : 10 ft to the next station 0 + 30. Change the point

list to match the points at station 0 + 30. These points are 8, 9, 10, 11, and 12. Now, press the **[ENTER]** softkey to compute the end-area and volume. Press the **[CUT]** softkey to add the volume to the total. After pressing these keys, you should see the following screen :



Key in the interval to the next station (25 ft); update the point list; and, press the **[ENTER]** and the **[CUT]** softkeys to compute the volume at the next station and add it to the total. In this manner, you can work your way through the stations along the berm to compute its volume piece-by-piece. If you pursue this example to the last station 1 + 45, you should have a computed volume of 46,812.5 cubic feet or 1733.8 cubic yards.

NOTE

This example assumes that there is a finite area at the end of each berm. Sometimes, your beginning or ending areas may indeed be zero. To start the job with a zero area cross-section, key in the distance from the zero cross-section area station to the first non-zero cross-section as the "Station interval" and press either **[CUT]** or **[FILL]**. Do not use the **[FIRST]** softkey. To end with a zero area, key in a final point list of only one or two point numbers or enter only one or two points' elevation and offset. This will force a zero end-area for the final cross-section.

NOTE

The average end-area method computes volumes by taking the average of the two end-areas of each section in turn and multiplying by the interval of the section. However, if one of the areas is zero, the method used by TDS-COGO48 will use one-third of the product of the non-zero end-area and the interval. This computation will result in an approximate volume which will be much closer to the actual volume.

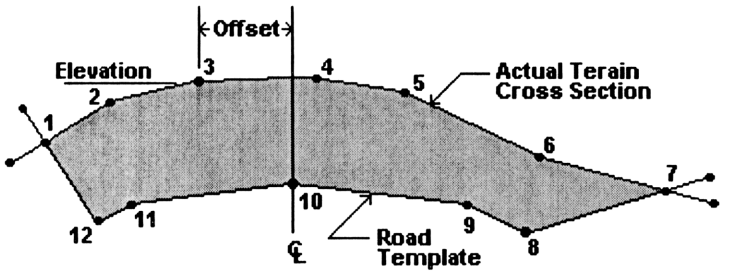
The technique of computing the volume of a gully is exactly the same as that for a berm except that you should use the **[FILL]** key to compute the volumes. The cumulative volumes of a fill will be negative instead of positive.

EARTH WORK

EARTHWORK AND ROAD CONSTRUCTION

In the first section of this chapter, you learned how to measure the volume of a berm or gully by using the average end-area method which is built into the TDS-COGO48. In this section, you will extend this method to include the volumetrics associated with converting a measured terrain to a design grade.

Assume that you have a series of cross-sections plotted for the actual terrain of a proposed stretch of new road. You have overlaid your road template at each cross-section so that each plot appears as shown below :



The elevations from a consistent datum and the offset from the center line of each of the points shown in the figure are given in the table below :

Point Number	Elevation	Offset
1	106.0	-63.0
2	109.0	-43.0
3	110.5	-22.0
4	111.0	2.0
5	110.5	21.0

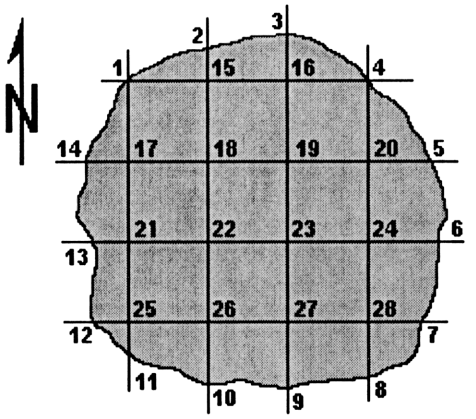
Point Number	Elevation	Offset
6	109.0	41.0
7	106.0	61.0
8	104.5	45.0
9	105.5	30.0
10	106.0	0.0
11	105.5	-30.0
12	104.5	-45.0

In this case, you will use the Average End-Area Screen in the Earthwork Menu. However, instead of using the point list to specify points to be used to compute the areas at each cross-section, you will key in the *elevation* and *offset* of each point that makes up the cross-sectional area. The elevation may be measured from any datum. The offset may be measured from any control line, such as the center line of the road shown here. After you have keyed in the elevation and offset of each point, you should use the **[ENTER]** (F1) softkey to move to the next point. The Point count line in the Screen will keep track of how many points you have keyed in. You may move around the figure in either clockwise or counterclockwise directions, keying in the elevations and offsets of the points that make up the border of the area to be computed. After the last point has been keyed in for a particular station, the "Current area" line and the "Volume" lines on the screen will display the cross-section area at the current station and the volume between the current station and the previous station. From here, the procedure to compute the appropriate volumes is identical to that used for measuring the volume of the berm in the example above. *Care should be taken to note **each** cross-section as either a cut or fill.* Remember, the **[FILL]** softkey will subtract from the accumulated volume; the **[CUT]** softkey will add to it. The area of the shaded portion of the figure above is 488.5 sq. ft.

EARTH WORK

THE VOLUME OF A MOUND OR BORROW PIT

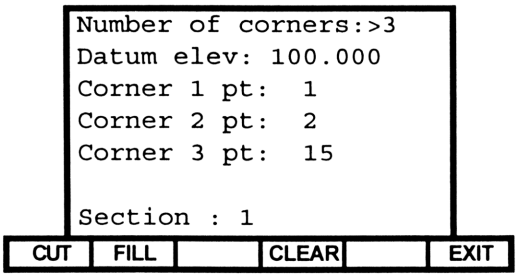
In this section, you will compute the volume of a borrow pit. The field technique is to gather data on the profile of the bottom of the pit along a network of grid lines that will yield a good description of the pit bottom profile. A plan view of the top of a borrow pit with the grid lines shown is illustrated below. The following table indicates the coordinates of the points shown on the figure.



POINT NUMBER	NORTHING	EASTING	ELEVATION	NOTE
1	2060.0000	2000.0000	100.0000	PIT
2	2070.0000	2020.0000	100.0000	PIT
3	2070.0000	2040.0000	100.0000	PIT
4	2060.0000	2060.0000	100.0000	PIT
5	2040.0000	2070.0000	100.0000	PIT
6	2020.0000	2070.0000	100.0000	PIT
7	2000.0000	2062.0000	100.0000	PIT
8	1995.0000	2060.0000	100.0000	PIT
9	1983.0000	2040.0000	100.0000	PIT
10	1988.0000	2020.0000	100.0000	PIT
11	1990.0000	2000.0000	100.0000	PIT
12	2000.0000	1990.0000	100.0000	PIT

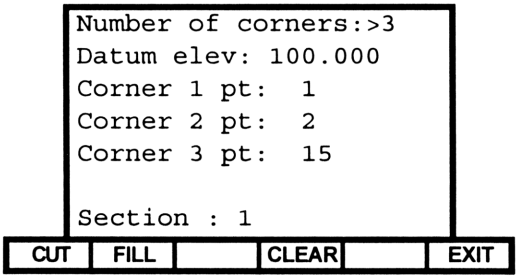
POINT NUMBER	NORTHING	EASTING	ELEVATION	NOTE
13	2020.0000	1990.0000	100.0000	PIT
14	2040.0000	1992.0000	100.0000	PIT
15	2060.0000	2020.0000	97.0000	PIT
16	2060.0000	2040.0000	96.0000	PIT
17	2040.0000	2000.0000	94.0000	PIT
18	2040.0000	2020.0000	86.0000	PIT
19	2040.0000	2040.0000	85.0000	PIT
20	2040.0000	2060.0000	96.0000	PIT
21	2020.0000	2000.0000	93.0000	PIT
22	2020.0000	2020.0000	81.0000	PIT
23	2020.0000	2040.0000	83.0000	PIT
24	2020.0000	2060.0000	98.0000	PIT
25	2000.0000	2000.0000	96.0000	PIT
26	2000.0000	2020.0000	93.0000	PIT
27	2000.0000	2040.0000	94.0000	PIT
28	2000.0000	2060.0000	99.0000	PIT

To practice with this example, open the file we have prepared for you called BOROWPIT.CR5. It contains the data given above. Next, select the **[H]** option from the Earthwork Menu. You will see the Borrow Pit Screen :



Each section of the borrow pit as defined by the grid lines has either three- or four-point corners. The northwest corner bounded by points 1, 2, and 15 is a three-corner section. The section due east of that, bounded by points 2, 3, 16, and 15, is a four-corner section. You may use the horizontal arrow keys to scroll from the three- and four-point sections in line 1 in this screen. When you have chosen the proper section, key in the point numbers for the corners. Press the **[CUT]** softkey or the **[FILL]** softkey. For the first

section in our example, you should key in points 1, 2, and 15, for the corners; select 100 feet for the datum (the elevation of the surrounding ground); then, press the **[FILL]** softkey because this is a pit; and, presumably, you want to measure the volume so you can fill it. After pressing the **[FILL]** softkey, you should see :



Now, you may key in the point boundary for the next section. First, select four corners; key in points 2, 3, 16, and 15 as the corners; and press the **[FILL]** softkey. In this way, you may move around the borrow pit, keying in the boundary points of the various sections. You must enter the points in the order they lie on the perimeter of the section. You may enter them in either clockwise order or counter-clockwise order. You may begin at any corner. The Section Line in the display will keep track of the number of sections that you have keyed in for this particular volume job. If you carry out this example to its completion, you should have a volume of -38,702.50 cubic feet or -1433.50 cubic yards.

NOTE

This example shows a grid of squares and one side of the grid running in a north-south direction. However, neither of these conditions is necessarily required for the borrow pit program to work. The grid-lines may be along any azimuth. The grid sizes may vary across the job. As a practical matter, you should set up the grid-lines to be closer together whenever there is a rapid change in elevation of the bottom of the pit.

The same technique may be used to compute the volume of a mound. However, use the **[CUT]** softkey rather than the **[FILL]** softkey to indicate that earth is to be removed.

9. PRINTING AND DATA COMM WITH YOUR TDS-COGO48

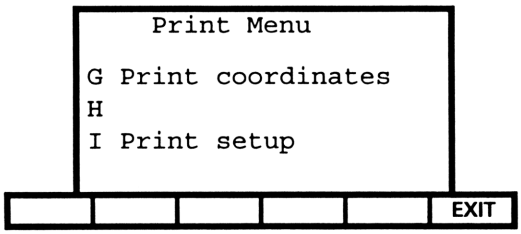
In this chapter, you will learn how to print out your coordinates directly from your TDS-COGO48. You will also learn how to prepare your TDS-COGO48 to transfer your coordinates and raw data to an office PC. The last several sections explain procedures that support data transfer to other HP-48 programs

PRINTING COORDINATES

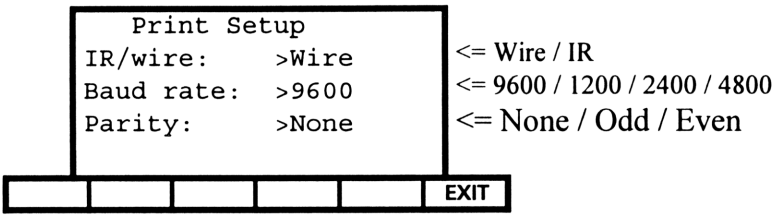
Periodically during a job, you may wish to make a hard copy of your work by printing the coordinate values of the points that you have surveyed. The TDS-COGO48 can use the HP-48's built-in infrared wireless data communications capability to print on the HP-82240B Infrared Printer. Or, you can use the serial port (RS232) to print to a printer with a similar serial port. The process for doing this is quite straightforward.

First, you should make sure that the active (open) job is the job whose data you want to print. You may select the job you want to print by using the Open Existing Job option from the Job Menu. Select **[G]** and then **[H]** from the MAIN Menu. Move the cursor to the proper job and press **[ENTER]**.

Next, **[EXIT]** back to the MAIN Menu and select **[R]** for the Print menu. The Print Menu will appear as:

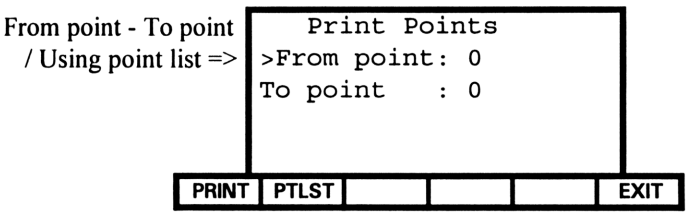


First let's press **[I]** and access the Print Setup Screen:



With this screen, you may choose whether or not to use an RS232 "wire" printer or the HP-82240B Infrared "wireless" printer. If you choose the RS232 printer, you may also specify the communication parameters of baud rate and parity. When you have filled out this screen properly for your particular printer, press **[EXIT]**. You will return to the Print Menu.

Now, select **[G]** and you will see the Print Points Screen:



As in other screens in the TDS-COGO48, you may define a block of points to be printed by specifying the From point and To point options or by using the currently active Point List. To use the Point List, press one of the horizontal cursor keys **[←]** or **[→]** while highlighting the "From point" line in the display and change the prompt to "*Using point list*". The Point List itself may be created or edited by pressing the **[PTLST]** softkey.

Once you have set up the screen to output the proper coordinate data, either plug your TDS-COGO48 into your "wire" printer with the appropriate RS232 cable or configure your TDS-COGO48 to communicate with your infrared printer. Place the HP-82240B Infrared Printer so that there is a direct line of sight between the IR emitter on the top of the HP-48 and the IR receiver on the front of the Printer. The range of these devices is approximately 3-6 inches. Make sure that the printer has an adequate supply of paper and is turned ON. Now press **[PRINT]**. Below is a sample printout to a serial printer:

PRINTING & DATA COMM

```
JOB    : SMITH          TIME:  15:57   DATE: 11-24-1992  Page 1
============================================================
Point      Northing          Easting         Elevation  Note
 ==========================================================
     1      5000.000000      5000.000000       100.000  START
     2      5710.235800      5040.837900       103.286  PT2
     3      5740.539200      5497.579200       106.365  PT3
     4      5654.968900      5679.780800       108.221  PT4
     5      5158.394900      5658.625700       117.360  PT5
     6      5198.246000      5438.227700       114.792  PT6
     7      4970.316800      5385.838900       112.303  PT7
```

The output to the infrared printer is one-way communication only. Thus, there is no way for the TDS-COGO48 to know if the printed output is properly received. If the signal is not received or is interrupted during transmission, some or all of the output will not be printed.

PRINTING SCREENS

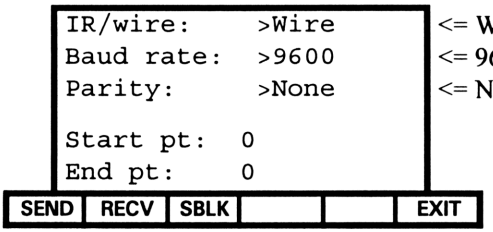
At any time, you may print the contents of any screen in your TDS-COGO48 by using the global key sequence [↵] **[D]**. When you want to make a hard copy of a screen, just set up your HP-82240B Infrared Printer properly, turn it on, and press [↵] **[D]** with the screen you want printed in the display. For example, if you take your infrared printer to the field, you may use this command after each shot to make a hard copy of your raw data as you go.

Screen prints may only be sent to the HP-82240B Infrared Printer.

DATA COMMUNICATION TO AN OFFICE PC

One of the most useful features of the TDS-COGO48 is that you may transfer the coordinates that you entered, to your office personal computer. You may also transfer coordinates from your office PC back to your TDS-COGO48 for COGO computations. The process for setting up your TDS-COGO48 to transfer a coordinate file to a PC running TFR, Tripod Data Systems communication and file conversion software, is as follows:

Path: From the MAIN Menu, select **[S]**, File transfer. You will now see the File Transfer Screen as shown:



<= Wire / IR
<= 9600 / 1200 / 2400 / 4800
<= None / Odd /Even

Step 1: The first three lines of this screen are scrolling prompt type and have to do with setting the actual data transfer communication parameters. How you set these values will be determined by the particular software that you will be using in your PC to communicate with your TDS-COGO48. If you are using the TFR software in your PC to communicate with your TDS-COGO48, these parameters should be set to wire, 9600 baud and no parity, as displayed in the screen above.

Step 2: Set you PC so that it is ready to receive data. Using TFR, you would choose, from its main menu, the receive file option and set what ever parameters are necessary. (For details pertaining to your particular version of TFR and the actual screens used, see your TFR User Manual.)

Step 3: Once your PC software is waiting for data from your TDS-COGO48, press **[SEND]** on your TDS-COGO48. This will bring up a list of your coordinate files. Highlight the file you wish to send and press **[SELCT]**. The transfer should begin. If it does not, check the trouble shooting appendix at the end of this manual.

As with all electronically stored data, your surveying jobs should be backed up frequently; at least once a day if possible. Tripod Data Systems has done all it can to improve the reliability of the TDS-COGO48. But with anything stored electronically in RAM, and especially where it is taken into the field, there is a risk of data loss. **Your best protection is to BACKUP often.**

The process of receiving data from your PC to the TDS-COGO48 is virtually the same as to send. In step 3 above, choose the TFR send file screen and select the file you want to send. Again see the TFR Manual for the specific screen and steps necessary to send a file from TFR. Then simply press **[RECV]** on your TDS-COGO48. When you are receiving, the File type is determined by the file that is sent from your PC and not by the selection displayed in the top line of your TDS-COGO48 screen.

If you want to send a part of a coordinate file, in step 4 above, enter the beginning and ending points of the block you want to send in the Start pt and End pt fields. Then press **[SBLK]** instead of **[SEND]**. All other steps are the same. The points between the Start pt and the End pt, including the start and end points, will be transferred. The numbers in the Start pt and the End pt fields are ignored except when the **[SBLK]** key is pressed.

File Transfer Between Two TDS-COGO48's

You may use the wireless communication capabilities of the HP-48 to copy a coordinate or point list file from one TDS-COGO48 to another or to a TDS-48 or a TDS system-95. The process is to select the I/R communication option in the File Transfer Screen in both units. Position the units so that the I/R data ports are facing each other and about 3-6 inches apart. The I/R port may be located by a small arrow molded on the top case of the HP-48 just above the Hewlett-Packard logo. Set all of the communication parameters the same on both units. When the units have been set up and configured properly, press **[RECV]** on the unit which is to receive the file and **[SEND]** on the unit that is to send the file.

ADVANCED TOPICS

The next few sections provide information for those users who wish to write their own programs for the HP-48 using coordinate data gathered by the TDS-COGO48 Surveying Card. Effective understanding of this material requires some understanding of the programming language of the HP-48.

QUICK RETURN TO THE TDS-COGO48 FROM THE HP-48 OPERATING SYSTEM

If you plan on writing your own programs to use in conjunction with the TDS-COGO48, you will want to set up the HP-48 to access the TDS-COGO48 software from a single softkey when you are in the operating system. This will facilitate a quick transfer back and forth from the Surveying Card software. The process for doing this is:

1) Type {TDSCOGO} in the command line. To do this you will actually have to press the following keys:  **[{}] [α] [α] [T] [D] [S] [C] [O] [G] [O] [α]**.

2) Press **[ENTER]**.

On an HP-48GX:

3) Press **[MODES]**. Even though the **[MODES]** function is printed on the keyboard in ***green***, you should use the ***purple*** shift key for this command.

4) Press the **[MENU]** softkey which brings up a second group of softkeys. Press the **[MENU]** softkey again (it will **not** be the same key).

On an HP-48SX:

3) Press **[MODES]**. Even though the **[MODES]** function is printed on the keyboard in ***orange***, you should use the ***blue*** shift key for this command.

4) Press the **[MENU]** softkey.

Now if you are in the operating system of the HP-48 and you want to return to the TDS-COGO48 Surveying Card, press **[CST]** and then the **[TDSCOGO]** softkey.

PRINTING & DATA COMM

USING TDS-COGO48 COORDINATE DATA IN YOUR OWN PROGRAMS

Many of the data collection and computational needs of the professional land surveyor are included within the Menus and Screens of the TDS-COGO48 Surveying Card. However, it is recognized that a user proficient in the programming and use of the HP-48 itself may choose to develop his or her own routines to solve additional problems. To this end, the TDS-COGO48 includes two functions which allow you direct access to the coordinate data files from the standard HP-48 operating system.

The full understanding of these functions requires some working knowledge of the system organization and programming language of the HP-48. It is well beyond the scope of this manual to provide this. The Owner's Manuals that come with your HP-48 should be your primary source for this information.

RETRIEVING DATA FROM A COORDINATE FILE - THE RCLPT FUNCTION.

The RCLPT function will use a point number within level 1 of the stack as a single argument and return the following to the stack:

The point descriptor is returned as an alpha string to level 6.
The point elevation is returned as a real number to level 5.
The point easting is returned as a real number to level 4.
The point northing is returned as a real number to level 3.
The point number is returned as an real number to level 2.
Either the number 1 or 0 is returned to level 1.

The number in level 1 serves as a flag to indicate that indeed the point data recall has taken place. If the value in level 1 is a 1, the point data as listed above is valid. If the value in level 1 is a 0, the point data has failed to be recalled for some reason (such as the specified point number is nonexistent in the active job). In this case levels 2 to 6 will *not* contain valid point data. The stack that existed prior to executing RCLPT will have been lifted one level.

As an example, to recall the coordinates of point 2 of the active job to the stack: key in **[2]** into the command line. Press **[ENTER]**. Press **[α] [α] RCLPT [ENTER]**.

STORING DATA TO A COORDINATE FILE -
`THE STOPG FUNCTION

In order to store data into a coordinate file you must do four things:

1) create a three dimensional vector variable called 'CURPT' that contains the point's northing, easting, and elevation in that order.

2) create a string variable called 'DESC' that contains the point descriptor.

3) place the point number in level 1 or the stack.

4) Execute STOPG.

As an example, to store the following coordinate values for point 7 in the active job -

Northing - 2500
Easting - 3000
Elevation - 100
Descriptor - "POINT"

execute the following keystrokes:

[=] [[]] 2500 **[SPC]** 3000 **[SPC]** 100 **[SPC] [ENTER]**
['] [α] [α] CURPT **[ENTER] [STO]**
[-] ["""] [α] [α] POINT **[ENTER]**
['] [α] [α] DESC **[ENTER] [STO]**
7 **[ENTER]**
[α] [α] STOPG [ENTER]

If the point is already in use in the current job, you will be prompted if you would like to overwrite it. In any event, if the point data has been stored, the stack will contain the point number in level 2 and the number 1 in level 1. If the data storage has not been accomplished, the number 0 will be returned to level 1 in the stack.

NOTE:

Both the RCLPT function and the STOPG function operate on the *active job's* coordinate file. You may establish the active job by using the Jobs Menu and the Open an Existing Job Screen in the TDS-COGO48.

REFERENCE

This section of the manual presents the reference material about the TDS-COGO48. Each screen is presented in a common and consistent format. You should read the tutorial sections (chapters 1 through 8) to learn the concepts behind the operation of the TDS-COGO48. The reference section should be used as a refresher to understand how specific screens are used and to fill in the detailed information that was omitted from the tutorial section in the interests of brevity.

ORGANIZATION OF THE REFERENCE MANUAL

The reference section of this manual is presented in a complete and consistent format. It is assumed that you have read and understood the tutorial section of this manual. The reference section is not written to be read to learn how to use the TDS-COGO48. It is assumed that you know how the basic user concepts of the machine are organized and, specifically, that you understand the difference between Menus and Screens. (If you do not, reread Chapter 2 - Getting Started.)

Thus, the Menus are not presented individually. They are discussed in general in the beginning of this section. Then each screen is presented. Screens are grouped by class of application from the Main Menu and by access letter within this grouping. Screens which may be accessed via multiple menu paths are cross referenced from the various starting menus.

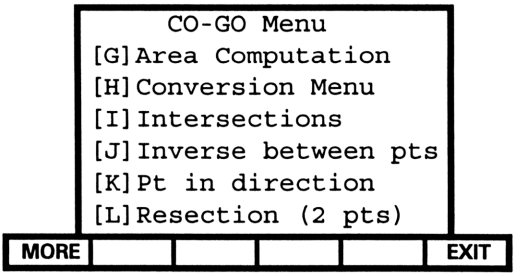
REFERENCE

INTRODUCTORY COMMENTS

All work in the TDS-COGO48 is accomplished within the machine's Screens. Access to the various screens is accomplished via the machine's Menus. It is important to understand the difference between Menus and Screens. That material is covered in Chapter 2 - Getting Started. This section of the Reference Manual will discuss Menus and Screen in a generic way. Following sections will cover each Screen in detail. Menus will not be covered beyond the present discussion.

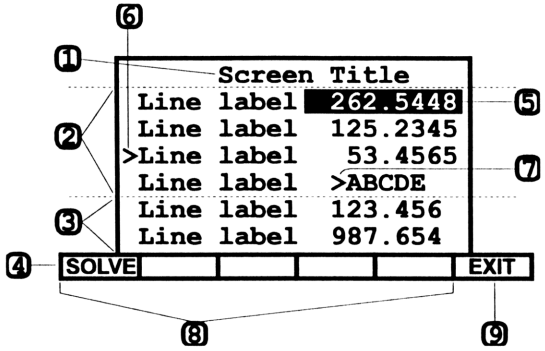
THE GENERIC MENU

The generic Menu is characterized by a sequence of choices in the display, each of which is preceded by a letter of the alphabet. A choice is made by pressing the appropriate letter-key on the keyboard. The generic menu is also characterized by the single "soft" key **[EXIT]** shown in the right hand key position in the display. Menus which have more than six or seven choices will also have a **[MORE]** softkey displayed at the left of the screen. Pressing this key will display more menu choices. A sample menu is shown below for reference:



THE GENERIC SCREEN

The figure below is of an imaginary generic screen labeled to show the various features of real screens.



None of the screens in the TDS-COGO48 has all of these features. However, by understanding the nature of the generic features as shown in this screen, you will have a firm understanding of the use of the real screens that you will encounter as you use the TDS-COGO48.

Each of the features is described by reference to the feature number as shown in the figure above:

1. Screen Title: The screen's title is shown in the top line of the display. Some screens which require more lines of information will not show the title at all. If the title is shown, it will be in the top row.

2. Input Region: Some of the lines in the display are reserved for data input. The left part of the line shows the label defining the data to be input. The right side is where the data goes. The input lines will allow the screen cursor to be placed in the data field of that line. (See 5., below) Some screens that only show the results of computations will not have any input region.

3. Output region: Some of the lines in the display are reserved for data output: the results of computations based on the contents of the input region. The left part of the line shows the label defining the nature of the output. The right side shows the output itself. The output lines will not allow the screen cursor to occupy the data field of the line. (See 5., below.) Some screens that require a significant amount of data input will not have

an output region. The solution will be shown on a separate output screen. Separate output screens normally follow immediately when data input is complete and the necessary function key is pressed.

4. "Soft" Key Region: Every screen will have the bottom row reserved for the definition of up to six "soft" keys which are activated by pressing the six keys in the top row of the TDS-COGO48. The first five keys can be any of a variety of functions dependent on the particular screen being used. (See 8., below.) The sixth key will contain the label **[EXIT].** (See 9., below)

5. Data Entry Cursor: In any screen which has an input region, there will be a data entry screen cursor that will be positioned on the line that is active and ready to receive data from the keyboard. The cursor is recognized by the fact that it shows the data in "inverse video". The cursor may be moved to the next legal input line by pressing either of the vertical cursor keys **[↑]** , **[↓]** , or by pressing **[ENTER]**. The **[↑]** key will move the cursor to the previous data input line; the **[↓]** key will move it to the next following data input line. When the cursor is in position at a data input field, the field will

only accept entries from the keyboard which are legal for the kind of data being entered. For example, it is not possible to key in alpha data into a field for which only numeric data makes sense (such as a distance). Entering *alpha data* into an input line *requires* pressing the **[α]** key *once* both before and after the entry.

NOTE:

Some screens will have more than one data input field contained within a single display line. For example, the Traverse / Sideshot Screen shows both the occupied point and the foresight point on the top line. It also shows the height of the instrument and the height of the rod on the same line, just above the command "soft" key line. To move the cursor from one data field to the other, you still use the vertical cursor keys, **[↑]** or **[↓]**, even though the cursor is moving "sideways". The horizontal cursor keys **[→]** and **[←]** are reserved for scrolling prompts and scrolling data.

6. Scrolling Prompt Symbol: Input lines which have a ">" character *before* the line label provide you with a choice of the kind of data which may be keyed in to solve the problem represented by the screen. For example, in many cases, angles may be keyed into the TDS-COGO48 as an azimuth or as a bearing. The scrolling prompt gives you an opportunity to change the prompt (line label) of the input line to match the kind of input data that you want to use. To *"scroll"* (change the prompt), move the data entry cursor to the line in question and press either of the horizontal cursor keys **[→]** or **[←]**. Pressing one of these keys successively will allow you to review all of the prompt options which are permissible for this particular input line.

7. Scrolling Data Symbol: When the ">" character appears in *front* of an *input data* field, you know that you have a very restricted choice of inputs that you may specify for this data line. All of the choices may be reviewed by moving the data entry cursor to the line in question and pressing either one of the horizontal cursor keys **[→]** or **[←]**. Pressing one of these keys successively will allow you to review all of the data input options which are permissible for this particular input field.

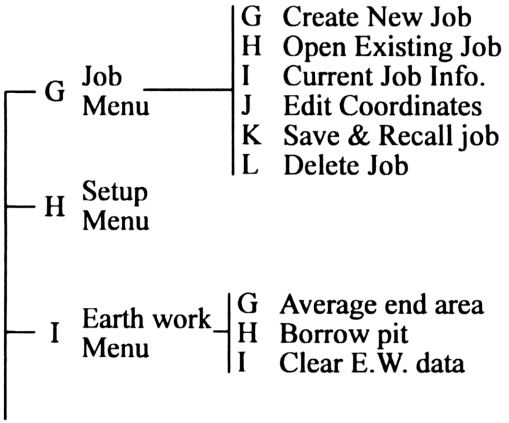
8. Command "Soft" Keys: The first five "soft" key positions are reserved for the screen commands. These are the keys that will cause the TDS-COGO48 to perform some action based on the data which has been entered into the input data lines prior to invoking the command. The action may be any number of things. Some commands transfer control to another screen. Others will perform some computation and return the results to the output lines of the current screen. Still others will compute some results and transfer control to another screen. Most often, given the problem being solved and the name of the command, the action taken will be obvious. In any event, all of the commands are described in detail in this reference manual. Consult the section that describes the screen in question.

9. The **[EXIT]** Key: The right hand "soft" key position is reserved for the label **[EXIT].** The **[EXIT]** key will always return you to an immediately previous screen or menu.

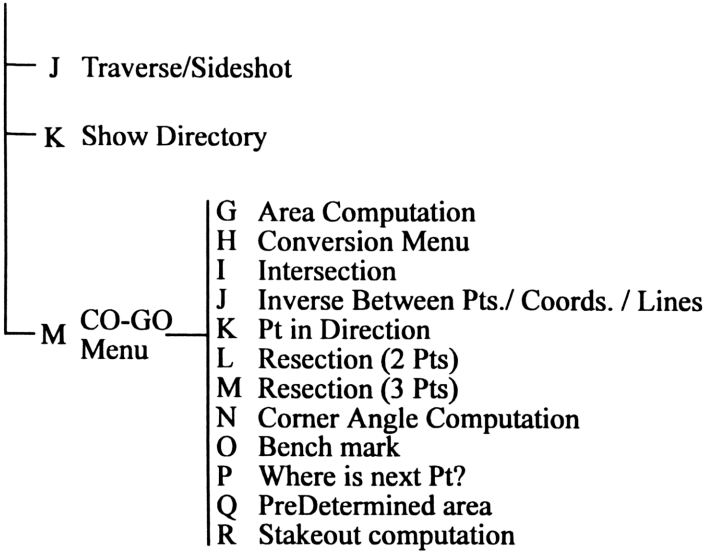
REFERENCE

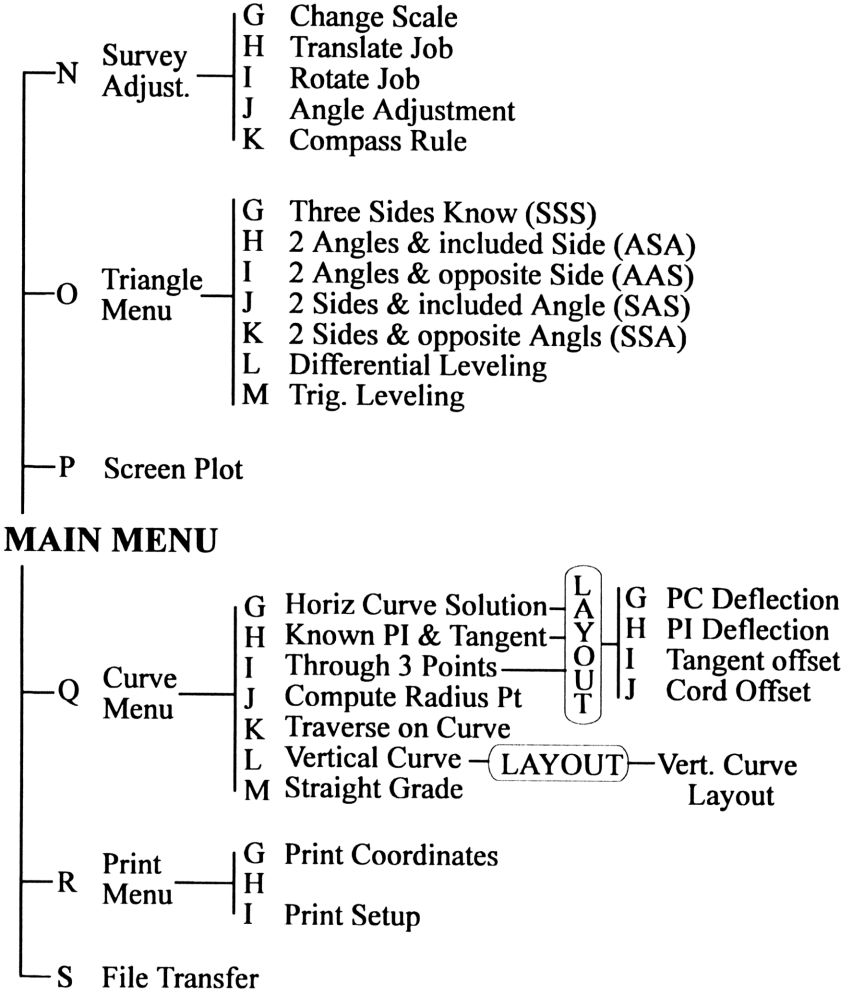
SCREEN TREE MAP

The next three figures provide a pictorial "map" of the TDS-COGO48 screen tree. Using this tree, you can determine the sequence of menus and alpha keys required to access any of the screens that you may need to use to solve surveying problems with your TDS-COGO48.



MAIN MENU



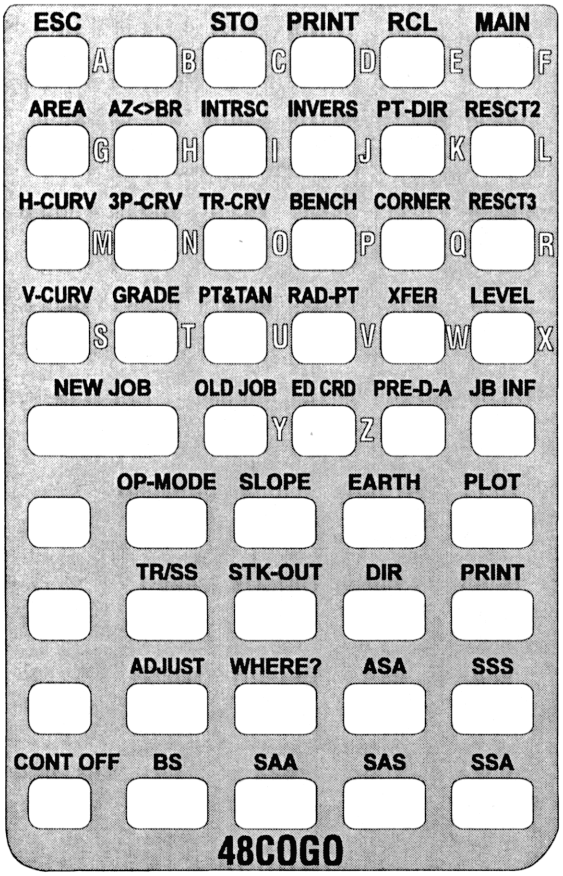

MAIN MENU
N Survey Adjust.
G Change Scale
H Translate Job
I Rotate Job
J Angle Adjustment
K Compass Rule
O Triangle Menu
G Three Sides Know (SSS)
H 2 Angles & included Side (ASA)
I 2 Angles & opposite Side (AAS)
J 2 Sides & included Angle (SAS)
K 2 Sides & opposite Angls (SSA)
L Differential Leveling
M Trig. Leveling
P Screen Plot
Q Curve Menu
G Horiz Curve Solution
H Known PI & Tangent
I Through 3 Points
J Compute Radius Pt
K Traverse on Curve
L Vertical Curve
M Straight Grade
LAYOUT
G PC Deflection
H PI Deflection
I Tangent offset
J Cord Offset
LAYOUT
Vert. Curve Layout
R Print Menu
G Print Coordinates
H
I Print Setup
S File Transfer

REFERENCE

THE KEYBOARD OVERLAY

Your TDS-COGO48 Surveying Card comes with an overlay which you may install on your HP-48GX's keyboard to help you locate the alpha keys more easily and to mask the shifted functions of the 48GX which are not used by the TDS-COGO48. The overlay also displays the shifted function of each key (in purple) for direct access to many of the TDS-COGO48's most-used routines. The overlay appears as shown:

Overlay for TDS-COGO48



Note that the alpha keys, printed in white, are positioned to the right of the associated key. The **[CONT]** and **[OFF]** functions, printed in purple and green respectively, are positioned above the **[ON]** key with which they are associated. The Global Top-Row Keyboard Functions (see above) are printed in purple. These keys perform a function and return to where you left off. The remainder of the shifted function keys send you to a screen or menu within the TDS-COGO48 program's tree structure. When you **[EXIT]** from that screen, you will return to the screen from which you pressed the direct access key. With the exception of the top row keys, all direct access functions can be accessed from the menu tree in the normal manner. Below is a table listing each Global and Direct Access key used by TDS-COGO48 and a simple description of what each does:

Key	Function	Description
A	ESC	Escape temporarily from the TDS-COGO48 program and return to the main operating system of the HP-48. See the **ON** or **CONT** key to return to the TDS-COGO48
B		
C	STO	Store a value to the Clipboard register.
D	PRINT	Print the current screen to an Infrared Printer.
E	RCL	Recall a value from the Clipboard.
F	MAIN	Return to the Main Menu from wherever you are in the TDS-COGO48.
G	AREA	Compute the area of a parcel of land.
H	AZ<>BR	Converts Azimuths to Bearings or visa-versa.
I	INTRSC	Find a point at the intersection of two lines.
J	INVERS	Compute the Inverse between two points or a point and a line.
K	PT-DIR	Compute the coordinates of a new point by specifying a known point, a direction and distance.
L	RESCT2	Determine the coordinates of an unknown occupied point by field measurements (angles and distances) to two known points.
M	H-CURV	Solve for the properties of a horizontal curve.

N	3P-CRV	Solve for a curve that will pass through three known points.
O	TR-CRV	Include a horizontal curve in a traverse.
P	BENCH	Compute the elevation of the occupied point given the known elevation of the foresight.
Q	CORNER	Compute the angle made by two lines that meet at a common (corner) point.
R	RESCT3	Determine the coordinates of an occupied point by field measurements (angles) to three known points.
S	V-CURV	Compute the elevations at various stations along a vertical curve.
T	GRADE	Solve for the elevation at various stations along a straight grade.
U	PI&TAN	Solve for the PC and PT with known PI, tangents and radius.
V	RAD-PT	Calculate the radius point of a curve with two points and one other parameter known.
W	XFER	Will transfer you to the Transfer Screen.
X	LEVEL	Provide access to the Trig-leveling and Differential leveling routines.
Y	OLDJOB	Allow you to select an existing job to be opened.
Z	ED CRD	Provide a way to review and edit coordinate data.
ENTER	NEW JOB	Allow for the creation of a new job file.
DEL	PRE-D-A	Lets you set a point to form a parcel of a specified size.
←	JB INF	Provide for a way of reviewing many of the important parameters of the currently active job.
9	EARTH	Will transfer you to the Earthwork Menu.
8	SLOPE	Converts Zenith and Slope distance to horizontal and vertical distances.
7	OP-MODE	Set the operating modes.
6	DIR	Displays the job files stored in the TDS-COGO48.
5	STK-OUT	Calculate the Direction and distance needed to performing a point stake.
4	TR/SS	Will transfer you to the Traverse/Sideshot Screen.
3	ASA	Bring up the Angle-Side-Angle Triangle routines.

2	WHERE?	Help the rod man to quickly find the next point, relative to his own point of view, during a point stake.
1	ADJUST	Will transfer you to the Adjustment Menu.
0	BS	Bring up the Backsight Screen.
÷	PLOT	View a plot of a block of points in the TDS-COGO48 screen display.
*	PRINT	Bring up the Print Menu.
-	SSS	Provide access to the Side-Side-Side Triangle routines.
+	SSA	Bring up the Side-Side-Angle Triangle routines.
ON	CONT	Return to the TDS-COGO48 program after ESC to the operating system of the HP-48.
•	SAA	Bring up the Side-Angle-Angle Triangle routines.
SPC	SAS	Provide access to the Side-Angle-Side Triangle routines.

GLOBAL TOP-ROW KEY COMMANDS

In addition to the six softkeys whose functions change depending on the screen that is active, there are six *Global Keys* that you access with the *purple* shift key and the keys in the top row. The functions they perform are **[ESC]**, **[NOTE]**, **[STORE]**, **[PRINT]**, **[RECALL]** and **[MAIN]** respectively. These functions are described in more detail below:

ESCAPE COMMAND

Purpose of command - to allow you to escape from the TDS-COGO48 program and return to the operating system of the HP-48GX in order to run some other software or to do manual calculations.

Path: From any screen, press ← **[A]**.

The **[ESC]** (Escape) function may only be executed from a SCREEN. When you are in a screen and you press **[ESC]** - (← **[A]**), control of the system is passed temporarily from the TDS-COGO48 to the operating system of the HP-48 GX/SX.

In addition, the numerical value in the screen at the current cursor location is loaded in the operational stack of the 48GX at level 1. The word "HALT" appears in the annunciator line at the top of the screen to indicate that a running program has been halted. Thus, it is now possible for you to perform any calculations that you want in the stack, including calculations on the value that has been returned. This can be done either manually from the keyboard or via other software routines which you may have written and loaded into the system memory. When you are finished and wish to return to the TDS-COGO48, press **[CONT]** or [ON] **[ON]**. **[CONT]** is the purple shifted function above the **[ON]** key. You will return to the screen you were in before executing **[ESC]**. When you return, the value at the cursor location is replaced by the value from level 1 of the 48GX's stack.

If you find yourself at the HP-48GX system stack and do not know why or how you got there, you may have inadvertently pressed the **[ESC]** key. Check and see if **HALT** is displayed on the top of the screen. If it is, then press the **[CONT]** or [ON] **[ON]** keys. If **HALT** is not displayed, you must have accidentally **[EXIT**ed**]** the program; Rerun the TDS-COGO48 program.

STORE COMMAND

Purpose of command - to allow you to take any numeric value from an input field and store it to a temporary clipboard register.

Path:	From any screen or menu, press [ON] **[C]**.

To save a numeric value, first highlight the field that you want stored and then press [ON] **[C]**. The value can be moved to another field using the **[RECALL]** key (see below).

PRINT COMMAND

Purpose of command - to allow you to print any screen or menu in the TDS-COGO48 with the HP-82240B Infrared Printer.

Path: From any screen or menu, press [↩] **[D]**.

This command will output whatever is in the display of the TDS-COGO48 to the HP-82240B Infrared Printer. Before issuing this command, you should be certain that the printer is properly positioned to receive the information; that the printer has an adequate supply of paper; and, that it has been turned ON. This function may be accessed from any screen or menu in the TDS-COGO48 at any time that you want a hard copy of your work.

RECALL COMMAND

Purpose of command - to allow you to copy a numeric value from the clipboard register to the currently highlighted input field.

Path: From any screen or menu, press [↩] **[E]**.

This command is used in conjunction with the **[STORE]** command. After you have stored a numeric value to the clipboard register, you can use **[RECALL]** to copy that value into a new field. To copy a numeric value, first, highlight the field that you want to move it to, then, press [↩] **[E]**.

MAIN COMMAND

Purpose of command - to allow you to return to the MAIN MENU from any other screen or menu in the TDS-COGO48.

Path: From any screen or menu, press [↩] **[F]**.

This command will immediately return to the MAIN MENU of the TDS-COGO48. It is a shortcut method of returning to the Main Menu "home base" without pressing **[EXIT]** repeatedly.

GENERALIZED OPERATION OF A SCREEN

The generalized operation of a TDS-COGO48 screen is to enter all of the required input data by moving the cursor key to the various data fields and keying in the required information. For those data fields that are preceded by a scrolling data symbol ">", you should use the horizontal cursor keys and scroll to the data input option that you want. Data may be entered in any order. During the data entry procedure, no "action" is being taken by the TDS-COGO48. TDS-COGO48 action is initiated by pressing one of the "soft" command keys at the bottom of the screen.

DESCRIPTION OF SCREENS

In the sections of the reference manual that follow, each screen will be described as follows:

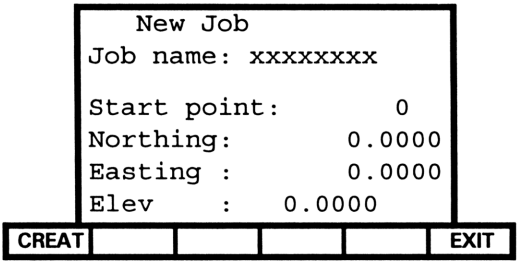
First, the title of the screen will be in a box at the top of the page. This will be followed by the primary menu path to arrive at the screen. If there are alternative paths to the screen, they will also be given. Next, the screen itself is presented. Alternative scrolling prompts are shown to the left of the screen picture. Alternative scrolling data fields are shown to the right of the screen picture. Below the screen picture are two framed groups of information. The first framed group is reserved for a detailed description of each input and output line of the display. The second framed group is reserved for a detailed description of the command "soft" keys.

The screens are organized within this reference section by class and order of screen. At the end of the screen descriptions, there is an alphabetical reference list of screens by title.

NEW JOB SCREEN

Purpose of screen - to allow for the creation of a new, named job file.

Path:	From the Main Menu, press **[G]** Jobs Menu - **[G]**



Job name: is the name of the new job file to be created
Start point: is the lowest numbered point for this job. Once this number has been selected you may *not* use a smaller point number in this job.
Northing: is the north coordinate for the start point.
Easting: is the east coordinate for the start point.
Elevation: is the elevation for the start point.

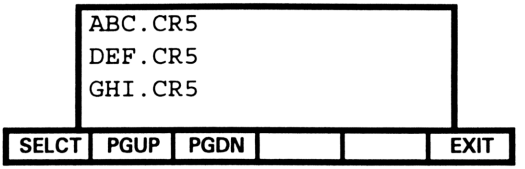
[CREAT] will establish the job file for this job with the parameters selected as shown in the screen.

NOTE: If your starting point for the survey is not the lowest numbered point, you should still specify the lowest numbered point as the Start point line. The starting point number is the lowest point number that you can usein this job.

OPEN EXISTING JOB SCREEN

Purpose of screen - to allow you to select an existing job to be opened.

Path:	From the Main Menu press **[G]**, Jobs Menu - **[H]**



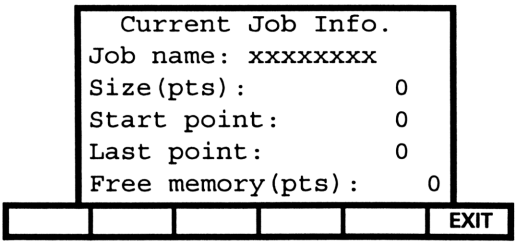
This screen shows the names of the jobs that have been created in the TDS-COGO48. Move the scroll bar to the job you want to open by using the vertical cursor keys **[↑]** and **[↓]**. Then press **[SELCT]**.

[SELCT] will chose the highlighted name as the job to open.
[PGUP] will move the display up a page.
[PGDN] will move the display down a page.

CURRENT JOB INFO SCREEN

Purpose of screen - to provide for a way of reviewing many of the important parameters of the currently active job.

Path: From the Main Menu press **[G]**, Jobs Menu - **[I]**

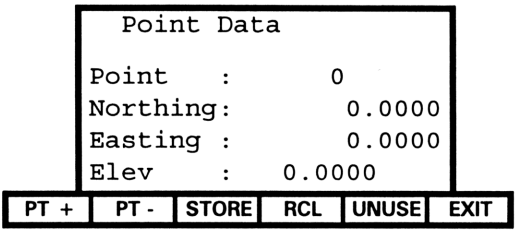


Job: is the name of the currently opened and active job.
Size (points): is the current size of the coordinate file in number of points.
Start point: is the lowest-numbered point in the job file.
Last point: is the current highest-numbered, used point in the job file.
Free mem (points): is the approximate amount of unused memory expressed in number of points.

POINT DATA SCREEN

Purpose of screen - to provide a way to review and edit the coordinate data for the currently active job file.

Path: From the Main Menu, press **[G]** Jobs Menu - **[J]**



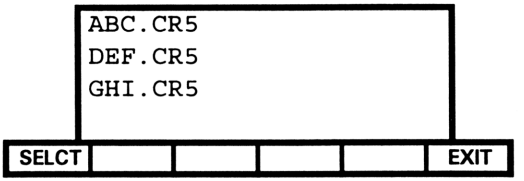
Point number: is the value of the point number for which the rest of the data in the screen applies.
Northing: is the north coordinate of the current point.
Easting: is the east coordinate of the current point.
Elevation: is the elevation of the current point.

[PT +] will increment the point number to the next largest used point and display its coordinate information.
[PT -] will decrement the point number to the next smallest used point and display its coordinate information.
[STORE] will store the coordinate information currently shown in the display as the information in the job file at the currently displayed point number. If the current number already exists in the file, a warning screen will be displayed to confirm that the point is to be overwritten.
[RCL] will temporarily shift to a recall point number screen. You may then specify the point number to be recalled and press **[ENTER]** to return to the Point Data Screen.
[UNUS] will display the next occurrence of an unused point with a point number greater than the current point number in the file.

SAVE JOB TO CARD SCREEN

Purpose of screen - to allow you to store a coordinate file to a RAM card in port 2 of an HP-48SX. This feature is not available on the HP-48GX.

Path:	From the Main Menu, press **[G]** Jobs Menu - **[K]** Save & recall job - **[G]**



This screen shows the names of the jobs that have been created in the TDS-COGO48. Move the scroll bar to the job you want to save by using the vertical cursor keys **[↑]** and **[↓]**. Then press **[SELECT]**.

[SELCT] will chose the highlighted name as the job to save.

RECALL JOB FROM CARD SCREEN

Purpose of screen - to allow you to recall a coordinate file from a RAM card in port 2 of an HP-48SX. This feature is not available on the HP-48GX.

Path:	From the Main Menu, press **[G]** Jobs Menu - **[K]** Save & recall job - **[H]**

This screen shows the names of the jobs that have been save on the RAM card in port 2. Move the scroll bar to the job you want to recall by using the vertical cursor keys **[↑]** and **[↓]**. Then press **[SELECT]**.

[SELCT] will chose the highlighted name as the job to recall.

DELETE JOB FROM CARD SCREEN

Purpose of screen - to allow you to remove a coordinate file from a RAM card in port 2 of an HP-48SX. This feature is not available on the HP-48GX.

Path:	From the Main Menu, press **[G]** Jobs Menu - **[K]** Save & recall job - **[I]**

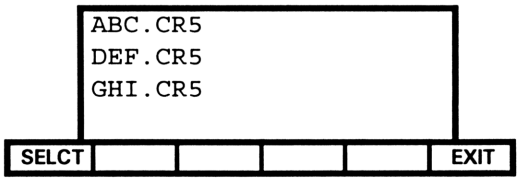
This screen shows the names of the jobs that have been save on the RAM card in port 2. Move the scroll bar to the job you want to delete by using the vertical cursor keys **[↑]** and **[↓]**. Then press **[SELECT]**.

[SELCT] will chose the highlighted name as the job to delete.

DELETE JOB SCREEN

Purpose of screen - to allow a job to be deleted from the TDS-COGO48.

Path:	From the Main Menu, press **[G]** Jobs Menu - **[L]**



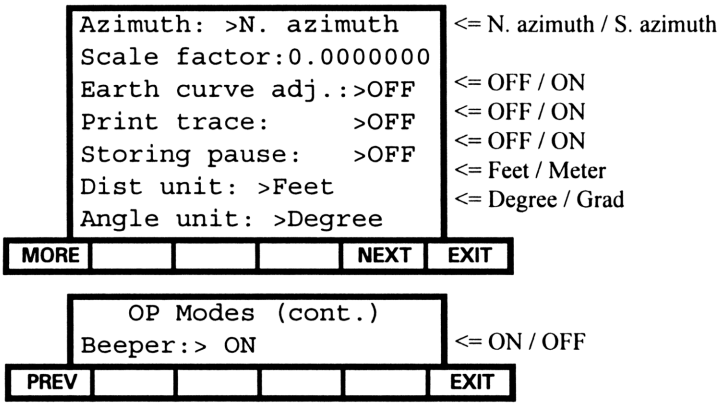
This screen shows the names of the jobs that have been created in the TDS-COGO48. Move the scroll bar to the job you want to delete by using the vertical cursor keys **[↑]** and **[↓]**. Then press **[SELECT]**.

[SELCT] will chose the highlighted name as the job to delete.

SETUP SCREEN

Purpose of screen - allow you to set the operating modes of the TDS-COGO48 .

Path: From the Main Menu, press **[H]** Setup Menu - **[I]**



Azimuth: indicates the assumed direction of a zero azimuth, either North or South.
Scale factor: is the factor by which all distances entered in the field will be multiplied before coordinate values are computed.
Earth curve adjust: when set ON, will include calculations to compensate for earth curvature and refraction in the computation of coordinates. Elevations will be adjusted according to the formula:

Vertical distance adjustment(ft) = 0.574 * horizontal distance(in miles)^2

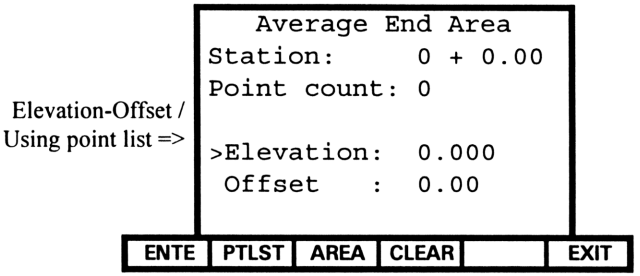
Print trace: when set ON, will print results to the infrared printer automatically when the [SOLVE] function is executed in every screens.
Storing pause: when set ON, will pause and display the computed coordinates as each point is shot.
Dist unit: specifies units to be used for all distance computations. (Feet or Meters)
Angle unit: specifies units to be used for all angle computations.(Degrees or Grads)
Beeper: Turns the HP-48's beeper ON or OFF. When set to OFF the TDS-COGO48 will not cause the HP-48 to beep.

EARTHWORK MENU SCREENS

AVERAGE END AREA SCREEN

Purpose of screen - to allow you to compute the area of a cross sectional profile at a given station.

Path: From the Main Menu, press **[I]** Earthwork Menu - **[G]**



Elevation-Offset / Using point list =>

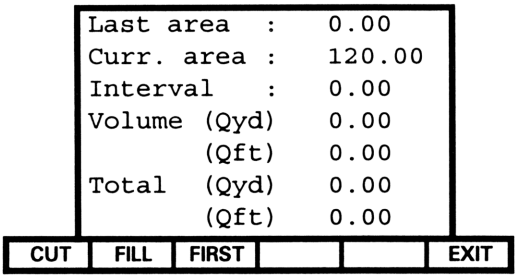
Station: is the station at which the end area is being measured.
Point count: {output only} will track the number of points that you have entered if you are keying in point offsets and elevations.
Elevation: - <Using point list>
Offset: are the alternative methods of entering the cross sectional profile data for the given station.

[ENTER] will enter points by elevation and offset one at a time into the TDS-COGO48.
[PTLST] will transfer to the Point List Screen.
[AREA] will compute the average end area and transfer to volume accumulation screen.
[CLEAR] will clear the points that have been previously entered for this station.

VOLUME ACCUMULATION SCREEN

Purpose of screen - to allow you to use the end area just computed to a volume and accumulate it to the total volume of the earthwork job.

Path:	From the Main Menu, press **[I]** Earthwork Menu - **[G]** Average End Area Screen - **[AREA]**



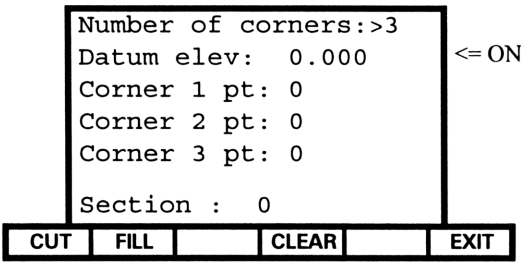
Last area: is the area computed at the previous station.
Curr. area: is the area computed at the current station.
Interval: is the distance between the previous station and the current station.
Volume (Qyd): {output only} is the current section volume in cubic yards.
Volume (Qft): {output only} is the current section volume in cubic feet.
Total V (Qyd): {output only} is the total volume of the in cubic yards (+ for a cut; - for a fill).
Total V (Qft): {output only} is the total volume of the job in cubic feet (+ for a cut; - for a fill).

[CUT] will compute the current section volume as a cut and add it to the total volume.
[FILL] will compute the current section volume as a fill and subtract it from the total volume.
[FIRST] will set up the area of the first section in preparation for computing the first section volume after the next station area has been computed.

BORROW PIT SCREEN

Purpose of screen - enter each section of a borrow pit for compute its volume. The Pit is divided into rectangular or triangular sections, then it calculates the volume of each section as well as the total accumulated volume.

Path:	From the Main Menu, press **[I]** Setup Menu - **[H]**



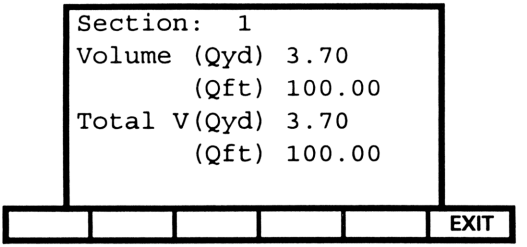
Number of corners: - is either 3 or 4 depending on the number of corners of the borrow pit section. When 4 is chosen, the screen include Corner 4.
Datum elevation: - is the elevation of the datum (top of the pit).
Corner 1: is the point number of the first corner.
Corner 2: is the point number of the second corner.
Corner 3: is the point number of the third corner.

[CUT] will compute the volume of the specified section of the pit, add it to the total volume; and, transfer to the Pit Volume Accumulation Screen.
[FILL] will compute the volume of the specified section of the pit, subtract it from the total volume; and, transfer to the Pit Volume Accumulation Screen.
[CLEAR] will clear all accumulated data from the Borrow Pit calculations

PIT VOLUME ACCUMULATION SCREEN

Purpose of screen - Calculates the volume of a borrow pit.

Path:	From the Main Menu, press **[I]** Earthwork Menu - **[H]** Borrow Pit Screen - **[CUT]** or **[FILL]**



Section: {output only} is the total number of borrow pit sections that have had their volumes accumulated.
Volume (Qyd): {output only} is the current section volume in cubic yards.
Volume (Qft): {output only} is the current section volume in cubic feet.
Total V(Qyd): {output only} is the total volume of the job in cubic yards (+ for a cut, - for a fill).
Total V(Qft): {output only} is the total volume of the job in cubic feet (+ for a cut, - for a fill).

CLEAR EARTHWORK DATA

Purpose of command - to clear the accumulated earthwork data from all earthwork screens.

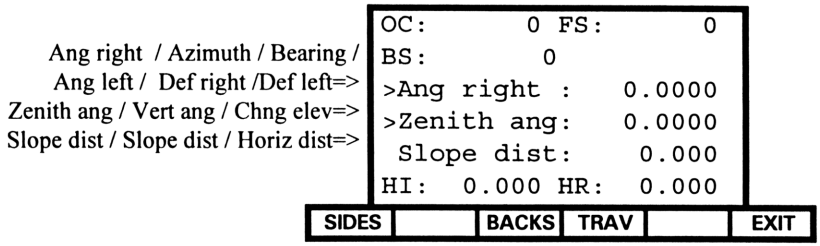
Path:	From the Main Menu, press **[I]** Earthwork Menu - **[I]**

This is actually a command issued from the Earthwork Menu rather than a Screen. It is particularly useful if you suspect that you have made a mistake during the earthwork procedure and you would like to start over.

TRAVERSE/SIDESHOT SCREEN

Purpose of screen - to organize the gathering of the data required to perform traverses and sideshots in the field.

Path: From the Main Menu, press **[J]**



OC: is the currently occupied gun position point number.
FS: is the point number of the foresight.
BS: is the point number of the backsight. If the backsight point is shown as 0, this indicates that the backsight has been specified as a known azimuth or bearing, but not by point number.
Ang. right - Azimuth - Bearing - Ang left - Def right - Def left: are the descriptions for the various ways that a horizontal angle may be entered.
Zenith ang - Vert ang - Ch elev:
Slope dist Slope dist Horiz dist: these two lines scroll together to specify the various combinations of angles and distances (or elevation changes and distances) that may be used to enter field data into the TDS-COGO48.
HI: is the height of the instrument above the point on the ground.
HR: is the height of the target on the rod above the ground.

[SIDES] will take the information which has been input into the screen and will compute the coordinates of the foresight point as a sideshot from the occupied point. These coordinates will be displayed depending upon whether or not the "Storing Pause" setting in the Operating Modes Screen. The coordinates will be stored in the job file at the foresight point number; and, the foresight point number will be incremented by one to prepare for the next shot. (See note below for more information.)
[BACK] will transfer to the Backsight Screen.

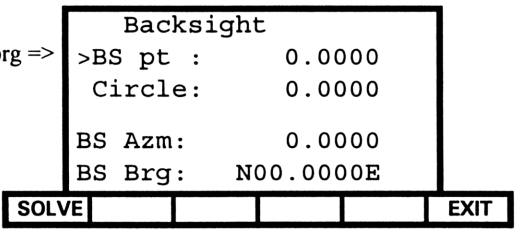
[TRAV] will take the information which has been input into the screen and will compute the coordinates of the foresight point as a traverse from the occupied point. These coordinates will be displayed depending upon whether or not the "Storing Pause" setting in the Operating Modes Screen. The coordinates will be stored in the job file at the foresight point number; and, the foresight point, occupied point, and backsight point number will be adjusted to prepare for the next shot.

BACKSIGHT SCREEN

Purpose of screen - to allow you to establish a backsight for your field work.

Path:
- → From the Main Menu, press **[J]** Traverse/Sideshot Menu - **[BACK]**
- → From the Main Menu, press **[Q]** Curve Menu - **[K]** Traverse on Curve Screen - **[BACK]**

BS point / BS azm / BS brg =>



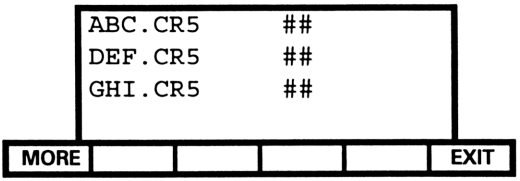
Circle: is the horizontal angle reading of the gun when you are sighting the back sight.
BS azm: {output only} the computed back azimuth from the data supplied in this screen.
BS brg: {output only} the computed back bearing from the data supplied in this screen.

[SOLVE] will take the information provided in the first two lines of this screen; compute the back azimuth; and display it in the output line. this key must be pressed prior to pressing **[EXIT]** or the backsight will not be set properly.

DIRECTORY SCREEN

Purpose of screen - to allow you to review the directory of files in the TDS-COGO48.

Path:	From the Main Menu, press **[K]**



This screen will prompt you to enter a file specification. The file extensions which is used to stored Coordinate files in the TDS-COGO48 is .CR5.

REFERENCE

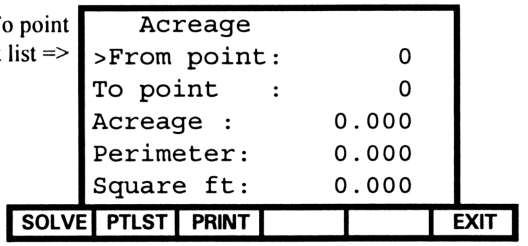
CO-GO MENU SCREENS

ACREAGE SCREEN

Purpose of screen - To allow the computation of the area of a parcel of land defined by a series of points stored in the TDS-COGO48.

Path: From the Main Menu, press **[M]** CO-GO Menu - **[G]**

From point - To point /Using point list =>



NOTE:

When the units are feet, the area is reported in both acres and square feet and the perimeter is in feet.
When the units are meters, the screen is called the Area Screen, the area is in square meters and the perimeter is in meters.

From point: - <Using point list>
To point: These are the alternative methods of specifying a sequence of points that are to make up the boundary of the parcel. From point To point specifies that the points are to be connected in numerical sequence. Also, the last point is connected to the first to complete the closed area. The point list is a technique that you may use to specify a boundary that is made up of points that are not in numerical sequence. (See the Section of this Reference Manual that covers the Point List Screen.)
Acreage: {output only} is the computed area in acres.
Perimeter: {output only} is the computed perimeter of the parcel in feet.
Sq feet: {output only} is the computed area in square feet.

[SOLVE] will compute the output lines based on the input points specified at the top of the display.
[PTLST] will transfer to the Point List Screen.
[PRINT] will compute the area and perimeter and print the distance and azimuth of each side of the polygon.

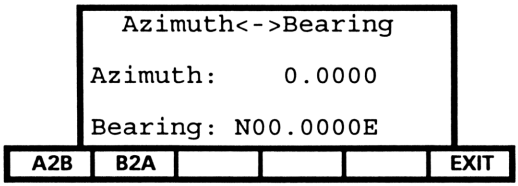
NOTE:

If the boundary of the area to be computed includes sections of horizontal curves, they may be included in the point list. Point lists that have curves included will compute the area **within** the curved boundaries.

AZIMUTH <---> BEARING SCREEN

Purpose of screen - to allow you to convert azimuths to bearings or bearings to azimuths.

Path: From the Main Menu, press **[M]** CO-GO Menu - **[H]** Conversion Menu - **[G]**



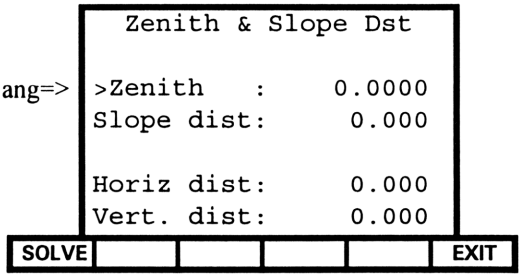
Azimuth: is the angle of a line expressed as an azimuth.
Bearing: is the angle of the same line expressed as a bearing.

[A 2 B] (read azimuth to bearing) will compute the bearing based on the value of the azimuth line in the screen.
[B 2 A] (read bearing to azimuth) will compute the azimuth based on the value of the bearing line in the screen.

VERT/ZENITH & SLOPE SCREEN

Purpose of screen - to allow you to convert a vertical angle, or a zenith angle and slope distance to a horizontal distance and a change in elevation.

Path:	From the Main Menu, press **[M]** CO-GO Menu - **[H]** Conversion Menu - **[H]**



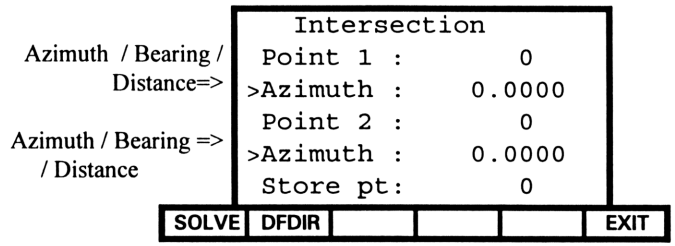
Zenith - Vert ang: is the specification of a vertical angle that is to be used in the conversion.
Slope dist: is the specification of the slope distance to be used in the conversion.
Horiz dist: {output only} is the computation of the horizontal distance from the data which has been entered into the screen.
Vert dist: {output only} is the vertical distance (change in elevation) which has been computed from the data which has been entered into the screen.

[SOLVE] will compute the output values of horizontal and vertical distance from the data which has been entered into the input lines of the screen.

INTERSECTION SCREEN

Purpose of screen - to find a point at the intersection of two lines emanating from two known points. The intersection may be specified as two directions, a direction and a distance, or two distances.

Path: From the Main Menu, press **[M]** CO-GO Menu - **[I]**



Point 1: is the point number of the first point from which the intersection line is to be defined.
Azimuth - Bearing - Distance: is the known parameter from point 1, either an azimuth, bearing, or distance.
Point 2: is the point number of the second point from which the intersection line is to be defined.
Azimuth - Bearing - Distance: is the known parameter from point 2, either an azimuth, bearing, or distance.
Store pt: is the point number of the intersection point at which the coordinates should be stored.

[SOLVE] will compute the coordinates of the intersection point from the data provided in the screen and store these coordinates at the specified point number in the job coordinate file. After **[SOLVE]** has been pressed, the **[←]** and **[→]** may be used on the appropriate lines of this screen to see the other quantities to the intersection point. For example if you have solved for a bearing-bearing intersection, you may display the distances from the two points to the intersection point.
[DFDIR] will transfer to the Define A Direction Screen, where the azimuth required for a direction specification for this screen may be computed from other point information (see below).

DEFINE A DIRECTION SCREEN

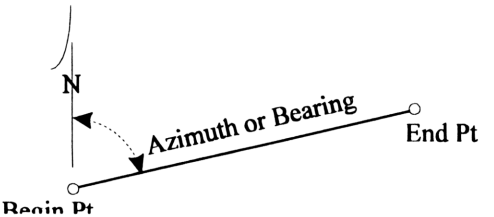
Path:	From the Main Menu, press **[M]** CO-GO Menu: • **[I]** Intersection Screen - **[DFDIR]** • **[Q]** Pre-Determined Area Screen - **[DFDIR]**

```
  Define a Direction
Begin pt:        0
End pt  :        0
+/- ang :     0.0000
Bearing : N00.0000E
Azimuth :     0.0000
Distance:      0.000
```

SOLVE | | | | | EXIT

Begin point: is the first point on the line to define a direction.
End point: is the second point on a line to define a direction.
+/- ang: is the deviation from the computed azimuth or bearing from the first point to the second point on the line that is to be returned as the azimuth or bearing to be used in subsequent calculations. A + angle is in the clockwise direction from the first point to the second point; a - angle is in the counter-clockwise direction.
Bearing: {output only} the bearing from the beginning point to the end point.
Azimuth: {output only} the azimuth of the line from the beginning point to the end point.
Horiz dist: {output only} the horizontal distance between the two lines.

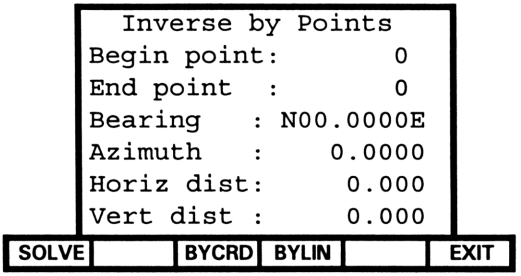
[SOLVE] will compute the output bearing and azimuth from the point numbers of the two points on the line as specified in the screen.
[EXIT] will first prompt for the azimuth or bearing that is required in the intersection being solved and then return to the Intersection Screen.



INVERSE BY POINT SCREEN

Purpose of screen - to compute the inverse (bearing and distance) between two points expressed as point numbers.

Path: From the Main Menu, press **[M]** CO-GO Menu - **[J]**



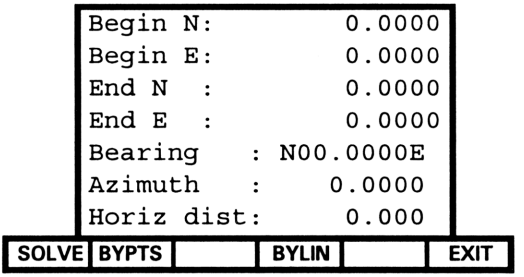
Begin point: is the first point on the line for which the inverse is to be computed.
End point: is the second point on the line for which the inverse is to be computed.
Bearing: {output only} is the bearing of the line from the first point to the second point.
Azimuth: {output only} is the azimuth of the line from the first point to the second point.
Horiz dist: {output only} is the horizontal distance between the two inputs in this screen.
Vert dist: {output only} is the vertical distance between the two points in this screen.

[SOLVE] will compute the azimuth, bearing and distance between the points specified in the screen.
[BYCRD] will transfer to an alternate Inverse Screen that will compute the inverse between points specified by coordinates (see below).
[BYLIN] will transfer to an alternate Inverse Screen that will compute the perpendicular bearing and distance from a point to a line (see below).

INVERSE BY COORDINATES SCREEN

Purpose of screen - to compute the inverse (bearing and distance) between two points expressed as coordinates.

Path: From the Main Menu, press **[M]** CO-GO Menu - **[J]** Inverse By Points Screen - **[BYCRD]**



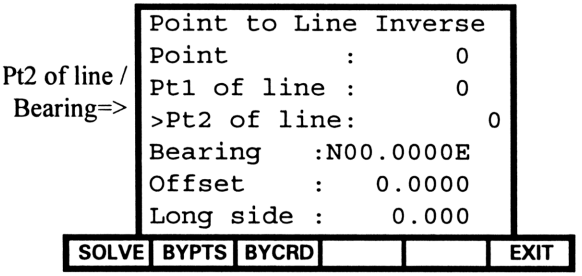
Begin N: is the north coordinate of the first point on the line for which the inverse is to be computed.
Begin E: is the east coordinate of the first point on the line for which the inverse is to be computed.
End N: is the north coordinate of the second point on the line for which the inverse is to be computed.
End E: is the east coordinate of the second point on the line for which the inverse is to be computed.
Azimuth: {output only} is the azimuth of the line from the first point to the second point.
Bearing: {output only} is the bearing of the line from the first point to the second point.
Horiz dist: {output only} is the horizontal distance between the two points in this screen.

[SOLVE] will compute the azimuth, bearing and distance between the points specified in the screen.
[BYPTS] will transfer to an alternate Inverse Screen that will compute the inverse between points specified by point numbers (see above).
[BYLIN] will transfer to an alternate Inverse Screen that will compute the perpendicular bearing and distance from a point to a line (see below).

POINT TO LINE INVERSE SCREEN

Purpose of screen - to compute the inverse (bearing and distance) between a point and a line defined by two other points.

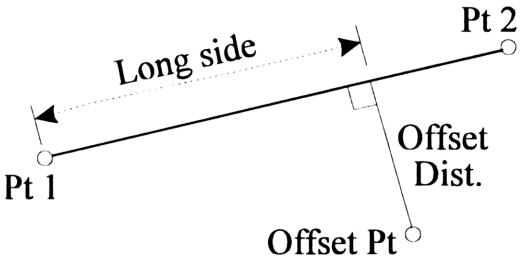
Path:	From the Main Menu, press **[M]** CO-GO Menu - **[J]** Inverse By Points Screen - **[BYLIN]**



Point: is the point from which the inverse is to be computed.
Pt 1 of line: is the first point that defines the line to which the inverse is to be computed.
Pt 2 of line - Bearing: is the method that you use to define the line to which the inverse is to be computed.
Bearing: {output only} is the bearing of the line from the first point to the second point.
Offset: {output only} is the perpendicular distance from the offset point to the line from Point 1 to Point 2. If this distance is positive, the offset is to the right of the line from Point 1 to Point 2. If this distance is negative, the offset is to the left of the line from Point 1 to Point 2.
Long side: {output only} is the distance from Point 1 to the projection of the offset point to the line from Point 1 to Point 2. If this distance is positive, the distance is from Point 1 in the direction of Point 2. If this distance is negative, the distance is from Point 1 away from Point 2.

REFERENCE

[SOLVE] will compute the bearing and distances and display the results in the Results Screen as shown above.
[BYPTS] will transfer to an alternate Inverse Screen that will compute the inverse between points specified by point numbers (see above).
[BYCRD] will transfer to an alternate Inverse Screen that will compute the inverse between points specified by coordinates (see above).



POINT IN DIRECTION SCREEN

Purpose of screen - to allow you to compute the coordinates of a new point by specifying a known point and a direction and distance from the known point.

Path: From the Main Menu, press **[M]** CO-GO Menu - **[K]**

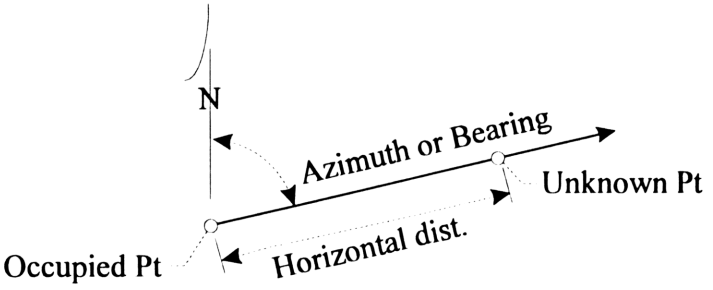
Azimuth / Bearing=>

```
  Point in Direction
Occupy pt:        0
>Azimuth  :           0
Horiz dist:      0.000
+/- ang :     0.0000
Store pt:         0
```

SOLVE	DFDIR				EXIT

Occupy point: is the point number of the known point.
Azimuth: - Bearing: is the direction from the known point to the unknown point.
Horizontal dist: is the distance from the known point to the unknown point.
+ / - ang: is the angle that will be added to or subtracted from the azimuth.
Store pt: is the point number of the unknown point whose coordinates are to be computed.

[SOLVE] will solve for the unknown point coordinates based on the input information in the screen and will store these coordinates into the current job file at the specified point number.
[DFDIR] will transfer to the Define A Direction Screen.



RESECTION FROM TWO POINTS SCREEN

Purpose of screen - to allow you to determine the coordinates of an occupied point by field measurements (angles and distances) to two known points.

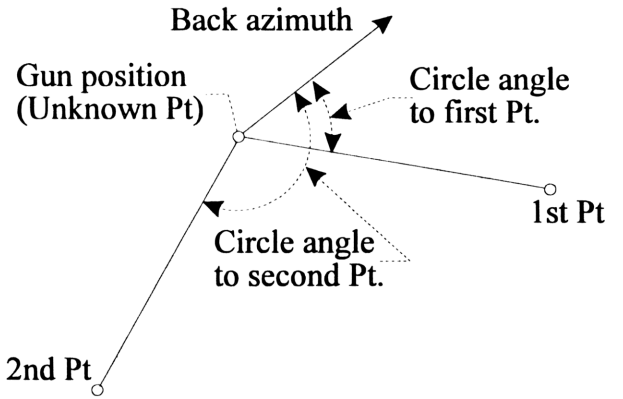
Path: From the Main Menu, press **[M]** CO-GO Menu - **[L]**

```
  Resection from 2 Pts
First pt:          0
Circular:       0.0000
Zenith ang:     0.0000
Slope dist:      0.000
HI:  0.000 HR:   0.000
```

SOLVE | | | | | EXIT

First point: is the number of the first known point.
Circular: is the horizontal angle reading when sighting the first point.
Zenith ang: is the zenith angle to the first point.
Slope dist: is the slope distance to the first point.
HI: is the height of the instrument above the unknown point on the ground
HR: is the height of the target on the rod above the ground.

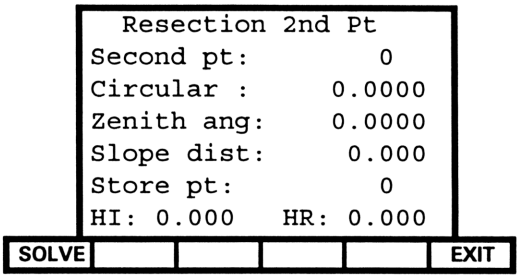
[SOLVE] will transfer to the Second Point Screen for this two point resection.



SECOND POINT SCREEN

Purpose of screen - to complete the two point resection begun in the previous screen.

Path: From the Main Menu, press **[M]** CO-GO Menu - **[L]** Resection From Two Points Screen - **[SOLVE]**



Second point: is the number of the second known point.
Circular: is the horizontal angle reading when sighting the second point.
Zenith ang: is the zenith angle to the 2nd point.
Slope dist: is the slope distance to the 2nd point.
Store pt: is the number of the occupied point whose coordinates are to be determined.
HI: is the height of the instrument above the unknown point on the ground
HR: is the height of the target on the rod above the ground.

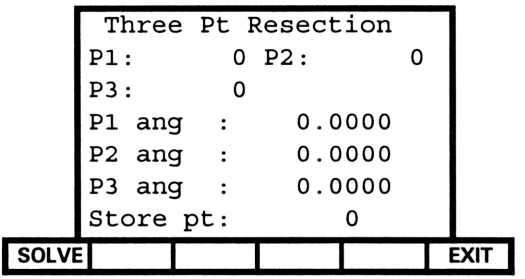
[SOLVE] will solve for the coordinates of the unknown occupied point based on the contents of this and the previous screen. It will also store these coordinates in the job file at the specified point number.

NOTE: In both this and the previous screen, if you are in the field and connected to an *electronic total station*, pressing **[SOLVE]** will trigger the gun to collect the data for each point of the resection.

RESECTION FROM THREE POINTS SCREEN

Purpose of screen - to allow you to determine the coordinates of an occupied point by field measurements (angles) to three known points.

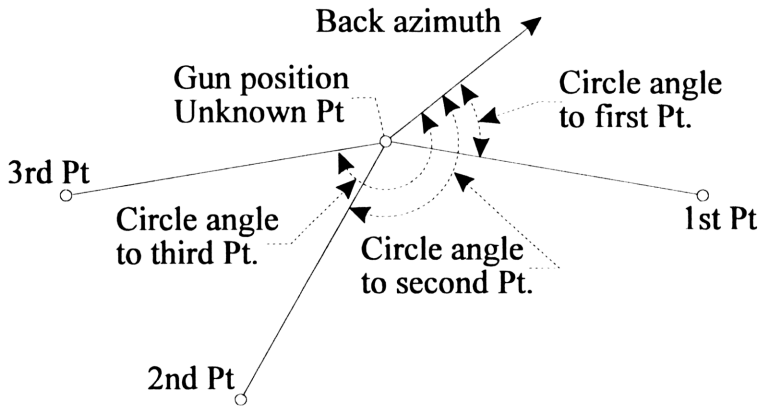
Path:	From the Main Menu, press **[M]** CO-GO Menu - **[M]**



P1: is the point number of the first known point.
P2: is the point number of the second known point.
P3: is the point number of the third known point.
P1 ang: is the circular (horizontal) angle reading when sighting the first known point.
P2 ang: is the circular (horizontal) angle reading when sighting the second known point.
P3 ang: is the circular (horizontal) angle reading when sighting the third known point.
Store pt: is the point number of the unknown occupied point.

[SOLVE] will compute the coordinates (northing and easting) of the unknown occupied point and store them in the job file at the specified point number.

NOTE: P1, P2, and P3 are required to be in *clockwise* order as viewed from above the gun position.



NOTE: Since a three point resection only requires horizontal angles to be measured, it is *not* possible to use this method to determine the elevation of the unknown point. Only the north and east coordinates are solved.

COMPUTE CORNER ANGLE SCREEN

Purpose of screen - to allow you to compute the angle made by two lines that meet at a common (corner) point.

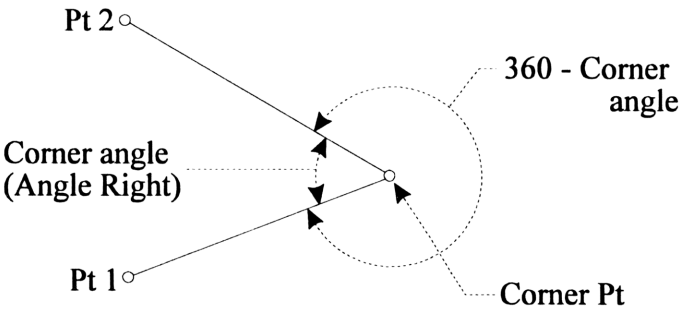
Path: From the Main Menu, press **[M]** CO-GO Menu - **[N]**

```
  Compute Corner Angle
Point 1:          0
Corner pt:        0
Point 3:          0
HD to Pt 3:    0.000
Corner ang:    0.0000
360 -:     0.0000
```

SOLVE | | | | | EXIT

Pt 1: is a point on the first line.
Corner pt: is the common point (corner) of the two lines.
Pt 3: is a point on the second line.
HD to Pt 3: is the horizontal distance from pt 1 to pt 3.
Corner angle: {output only} is the *internal* corner angle determined at the intersection of the two lines.
360 - : {output only} is 360_ minus the corner angle computed above.

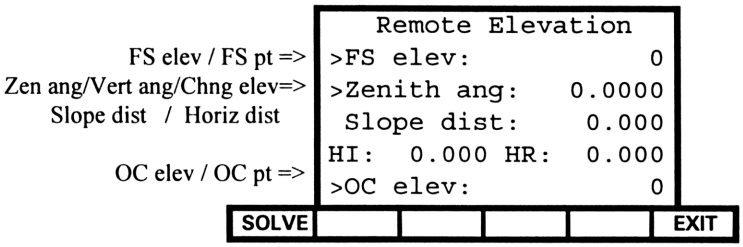
[SOLVE] will compute the *internal* corner angle determined by the two lines defined by points 1 and 3 and the corner point.



SHOOT BENCHMARK SCREEN

Purpose of screen - to allow you to compute the elevation of the occupied point given the known elevation of the foresight.

Path: From the Main Menu, press **[M]** CO-GO Menu - **[O]**



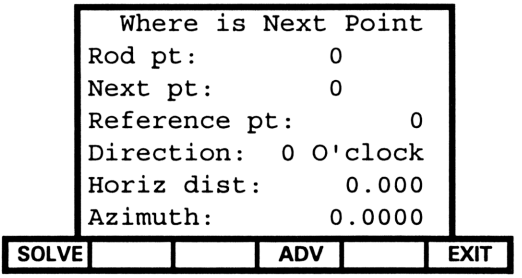
FS elev: - FS point: is the specification of the remote foresight elevation either by elevation or by the point number of the foresight.
Zenith ang: is the zenith angle from the occupied point to the foresight.
Slope Dst: is the slope distance from the occupied point to the foresight.
HI: is the height of the instrument.
HR: is the height of the rod.
OC elev: is the computed elevation of the occupied point. If this prompt is set at OC point, the computed elevation will be stored in the coordinate file of the designated point. The northing and easting values will not be changed.

[SOLVE] if the TDS-COGO48 is connected to an electronic station, this key will trigger the gun to take a shot. If the TDS-COGO48 is in manual mode, the elevation of the occupied point will be computed from the values of zenith angle and slope distance that have been keyed in the screen.

WHERE IS NEXT POINT SCREEN

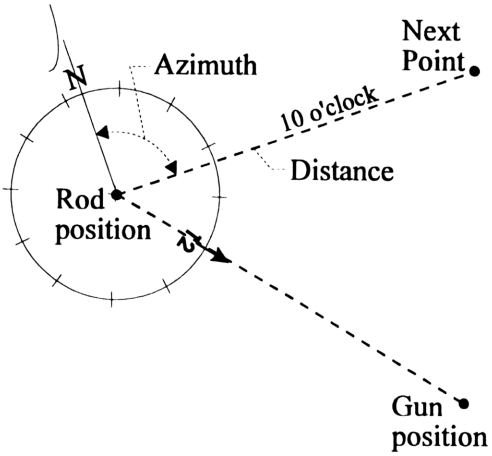
Purpose of screen - to allow the rod man to find quickly the next point relative to his own point of view during a stakeout by point number.

Path: From the Main Menu, press **[M]** CO-GO Menu - **[P]**



Rod pt: is the point number of the current location of the rod.
Next pt: is the point number of the next point to be staked.
Reference pt: is any other point number in the job that is clearly visible by the rod man. For example, this point can be the point number location of the gun.
Direction: {output only} is the direction expressed as a "clock-face" direction from the rod point to the next point. If the rod man is standing at the rod point and facing the reference point and the direction, is computed as 2 o'clock, the next point is in the two o'clock direction assuming that 12 o'clock on the clock face is pointing toward the reference point.
Horiz. dist: {output only} is the computed horizontal distance from the rod point to the next point.
Azimuth: {output only} is the actual azimuth angle (based on north or south being zero azimuth) of the direction from the rod point to the next point. This value may be used in conjunction with a field compass to located the direction of the next point. This value is independent of the reference point.

[SOLVE] will compute the direction, horizontal distance, and azimuth based on the values of the input data for this screen.
[ADV] will put the next point as the rod point and increment the next point.


N
Azimuth
Next
Point
10 o'clock
Distance
Rod
position
Gun
position

PRE-DETERMINED AREA SCREEN

Purpose of screen - To enable you to find the coordinates of the missing boundary line of a parcel that will result in a pre-determined area for that parcel. The primary screen will assume that the unknown boundary is hinged at the last point in the point list and intersects the first line at an unknown point whose coordinates are to be determined.

Path:	From the Main Menu, press **[M]** CO-GO Menu - **[Q]**

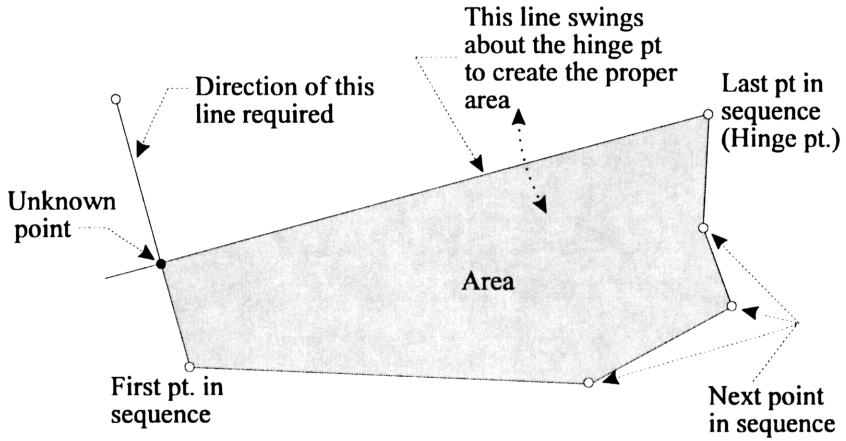
Acre / Square ft=>
From point-To point =>
/ Using point list
Pt on line / Bearing=>

```
>Acre      :       0.00
>From point:         0
To point    :         0
>Pt on line:     0.0000
 Store pt   :         0
 Line brg   : N00.0000E
 Line dist  :      0.000
```

SOLVE | PTLST | DFDIR | PARAL | | EXIT

Acre: - Square ft: is the predetermined area expressed as acres or square feet.
From point: - <Using point list>
To point: These are the alternative methods of specifying a sequence of points that are to make up the boundary of the parcel.
Pt on line: - Bearing: is the technique for describing the direction of the first side of the parcel.
Store pt: - is the point number of the unknown boundary point whose coordinates are to be determined.
Line brg: {output only} is the bearing of the missing last boundary line of the parcel.
Line dist: {output only} is the length of the first line segment of the parcel.

[SOLVE] will solve for the unknown point coordinates based on the input information in the screen and will store these coordinates into the current job file at the specified point number.
[PTLST] will transfer to the Point List Screen.
[DFDIR] will transfer to the Define a Direction Screen. In this way, the bearing of the first line may be computed from two points on the line.
[PARAL] will transfer to the Parallel Pre-determined Area Screen, an alternative technique for bounding a pre-determined area. (see below).



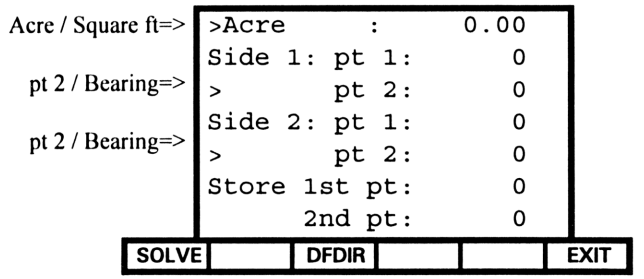
NOTE:

If the distance units setting has been specified as meters in the Operating Modes Screen, the area specification in this screen must be input as square meters. All output distances will be in meters.

PARALLEL PRE-DETERMINED AREA SCREEN

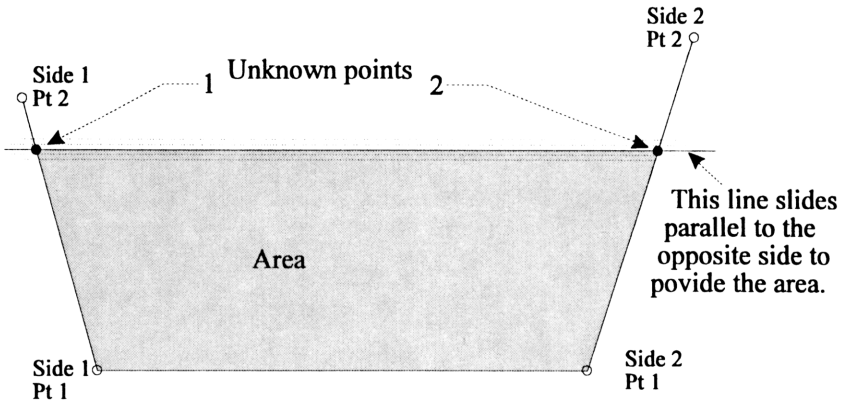
Purpose of screen - To allow a pre-determined area to be bounded by a sequence of boundary points and an unknown line that is parallel to a known line.

Path:	From the Main Menu, press **[M]** CO-GO Menu - **[P]** Pre-determined Area Screen - **[PARAL]**



Acre: - Square ft: is the predetermined area expressed as acres or square feet.
Side 1: Pt 1: is the first point that defines the first side of the parcel.
Pt 2: - Bearing: is the second point (or bearing) that defines the first side of the parcel.
Side 2: Pt 1: is the first point that defines the second side of the parcel.
Pt 2: - Bearing: is the second point (or bearing) that defines the second side of the parcel.
[Note: The line that defines the bearing of the unknown line is the line that connects the two Pt 1's above.]
Store 1st pt: is the point number of the intersection of the unknown boundary line with line 1.
Store 2nd pt: is the point number of the intersection of the unknown boundary line with line 2.

[SOLVE] will solve for the unknown point coordinates based on the input information in the screen and will store these coordinates into the current job file at the specified point numbers.
[DFDIR] will transfer to the Define a Direction Screen. In this way, the bearing of the first line may be computed from two points on the line.



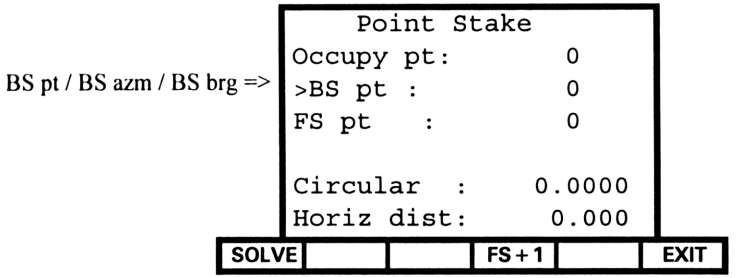
NOTE:

If the distance units setting has been specified as meters in the Operating Modes Screen, the area specification in this screen must be input as square meters. All output distances will be in meters.

STAKEOUT COMPUTATION SCREEN

Purpose of screen - allow you to stakeout coordinates stored in the current job.

Path: From the Main Menu, press **[M]** Stakeout Menu - **[R]**



Occupy pt: is the point number of the currently occupied gun position from which the stakeout will be done.
BS pt - BS azimuth - BS bearing: specifies the backsight either by point number, azimuth, or bearing.
FS point: is the number of the foresight point (the point to be staked).
Circular: {output only} is the horizontal angle reading of the foresight.
Horiz. dist: {output only} is the horizontal distance from the occupied point to the foresight point to be staked.

[SOLVE] will compute the circular angle and the horizontal distance from the rest of the information in the screen.
[FS+1] will increment the foresight number in the screen by one. This is useful when you have completed staking a point and you want to move on to the next one. **[FS +1]** will also perform the **[SOLVE]** command on the point after incrementing the point number.

SURVEY ADJUSTMENT MENU SCREENS

CHANGE SCALE SCREEN

Purpose of screen - to allow you to change the coordinates of a block of points to reflect a change in the relative distances between them.

Path:	From the Main Menu, press **[N]** Survey Adjustment Menu - **[G]**

From point - To point / Using point list =>

```
   Change Scale
>From point:        0
To point   :        0

Base point:         0
Scale factor:0.0000000
Scale elevation:> Yes
```

<= Yes / No

SOLVE	PTLST				EXIT

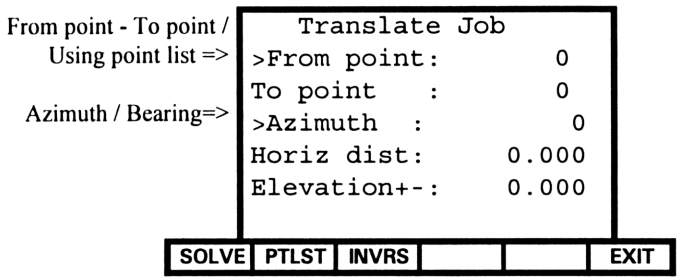
From point / To point - Using point list : allows you to specify all points which are to be included in the scale factor adjustment.
Base point : the "Origin" point for the scale factor adjustment. The coordinates of the base-point will not change.
Scale factor : the amount of change of the relative linear distance between the points as defined in the screen.
Scale elevation : specifies whether or not vertical distances should be scaled.

[SOLVE] will compute the new coordinates for all of the points selected, except the base-point, so that the relative distance between them will be changed by multiplying the existing distances by the .
[PTLST] will transfer to the Point List Screen.

TRANSLATE JOB SCREEN

Purpose of screen - to move all of the coordinates in a block of points to the north and/or east and/or change in elevation by a constant distance.

Path:	From the Main Menu, press **[N]** Survey Adjustment Menu - **[H]**



From pt: - <Using point list>
To point: are the alternative methods of specifying the points that are to be included in the translation.
Azimuth: - Bearing: is the *direction* in which the specified points in this job are to be translated. This screen *does not rotate* the job.
Horiz dist: is the horizontal distance through which the specified points in this job are to be translated in the direction noted by the azimuth or bearing in this screen.
Elevation +-: is the amount of change in the elevation of the specified points in this job.

[SOLVE] will compute new coordinates for all of the points identified in the top of the screen by the amounts specified in the +/- lines of the screen.
[PTLST] will transfer to the Point List Screen.
[INVRS] will transfer to the Inverse between Points Screen and then return the results to this screen.

ROTATE JOB SCREEN

Purpose of screen - to allow you to rotate a block of points about a central point and change the northings and eastings accordingly.

Path:	From the Main Menu, press **[N]** Survey Adjustment Menu - **[I]**

From point - To point / Using point list =>

```
   Rotate Job
>From point:        0
To point   :        0

Rotation pt:        0
Old bearing: N00.0000E
New bearing: N00.0000E
```

SOLVE	PTLST	DFDIR			EXIT

From point: - <Using point list>
To point: are the alternative methods of specifying the points that are to be included in the rotation.
Rotation pt: is the point about which the rotation is to be taken.
Old bearing: is the bearing of a line on the survey *before* the rotation.
New bearing: is the bearing of the same line on the survey *after* the rotation.

[SOLVE] will rotate all of the points specified in the top of the screen about the rotation point and at the rotation angle specified in the screen. New northings and eastings for these points will be computed.
[PTLST] will transfer to the Point List Screen.
[DFDIR] will transfer to the Define A Direction Screen, where the azimuth required for a direction specification for this screen may be computed from other point information

ANGLE ADJUSTMENT SCREEN

Purpose of screen - to allow you to adjust a traverse for angular error.

Path:	From the Main Menu, press **[N]** Survey Adjustments Menu - **[J]**

From pt: - To pt: or
Using point list =>

```
   Angle Adjustment
>From point:        0
To point   :        0

Traverse: >Close

Angle error:  -0.0026
```

<= Close / Open

SOLVE	PTLST		ERROR		EXIT

From point / To point - Using point list : allow you to specify all points which are to be included in the angle adjustment.
Traverse : defines the traverse as close or open traverse
Angle error: is the angular error that is to be "adjusted out" of the survey.

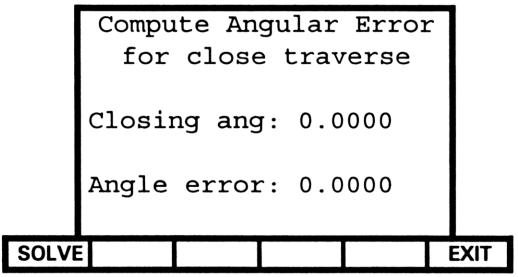
[SOLVE] will divide the angular error equally among all of the angles of the closed traverse and adjust the coordinates of all but the first two points.
[PTLST] will transfer to the Point List Screen.
[ERROR] will bring up the angular computation screens which are shown below. The angular error computations are different between close and open traverse.
compute the angular error using the polygon rule. You may either enter a closing angle or let the TDS-COGO48 compute the closing angle. (see below) The error will be displayed in the Angle error field. To adjust the angles of the traverse you must press **[SOLVE]** will a non-zero angle error.

COMPUTE ANGULAR ERROR SCREENS

Close traverse

Purpose of screen - to allow you to compute angular error for close traverse.

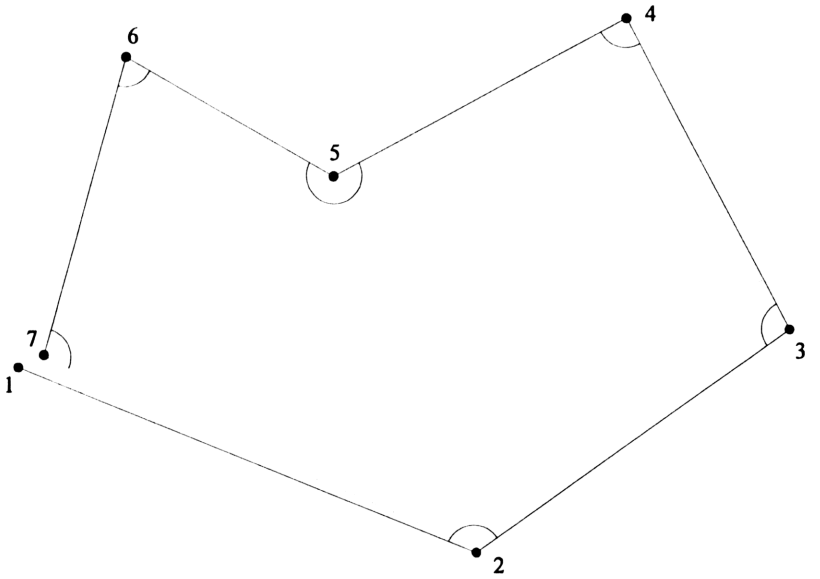
Path:	From the Main Menu, press **[N]** Survey Adjustments Menu - **[J]** - set the Traverse option on **CLOSE** - **[ERROR]**



Closing Ang: this is the angle between the next to the last traverse point through the closing point to the second point of the traverse. If you shot this angle in the field you should enter the result as the Closing ang. If you do not have the closing angle set this field to zero and the TDS-COGO48 will calculate it for you.
Angle error: {output only}is the angular error that is to be "adjusted out" of the survey.

[SOLVE] will compute the angular error using the polygon rule. You may either enter a closing angle or let the TDS-COGO48 compute the closing angle. (see below)
Angular error will be calculated by using the rule that the sum of all internal angles of a polygon will be equal to the number of sides minus two multiplied by 180 degrees. If the Closing angle is zero, the angle between the next to the last, the last and the second points will be used. See the example below.

REFERENCE



The angular Error is computed by adding together:

1-2-3
2-3-4
3-4-5
4-5-6
5-6-7
Closing ang value or 6-7-2

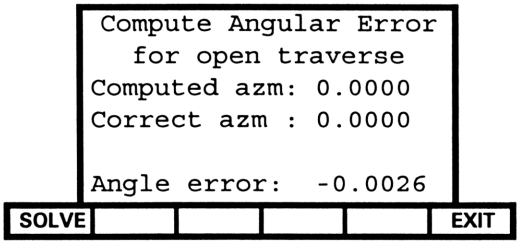
The result is then compared to (6-2)*180 and the difference is the error

COMPUTE ANGULAR ERROR SCREENS

Open traverse

Purpose of screen - to allow you to compute angular error for open traverse.

Path:	From the Main Menu, press **[N]** Survey Adjustments Menu - **[J]** - set the Traverse option on **OPEN** - **[ERROR]**



Computed azm: is the azimuth measured from the closing point to the second point of the survey. This angle is entered by the user.
Correct azm: is the azimuth measured from the beginning point to the second point of the survey. This angle is also entered by the user.
Angle error: {output only}is the angular error that is to be "adjusted out" of the survey.

[SOLVE] will compute the angular simply by taking the difference between the computed and the correct azimuths.

COMPASS RULE SCREENS

CLOSED TRAVERSE

Purpose of screen - to allow you to adjust a *closed* traverse by the Compass Rule.

Path:	From the Main Menu, press **[N]** Survey Adjustment Menu - **[K]**

From point - To point / Using point list =>

```
   Compass Rule
>From point:        0
To point   :        0
   CLOSE TRAVERSE
Include vertical
  closure:> Yes
```

<= Yes / No

SOLVE	PTLST	OPEN	PRECI		EXIT

From pt: - <Using point list>
To point: are the alternative methods of specifying the points that are to be included in the angular adjustment.
Include vertical closure: specifies whether elevations will be included in the adjustment.

[SOLVE] will apply the Compass Rule to the points specified in the closed traverse in the screen. It will compute new coordinates for all points *but the first point* and store these new coordinates in the job file.
[PTLST] will transfer to the Point List Screen.
[OPEN] will transfer to the Compass Rule Screen for open traverses (see below).
[PRECI] will compute the precision of the closed traverse based on the original data. The **[PRECI]** key should be used to check the precision *before* **[SOLVE]** is used. After pressing **[SOLVE]** the precision will be near perfect.

OPEN TRAVERSE

Purpose of screen - to allow you to adjust an *open* traverse by the Compass Rule.

Path:	From the Main Menu press **[N]** Survey Adjustment Menu - **[K]** Compass Rule - **[OPEN]**

From point - To point / Using point list =>

```
   Compass Rule
>From point:        0
To point   :        0
   OPEN TRAVERSE
Correct N:    0.000
Correct E:    0.000
Correct EL:   0.0000
```

SOLVE	PTLST	CLOSE	PRECI	RCL	EXIT

From pt: - <Using point list>
To point: are the alternative methods of specifying the points that are to be included in the angular adjustment.
Correct N: is the true northing of the last point.
Correct E: is the true easting of the last point.
Correct EL: is the true elevation of the last point.

[SOLVE] will apply the Compass Rule to the points specified in the open traverse in the screen. It will compute new coordinates for all points *but the first point* and store these new coordinates in the job file.
[PTLST] will transfer to the Point List Screen.
[CLOSE] will transfer to the Compass Rule Screen for closed traverses (see above).
[PRECI] will compute the precision of the open traverse based on the original data. The **[PRECI]** key should be used to check the precision *before* **[SOLVE]** is used.
[RCL] will temporarily shift to a recall point number screen. You may then specify the point number whose coordinates will be used as the correct northing, easting, and elevation. Press **[ENTER]** to return to the Compass Rule Screen.

TRANSIT RULE SCREENS

CLOSED TRAVERSE

Purpose of screen - to allow you to adjust a *closed* traverse by the Transit Rule.

Path:	From the Main Menu, press **[N]** Survey Adjustment Menu - **[L]**

From point - To point / Using point list =>

```
   Transit Rule
>From point:        0
To point   :        0
   CLOSE TRAVERSE
```

SOLVE	PTLST	OPEN	PRECI		EXIT

From pt: - <Using point list>
To point: are the alternative methods of specifying the points that are to be included in the angular adjustment.

[SOLVE] will apply the Transit Rule to the points specified in the closed traverse in the screen. It will compute new coordinates for all points *but the first point* and store these new coordinates in the job file.
[PTLST] will transfer to the Point List Screen.
[OPEN] will transfer to the Transit Rule Screen for open traverses (see below).
[PRECI] will compute the precision of the closed traverse based on the original data. The **[PRECI]** key should be used to check the precision *before* **[SOLVE]** is used. After pressing **[SOLVE]** the precision will be near perfect.

OPEN TRAVERSE

Purpose of screen - to allow you to adjust an *open* traverse by the Transit Rule.

Path:	From the Main Menu press **[N]** Survey Adjustment Menu - **[L]** Transit Rule - **[OPEN]**

From point - To point / Using point list =>

```
   Transit Rule
>From point:        0
To point   :        0
   OPEN TRAVERSE
Correct N:    0.000
Correct E:    0.000
Correct EL:   0.0000
```

SOLVE	PTLST	CLOSE	PRECI	RCL	EXIT

From pt: - <Using point list>
To point: are the alternative methods of specifying the points that are to be included in the angular adjustment.
Correct N: is the true northing of the last point.
Correct E: is the true easting of the last point.
Correct EL: is the true elevation of the last point.

[SOLVE] will apply the Transit Rule to the points specified in the open traverse in the screen. It will compute new coordinates for all points *but the first point* and store these new coordinates in the job file.
[PTLST] will transfer to the Point List Screen.
[CLOSE] will transfer to the Transit Rule Screen for closed traverses (see above).
[PRECI] will compute the precision of the open traverse based on the original data. The **[PRECI]** key should be used to check the precision *before* **[SOLVE]** is used.
[RCL] will temporarily shift to a recall point number screen. You may then specify the point number whose coordinates will be used as the correct northing, easting, and elevation. Press **[ENTER]** to return to the Transit Rule Screen.

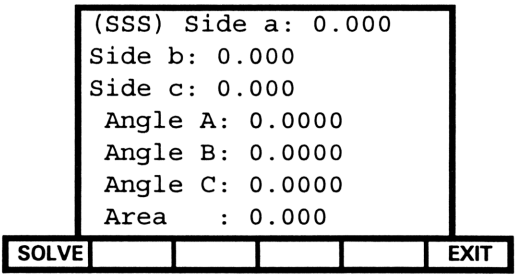
REFERENCE

TRIANGLE SOLUTIONS MENU SCREENS

THREE SIDES KNOWN SCREEN

Purpose of screen - to allow you to solve for the unknown elements of a plane triangle when you know the three sides.

Path:	From the Main Menu, press **[O]** Triangle Solutions Menu - **[G]**



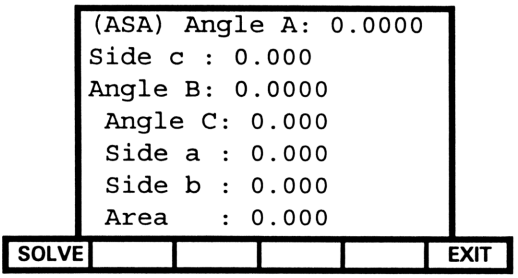
Side a: is one of the known sides of the triangle.
Side b: is one of the known sides of the triangle.
Side c: is one of the known sides of the triangle.
Angle A: {output only} is the computed value of one of the unknown angles.
Angle B: {output only} is the computed value of one of the unknown angles.
Angle C: {output only} is the computed value of one of the unknown angles.
Area: {output only} is the computed value of the area of the triangle.

[SOLVE] will solve for the unknown elements and the area of the triangle for which you have keyed in the known elements.

2 ANGLES & THE INCLUDED SIDE SCREEN

Purpose of screen - to allow you to solve for the unknown elements of a plane triangle when you know two angles and the included side.

Path:	From the Main Menu, press **[O]** Triangle Solutions Menu - **[H]**



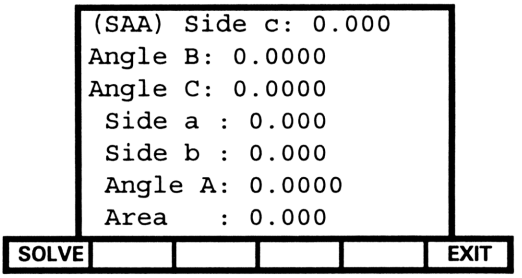
Angle A: is one of the known angles of the triangle.
Side c: is the included side of the triangle.
Angle B: is one of the known angles of the triangle.
Angle C: {output only} is the computed value of one of the unknown angles.
Side a: {output only} is the computed value of one of the unknown sides.
Side b: {output only} is the computed value of one of the unknown sides.
Area: {output only} is the computed value of the area of the triangle.

[SOLVE] will solve for the unknown elements and the area of the triangle for which you have keyed in the known elements.

2 ANGLES & AN OPPOSITE SIDE SCREEN

Purpose of screen - to allow you to solve for the unknown elements of a plane triangle when you know two angles and a side opposite one of them.

Path:	From the Main Menu, press **[O]** Triangle Solutions Menu - **[1]**



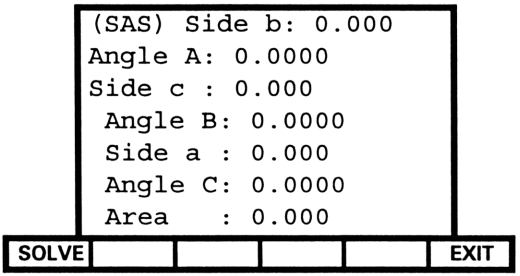
Side c: is the known side of the triangle.
Angle B: is one of the known angles of the triangle.
Angle C: is the known angle opposite side c.
Side a: {output only} is the computed value of one of the unknown sides.
Side b: {output only} is the computed value of one of the unknown sides.
Angle A: {output only} is the computed value of the unknown angle.
Area: {output only} is the computed value of the area of the triangle.

[SOLVE] will solve for the unknown elements and the area of the triangle for which you have keyed in the known elements.

2 SIDES & THE INCLUDED ANGLE SCREEN

Purpose of screen - to allow you to solve for the unknown elements of a plane triangle when you know two sides and the included angle.

Path:	From the Main Menu, press **[O]** Triangle Solutions Menu - **[J]**



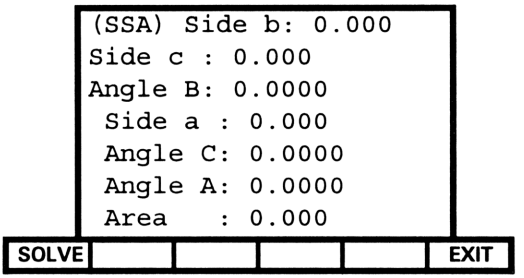
Side b: is one of the known sides of the triangle.
Angle A: is the included angle.
Side c: is one of the known sides of the triangle.
Angle B: {output only} is the computed value of one of the unknown angles.
Side a: {output only} is the computed value of the unknown side.
Angle C: {output only} is the computed value of one of the unknown angles.
Area: {output only} is the computed value of the area of the triangle.

[SOLVE] will solve for the unknown elements and the area of the triangle for which you have keyed in the known elements.

2 SIDES & AN OPPOSITE ANGLE SCREEN

Purpose of screen - to allow you to solve for the unknown elements of a plane triangle when you know two sides and an angle opposite one of them.

Path: From the Main Menu, press **[O]** Triangle Solutions Menu - **[K]**



Side b: is one of the known sides of the triangle.
Side c: is one of the known sides of the triangle.
Angle B: is the angle opposite side b.
Side a: {output only} is the computed value of the unknown side.
Angle C: {output only} is the computed value of one of the unknown angles.
Angle A: {output only} is the computed value of one of the unknown angles.
Area: {output only} is the computed value of the area of the triangle.

[SOLVE] will solve for the unknown elements and the area of the triangle for which you have keyed in the known elements.
[EXIT] will return to the previous screen or menu.

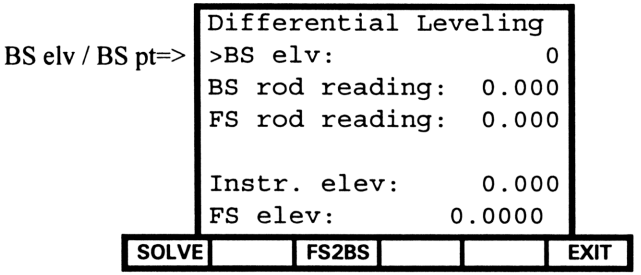
NOTE:

This last case *may* have two solutions. To see the second solution, press the **[MORE]** "soft" key that will appear after you press **[SOLVE]**. If any of the sides in this second solution have negative values, then the first solution is the only valid solution.

DIFFERENTIAL LEVELING SCREEN

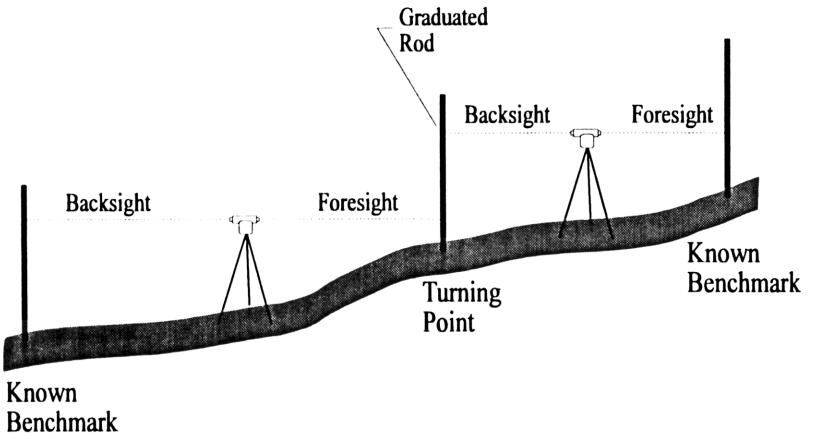
Purpose of screen - to allow you to compute the elevation of a point based on the elevation of another point.

Path: From the Main Menu, press **[O]** Triangle Solutions Menu - **[L]**



BS elev - BS pt: allows you to specify the back sight elevation either as an elevation or a point number which has a known elevation.
BS rod reading: is the height of the target on the rod at the backsight point.
FS rod reading: is the height of the target on the rod at the foresight point.
Instr. elev: { output only } is the elevation of the instrument.
FS elev: { output only } is the elevation at the foresight point.

[SOLVE] will solve for the output values based on the input information in the screen and will display the computed values on the screen.
[FS2BS] will transfer the foresight elevation computed to the backsight elevation field to allow you to check your readings.



TRIGONOMETRIC LEVELING SCREEN

Purpose of screen - to compute the elevation of a point based on the elevation of another point in the same vertical plane, the vertical angle between the two points, and the horizontal distance to the vertical plane.

Path:	From the Main Menu, press **[O]** Triangle Solutions Menu - **[M]**

Station elv / pt=>

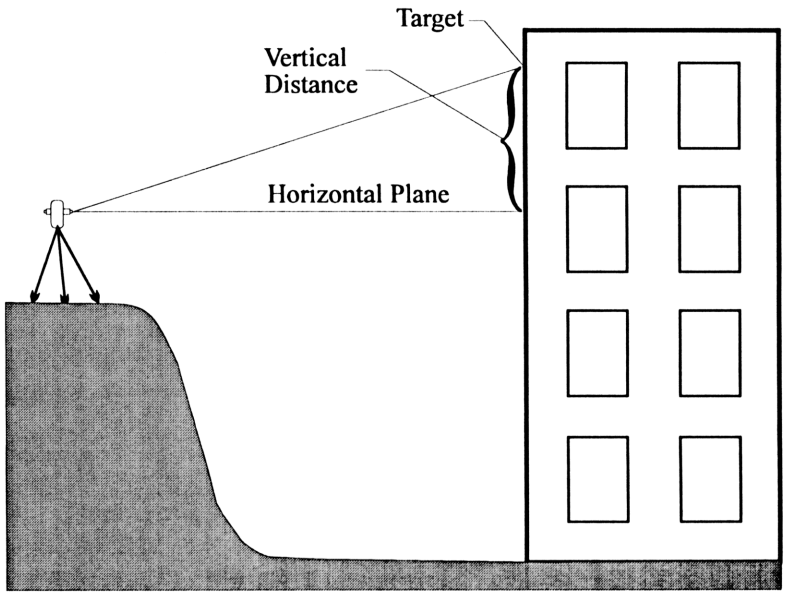
Vert ang / Zenith=>

```
    Trig. Leveling
>Station elv:          0
HI:  0.000
Horiz dist:        0.000
>Vert ang:        0.0000
Target elv:        0.000
VD +- hor plan:    0.000
```

SOLVE					EXIT

Station elv - Station point: allows you to specify the elevation of the instrument point either as an elevation or a point number which has a known elevation.
HI: the height of the instrument above the ground.
Horiz dist: the horizontal distance from the instrument point to the vertical plane containing the two points.
Vert ang - Zenith: allows you to specify the angle between the horizontal plane and the target point.
Target elv: { output only } the elevation of the target.
VD +- hor plan: { output only } the vertical distance from the target to the horizontal plane of the instrument.

[SOLVE] will solve for the output values based on the input information in the screen and will display the computed values on the screen.



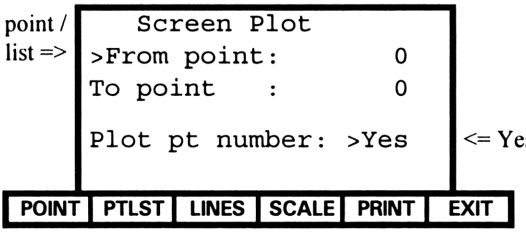
SCREEN PLOT SCREEN

SCREEN PLOT SCREEN

Purpose of screen - to allow you to view a plot of a block of points in the TDS-COGO48 screen display.

Path: From the Main Menu, press **[P]** Screen plot

From point - To point / Using point list =>



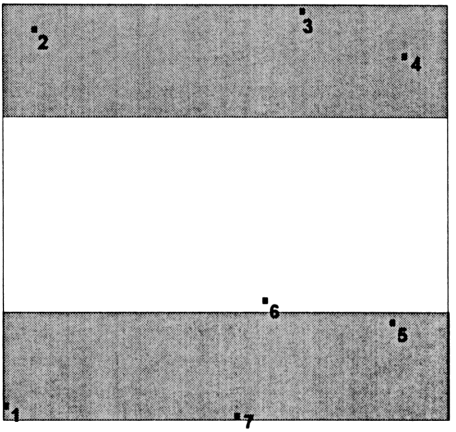
From point: - <Using point list>
To Point: are the techniques used to specify a sequence of points.
Plot pt number: will establish whether or not point numbers will be plotted.

[POINT] will cause the points indicated at the top of the screen to be plotted in the TDS-COGO48's display (see below).
[PTLST] will transfer to the Point List Screen.
[LINES] will cause the points indicated at the top of the screen to be plotted in the TDS-COGO48's display and to be connected by straight lines in the assigned sequence (see below).
[SCALE] will compute a scale for the plot that will display all of the specified points to be shown in the "square" virtual display.
[PRINT] will send the current screen plot to an HP-82240B Infrared Printer.

POINTS SCREEN

Purpose of screen - to show the point plot from the previous screen.

Path: From the Main Menu, press **[P]** Screen Plot - **[POINT]**

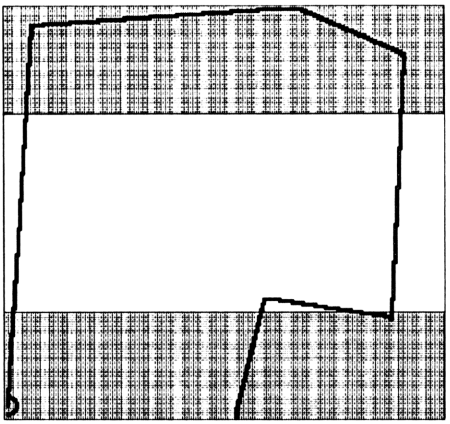


The points on this screen are shown on a square virtual display with the north direction at the top of the display. You may press and hold down the vertical cursor keys **[↑]** and **[↓]** to scroll to the rest of the display. To return to the Screen Plot Screen, press **[ON]**.

LINES SCREEN

Purpose of screen - to show the line plot from the previous screen.

Path: From the Main Menu, press **[P]** Screen Plot - **[LINES]**



The points and lines screens are shown on a square virtual display with the north direction at the top of the display. You may press and hold down the vertical cursor keys **[↑]** and **[↓]** to scroll to the rest of the display. To return to the Screen Plot Screen, press **[ON]**. The Points screen is displayed with the point numbers **On** while the Lines screen on the next page, has then **Off**.

NOTE:

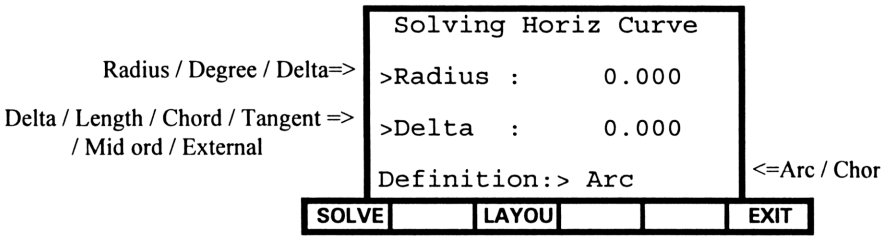
If you are using the Point List option to specify the point sequence and you want to show a figure that has more than one separate connected line sequence, you may "lift the pen" in this screen plot by inserting a PENUP command in the point list. Use the **[PENU]** softkey in the Point List Screen.

CURVE MENU SCREENS

SOLVING HORIZONTAL CURVE SCREEN

Purpose of screen - to solve for the properties of a horizontal curve.

Path:	From the Main Menu, press **[Q]** Curve Menu - **[G]**



Radius: - Degree (of curvature): - Delta: is a measure of the curvature of the curve.
Delta: -Length: - Chord: - Tangent: - Mid ord: - Externl: is a measure of the size of the curve segment.
Definition: defines the degree of curvature is based on either Chord or Arc.

[SOLVE] will solve for the remaining curve parameters and display them on the Curve Solution Screen (see below).
[LAYOU] will transfer to the Horizontal Curve Layout Menu (see below).

CURVE SOLUTION SCREEN

Purpose of screen - to display the results of the horizontal curve solution.

Path:	From the Main Menu, press **[Q]** Curve Menu - **[G]** Horizontal Curve Screen - **[SOLVE]**

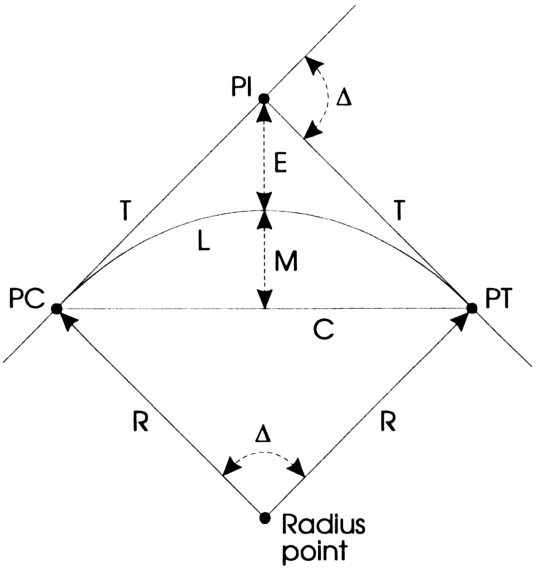
REFERENCE

Radius	:	0.000
Length	:	0.000
Chord	:	0.000
Degree	:	0.0000
Delta	:	0.0000
Tangent	:	0.000
External	:	0.000

MORE | | | | | EXIT

Midordinate	:	0.0000
Segment	:	0.000
Sector	:	0.000

					EXIT



PC - Point of Curvature
PT - Point of Tangency
PI - Point of Intersection
P - Radius Point

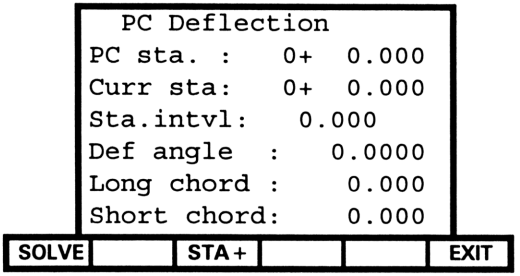
R - Radius
L - Length (Arc Length)
C - Chord Length
T - Tangent Length
E - External
M - Mid-ordinate
Δ - Internal angle from center to tangent points
Degree of Curvature - Internal angle equivalent to a 100 ft arc length
Degree of Curvature = (18,000) / (R x p) Expressed in degrees, minutes, and seconds.

[MORE] will show the value of the mid ordinate, Segment and Sector. Then pressing the **[EXIT]** key will return to the previous screen.

PC DEFLECTION SCREEN

Purpose of screen - to allow you to lay out a horizontal curve by deflection angles from the PC and entered from within the Curve Menu.

Path:	From the Main Menu, press **[Q]** Curve Menu - **[G]** Horizontal Curve Screen - **[LAYOU]** Horizontal Curve Layout Menu - **[G]**



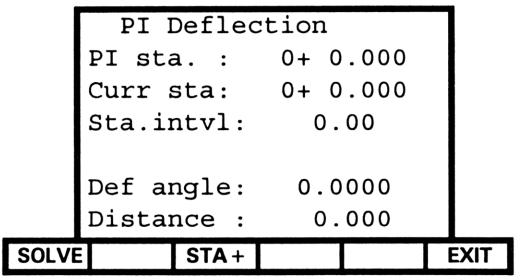
PC sta: is the station number of the PC. Your gun should be occupying the PC and backsighting the PI.
Curr sta: is the station number of the current station.
Sta. interval: is the interval from the current station to the next station.
Def ang: {output only} is the deflection angle from the PC-PI line to the next station assuming the current station is occupied.
Long chord: {output only} is the length of the chord from the next station to the PC.
Short chord: {output only}is the length of the chord from the next station to the current station.

[SOLVE] will compute the deflection angle and chord lengths from the screen data.
[STA+] will increment from the current station to the next station using the assigned station interval.

PI DEFLECTION SCREEN

Purpose of screen - to allow you to layout a horizontal curve by deflection angles from the PI from within the Curve Menu.

Path:	From the Main Menu, press **[Q]** Curve Menu - **[G]** Horizontal Curve Screen - **[LAYOU]** Horizontal Curve Layout Menu - **[H]**



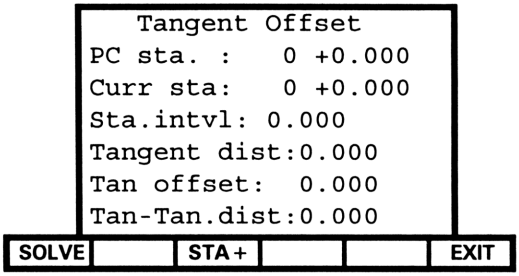
PI sta : is the station number of the PI. Your gun should be occupying the PI and backsighting the PC.
Curr sta: is the station number of the current station.
Sta. interval: is the interval from the current station to the next station.
Def ang: {output only} is the deflection angle from the PI- PC line to the next station.
Distance: {output only} is the distance from the PI to the next station.

[SOLVE] will compute the deflection angle and distance from the screen data.
[STA+] will increment from the current station to the next station using the assigned station interval.

TANGENT OFFSET SCREEN

Purpose of screen -

Path:	From the Main Menu, press **[Q]** Curve Menu - **[G]** Horizontal Curve Screen - **[LAYOU]** Horizontal Curve Layout Menu - **[I]**



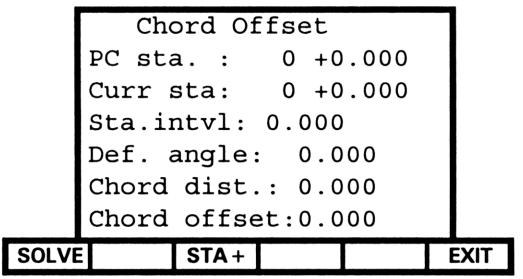
PC sta.: is the station number of the PC. Your gun should be occupying the PC and backsighting the forward tangent.
Curr sta: is the station number of the current station.
Sta. interval: is the interval from the current station to the next station.
Tangent dist: {output only} is the distance from the PC to the point at which the tangent is closest to the current station. This point is the point from which the Tangent Offset is measured.
Tan offset: {output only} is the distance from the current station to the point on the tangent line which is closest to the current station.
Tan-Tan. dist: {output only} is the distance from the PI to the point at which the tangent is closest to the current station.

[SOLVE] will compute the deflection angle and distance from the screen data.
[STA+] will increment from the current station to the next station using the assigned station interval.

CHORD OFFSET SCREEN

Purpose of screen -

Path:	From the Main Menu, press **[Q]** Curve Menu - **[G]** Horizontal Curve Screen - **[LAYOU]** Horizontal Curve Layout Menu - **[J]**



PC sta.: is the station number of the PC. Your gun should be occupying the PC and backsighting the forward tangent.
Curr sta: is the station number of the current station.
Sta. interval: is the interval from the current station to the next station.
Def. angle: {output only} is the deflection angle from the last station to the next station, assuming the current station is occupied.
Chord dist.: {output only} is the distance from the PC to the point on the chord which is closest to the current station.
Chord offset: {output only} is the distance from the current station to the closest point on the chord.

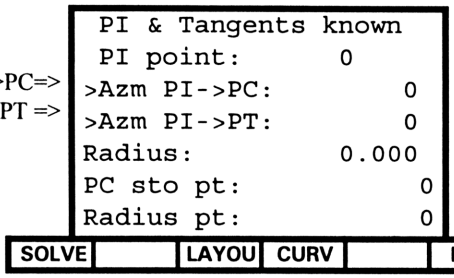
[SOLVE] will compute the deflection angle and distance from the screen data.
[STA+] will increment from the current station to the next station using the assigned station interval.

KNOWN PI & TANGENTS SCREEN

Purpose of screen - to allow you to compute the coordinates of the PC and PT of a curve with a known PI, the bearings of the tangents, and the radius or other curve parameters.

Path: From the Main Menu, press **[Q]** Curve Menu - **[H]**

Azm PI->PC / Brg PI->PC=>
Azm PI->PT / Brg PI->PT =>



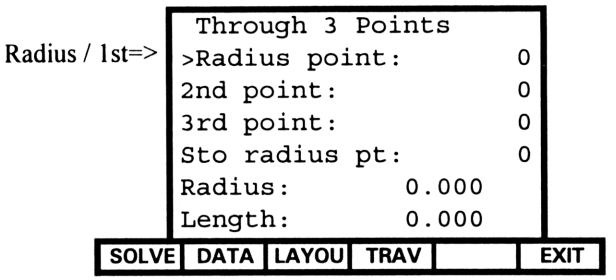
PI pt: is the point number of the PI.
Azm PI to PC:- Brg PI to PC: are two ways of specifying the direction of the line from the PI to PC.
Azm PI to PC:- Brg PI to PT: are two ways of specifying the direction of the line from the PI to PT.
Radius: is the radius of the curve.
PC store pt: is the point number where the computed coordinates of the PC should be stored. The computed coordinates of the PT will be stored in the next consecutive point number.
Radius pt: if this field has a valid point number, the radius point will be computed and stored. If this field is zero, no radius point will be computed.

[SOLVE] will compute the coordinates of the PC and PT and store them in the job file at the appropriate point numbers.
[LAYOU] will transfer to the Horizontal Curve Layout Menu (see above).
[CURV] will transfer to the Horizontal Curve Solution Screen (see above).

THROUGH 3 POINTS SCREEN

Purpose of screen - to allow you to solve for the curve which will pass through three known points. Also, to allow you to solve for a curve given two known points and the known center.

Path: From the Main Menu, press **[Q]** Curve Menu - **[I]**



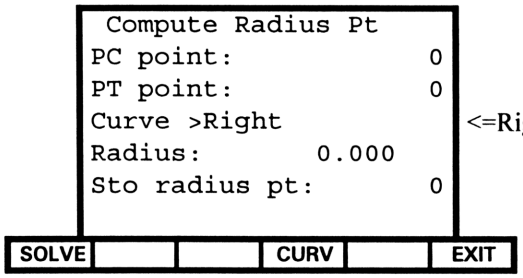
Radius Point: - 1st Point: 1st Point is the point number of the Start of Curve Point. Radius Point is the point number of the center of the curve.
2nd point: if the 1st Point-Radius Point line is set to 1st Point, this is the point number of the second point on the curve. This point may be at .any location between the start and the end of the curve. If the 1st Point-Radius Point line is set to Radius Point, this is the Start of Curve point.
3rd point: if the 1st Point-Radius Point line is set to 1st Point, this is the point number of the End of Curve point. If the 1st Point-Radius Point line is set to Radius Point, this is the point number of the End Azimuth Point.
Sto radius pt: if this field has a valid point number, the radius point will be computed and stored. If this field is zero, no radius point will be computed.
Radius: {output only} is the radius of the curve.
Length: {output only} is the arc length of the curve.

[SOLVE] will solve for the curve parameters.
[DATA] after solving for the curve parameters, this key will transfer to the Curve Solution Screen to display them.
[LAYOU] will transfer to the Horizontal Curve Layout Menu (see above).
[TRAV] will transfer to the Traverse on a Curve Screen (see above).

COMPUTE RADIUS POINT SCREEN

Purpose of screen - to allow you to find the coordinates of the radius-point of a curve given two points on the curve and one other known curve parameter.

Path: From the Main Menu, press **[Q]** Curve Menu - **[J]**



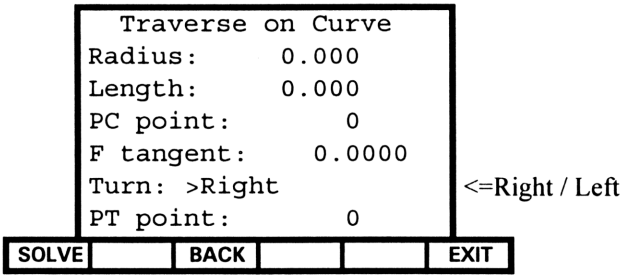
PC point : is the point number of the Point of Curvature on the curve.
PT point : is the point number of the Point of Tangency on the curve.
Curve Turn : is the direction that the curve should turn from the PC to the PT.
Radius: is the radius of the curve.
Store radius pt : is the point number into which the solved coordinates will be stored.

[SOLVE] will compute the radius point from the screen data and store the result.
[CURVE] will transfer you to the Horizontal Curve Solution Screen.

TRAVERSE ON CURVE SCREEN

Purpose of screen - to include a horizontal curve in a traverse.

Path: From the Main Menu, press **[Q]** Curve Menu - **[K]**



Radius: is the radius of the curve.
Length: is the arc length of the curve.
PC point: is the point number of the PC.
F tangent: is the azimuth of the tangent to the curve from the PC in the forward direction of the curve (toward the PT).
Turn: is the direction (right or left) that the curve turns from the forward tangent.
PT point: is the point number of the PT.

[SOLVE] will compute the coordinates of the PT and add this point to the coordinate file from the data in the rest of the screen.
[BACK] will transfer to the Backsight Screen. The Backsight Screen may be used to compute the azimuth of the forward tangent. When you return to this screen from the Backsight Screen, the value of the azimuth of the forward tangent will be automatically computed to be in the *opposite* direction of the backsight azimuth.

VERTICAL CURVE SCREEN

Purpose of screen - to allow you to compute the elevations at various stations along a vertical curve.

Path: From the Main Menu, press **[Q]** Curve Menu - **[L]**

PVC Sta./ PVI Sta. =>

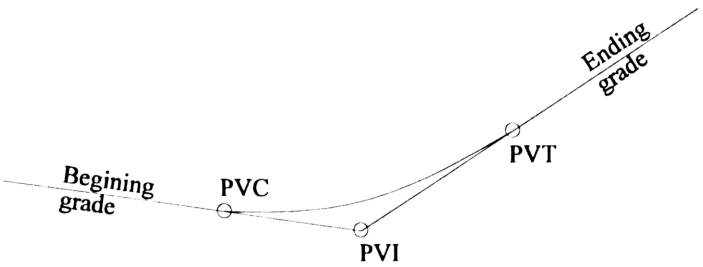
Length / Sta. Elevation / => H/L El

```
   Vertical Curve
>PVC sta.:    0   +0.000
 Elevation:       0.000
>Length:    0.00
 Beg.grade(%):    0.000
 End grade(%):    0.000
```

SOLVE | | LAYOU | | | EXIT

PVC sta.: - PVI sta: is the station number of either the PC or the PI of the vertical curve.
Elevation: is the elevation at the PVC or PVI station.
Length: - H/L pt ele: - Sta:
Elevation: is the horizontal length between the PC and PT or another station number and elevation along or the elevation of the high or low point of the vertical curve.
Beg grade (%): is the beginning grade of the vertical curve expressed as a % (+ for uphill; - for downhill).
End grade (%): is the ending grade of the vertical curve expressed as a % (+ for uphill; - for downhill).

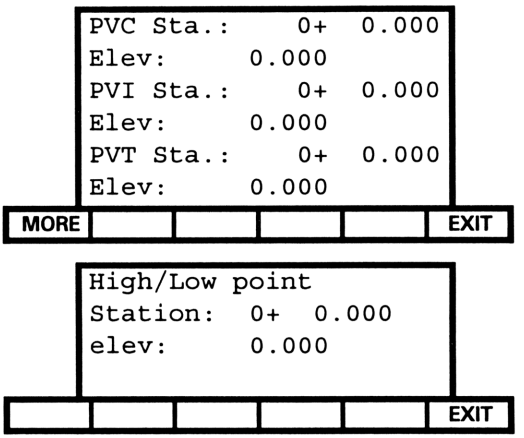
[SOLVE] will compute the properties of the vertical curve and display the results in the Vertical Curve Solution Screen (see below)
[LAYOU] will transfer to the Vertical Curve Layout Screen (see below).



VERTICAL CURVE SOLUTION SCREEN

Purpose of screen - to display the results of the vertical curve solution from the data in the previous screen.

Path:	From the Main Menu, press **[Q]** Curve Menu - **[L]** Vertical Curve Screen - **[SOLVE]**



PVC Sta: {output only} is the station number of the PC of the vertical curve.
Elev: {output only} is the elevation of the PC of the vertical curve.
PVI Sta: {output only} is the station number of the PI of the vertical curve.
Elev: {output only} is the elevation of the PI of the vertical curve.
PVT Sta: {output only} is the station number of the PT of the vertical curve.
Elev: {output only} is the elevation of the PT of the vertical curve.

High/Low point

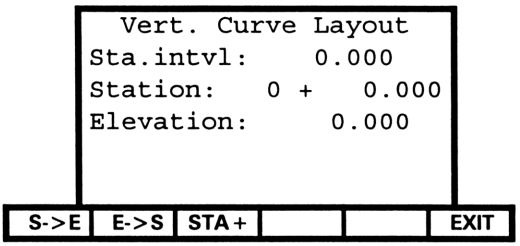
Station: {output only} is the station number of the highest or lowest point along the vertical curve.
Elev: {output only} is the elevation of the highest or lowest point along the vertical curve.

[MORE] will display the High / Low point values of the Solution screen.

VERTICAL CURVE LAYOUT SCREEN

Purpose of screen - to allow you to layout a vertical curve by station number from the Curve Menu.

Path:	From the Main Menu, press **[Q]** Curve Menu - **[L]** Vertical Curve Screen - **[LAYOU]**



Sta. intvl: is the interval between stations to be laid out.
Station: is the current station.
Elevation: is the elevation at the current station.

[S-->E] will assume the station in the current station line; compute the elevation at that station; and display it in the elevation line of this screen
[E-->S] will assume the elevation in the elevation line; compute the station at which that elevation occurs; and display it in the station line of this screen.
[STA+] will increment the current station line in the display by an amount equal to the station interval.

STRAIGHT GRADE SCREEN

Purpose of screen - to solve for the elevation at various stations along a straight grade.

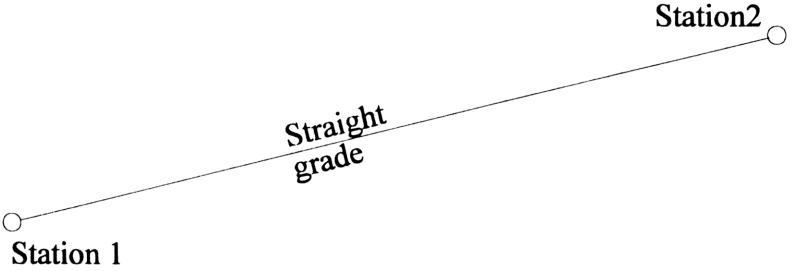
Path: From the Main Menu, press **[Q]** Curve Menu - **[M]**

```
  Straight Grade
Sta. 1:     0+    0.000
Elev 1:       0.000
Grad(%):    0.000
Sta.intvl:    0.000
Sta. 2:     0+    0.000
Elev 2:       0.000
```

S->E	E->S	STA+			EXIT

Sta. 1: is the station number of a station with a known elevation.
Elev 1: is the elevation at Sta 1.
Grade (%): is the grade of the section (+ for uphill; - for downhill).
Sta. intvl: is the interval to the next station
Sta. 2: is the station number of the next station.
Elev 2: is the elevation of the next station.

[S-->E] will assume the station in the Sta 2 line; compute the elevation at that station; and display it in the Elev 2 line of this screen.
[E-->S] will assume the elevation in the Elev 2 line; compute the station at which that elevation occurs; and display it in the Sta 2 line of this display.
[STA+] will increment the Sta 2 line in the display by an amount equal to the station interval.



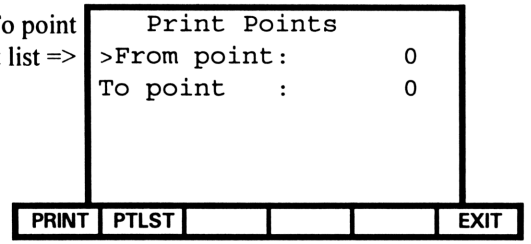
PRINT MENU SCREENS

PRINT POINTS SCREEN

Purpose of screen - to print out the coordinates of a block of points on a printer.

Path: From the Main Menu, press **[R]** Print Menu - **[G]**

From point - To point / Using point list =>



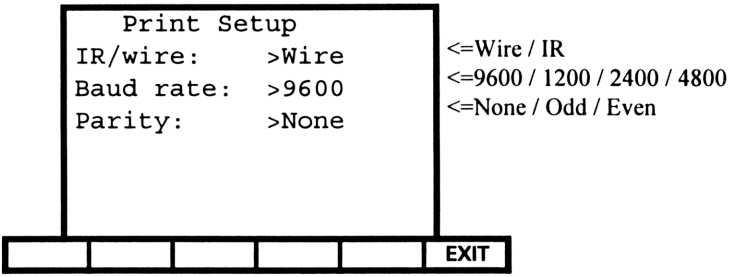
From pt: - <Using point list>
To pt: are the techniques for specifying the points to be printed.

[PRINT] will begin printing the coordinates of the specified points.
[PTLST] will transfer to the Point List Screen.

PRINT SETUP SCREEN

Purpose of screen - to setup your TDS-COGO48 for printing.

Path: From the Main Menu, press **[R]** Print Menu - **[I]**



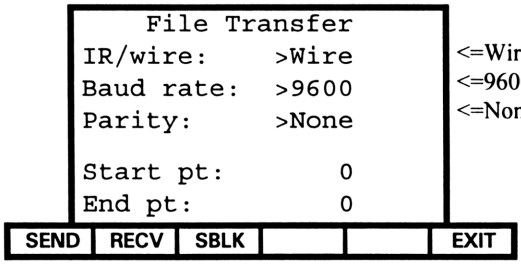
IR/wire: indicates whether or not the data communication is to be via the RS232 link or via the wireless infrared link.
Baud rate: is the data communication rate expressed in baud.
Parity: is the data communication parity setting (even, odd, or none)

FILE TRANSFER SCREEN

FILE TRANSFER SCREEN

Purpose of screen - to transfer data to or from the TDS-COGO48 from into a PC.

Path: From the Main Menu, press **[S]**



<=Wire / IR
<=9600 / 1200 / 2400 / 4800
<=None / Odd /Even

IR/Wire: indicates whether or not data communication is to be via the RS232 link or via the wireless infrared link.
Baud rate: is the data communication rate expressed in baud.
Parity: is the data communication parity setting (even, odd, or none).
Start pt: is the starting point if a block of points is to be sent.
End pt: is the ending point if a block of points is to be sent.

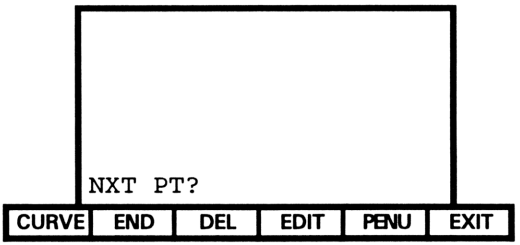
[SEND] will cause the designated data to be sent from the TDS-COGO48 to another device according to the established screen parameters.
[RECV] will set up the TDS-COGO48 to receive data from another device according to the established screen parameters and store it as the named job.
[SBLK] will cause a block of data to be sent as determined by the start and end points in the screen. The Start pt. and End pt. fields are only used when **[SBLK]** is pressed.

NOTE: If you are using the companion TDS-COGO48 TFR PC software, the proper communication parameter settings are: Baud rate - 9600, Parity - None, IR/Wire - Wire.

POINT LIST SCREEN

Purpose of screen - to allow you to specify a block of points that are not consecutively numbered for a variety of operations within the TDS-COGO48. You may also use the point list to specify a curve within the list of points as well as controlling several functions of the plotter.

Path:	from any screen which has a **[PTLST]** "soft" key, press **[PTLST]** Point List Menu - **[G]**



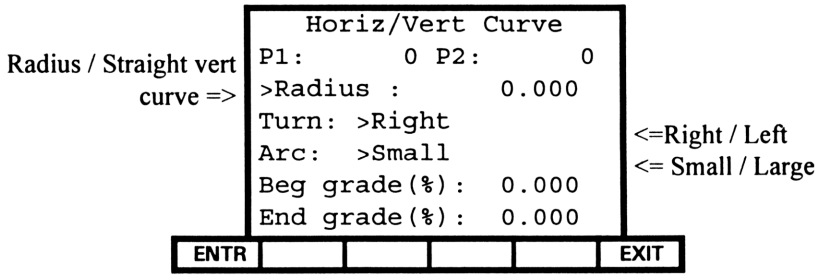
The Point List is a mechanism with which you can specify a block of points for some operations in the TDS-COGO48. You may build the list one point at a time or by specifying sequentially numbered points as groups by keying in the first and last point in the group with a **[-]** between. (such as "10-15"). Another special command is to insert a sideshot in a point list. To do this, press **[α] [S] [S]** [space] followed by the point number of the sideshot. These features may be combined. To insert a group of consecutively numbered sideshots into a point list, press **[α] [S] [S]** [space] followed by the first point number; then **[-]**; then the last point number in the sequence. This feature is particularly useful if you want to do an adjustment of a traverse that has sideshots in it. The traverse point coordinates will be adjusted according to the selected rule. The sideshot coordinates will be adjusted according to the adjusted values of the traverse coordinates. The screen plot will also recognize the SS symbol.

[CURVE] will transfer to the Horiz/Vert Curve Screen (see below).
[END] will move the scroll bar to the end of the point list.
[DEL] will delete the Point List entry line that is in the screen *immediately above* the data entry bar.
[EDIT] will replace the entry above the data entry bar with the contents of the bar.
[PENU] will "lift the pen" and not draw a line to the next point when doing a screen plot of the lines in this point list.
[ENTER] (main keyboard) will insert the contents of the data entry bar *after* the last entry currently on view in the screen.

HORIZ/VERT CURVE SCREEN

Purpose of screen - to allow you to insert a curve in a point list.

Path:	from any screen which has a **[PTLST]** "soft" key, press **[PTLST]** Point List Menu - **[G]** Point List Screen - **[CURVE]**



P1: is the first point on the curve.
P2: is the second point on the curve.
Radius: is the radius of a horizontal curve.

Turn: indicates that the horizontal curve will turn to the right or left of the forward tangent.
Arc: indicates whether the arc is small (less than 180^{o} central angle) or large (greater than 180^{o} central angle).
Beg grade(%): is the beginning grade for a vertical curve (+ for uphill; - for downhill).
End grade(%): is the ending grade for a vertical curve (+ for uphill; - for downhill).

[ENTER] will place the curve in the Point List.

CLEAR POINT LIST COMMAND

Purpose of screen - to clear all entries in the point list, allowing you to enter a "fresh" point list.

Path:	from any screen which has a **[PTLST]** "soft" key, press **[PTLST]** Point List Menu - **[H]**

Selecting this command will delete all entries in the currently active point list.

APPENDIX A

Technical Specifications*

COGO Software

Main Operating Functions

job creation	initialization
setup	

Traverse/Sideshot

single readings	differential leveling
trig. leveling	

CO-GO

areas	point-in -direction
elevation	2 and 3 point resections
conversions	corner angle computation
intersections	benchmark
inverses	pre-determined area

Earthworks

volume of a berm or gully	volume of mound or pit

Triangle Solutions

differential leveling	trig leveling

Curves

horizontals	verticals

Adjustments

scale changes	job rotations
translations	angle adjustment
compass rule	transit rule

Physical

Interfaces to:

Partial list of electronic total stations supported:

- LIETZ: Set2,3,4, SETsB, SDM3FR, DSM3F, SDM3ER, SDM3E, DT20E
- TOPCON: RS232 port
- NIKON: TOP GUN
- WILD: T2000+EDM, T1000+EDM, T2000, T1000
- PENTAX: PTS-10, PTS II
- KERN: E1/E2
- ZEISS: ELTA/C, Old ELTA
- GEODIMETER: RS232 port

APPENDIX A

File transfer to office equipment:

- Office computers and workstations
  Coordinate files and raw data
- Printers
  Coordinate files and raw data

Dimensions: 7.1" x 3.2" x 1.15"
Weight: 11 oz (including batteries and cards)

Power: 3 AAA Alkaline batteries
[batteries should last several months under normal usage]

Environmental:

- Operating Temperature:
- (with heater off) 32^{o} - 113^{o} F
- Storage Temperature:-20^{o} - 160^{o} F

Hardware features:

- Display: Liquid Crystal 8 line x 22 character
- Keyboard: 49 key membrane actuator with tactile feedback

Software features:

- Operating/Calculator System: (HP-48)
- Application: TDS-field computer routines

Memory

- 32k-byte, RAM built into the HP-48SX. (Up to 1000 Pts.)
  or
- 128k-byte, RAM built into the HP-48GX. (Up to 4000 Pts.)

Interfaces:

- RS-232 (4 pin) port built in for communication with desktop computers and total stations
- I/R port built in for wireless communication between units as well as to the HP 82240B Infrared Portable Printer.

**Specifications subject to change without prior notice*

APPENDIX B

File Format of TDS-48 Coordinate Files

Each file begins with a 20 byte header:

Bytes 1 - 13 is the file name in ASCII.
Byte 14 is the file type.
Bytes 15 - 17 is the file size.
Bytes 18 - 20 is the record pointer.

The header is followed by the point coordinate records which are each 41 bytes long:

Bytes 1 - 8 is the northing of the point.
Bytes 9 - 16 is the easting of the point .
Bytes 17 - 24 is the elevation of the point.
Bytes 24 - 41 is the point descriptor in ASCII.

C. TROUBLE SHOOTING

This appendix should be the first place you check for problems that you may have when operating your TDS-COGO48. These are a list of the most frequently asked technical support questions.

TRAVERSE, BACKSIGHT AND OTHER DIFFICULTIES

Your Problem	Solutions to Try
You wish to enter a backsight azimuth but your backsight screen is prompting you for a BS point. Or any other prompt that is not the one you want.	Remember, when there is a ">" character in front of a prompt, you can change that prompt, using the [←] or [→] arrow keys. Highlight the field that you want to change the prompt for and scroll through the choices until you have found the one desired.
As you traverse, your foresight point has the same or similar coordinates as your occupied point.	1. Check to see that you are recording a non-0 slope distance. 2. If you are entering data manually check to see that horizontal Zenith angles are 90° or horizontal vertical angles are 0°. A zenith angle of 0° or a vertical angle of 90 is straight up and therefore will result in a 0 horizontal distance.
Naming a file:	Caution should be used when naming a file. All letters and numbers are acceptable in a file name; but some punctuation symbols that will work on the HP-48, will cause problems when transferred to your PC. The "-" is fine but avoid using a space or period. Check your DOS manual for expectable characters in a DOS file name. Also the TDS-COGO system requires that the file name begin with a alpha character.

TROUBLE SHOOTING

COMMUNICATIONS INTERFACE (To PC or Instrument)

Your Problem	Solutions to Try
For each of these: You have TFR running on you PC, and you are connected to a TDS-COGO48, but you cannot get them to communicate. or TFR has worked in the past but now you cannot get it to communicate. or You are able to communicate with your with instrument but not with your PC.	Try all of the following Solutions: 1. Check to see if the Port you are using, is the one you have assigned in TFR. TFR versions before Ver 5.0, will only recognize ports 1 and 2. 2. The HP-48's battery warning is set to alert you to the fact that the batteries are almost too low to run the calculator. The HP-48 communication port takes more current to run than the calculator itself and will stop communicating long before the battery warning will come on. Changing batteries will often correct communication problems. If you are able to transfer part of a file and each try transfers less of the file, the problem is probably batteries. 3. If the communication port you are using is also used by any other device, check to see if that device uses a device driver. You should not share a port with a mouse or digitizer because each of these has a device driver that takes control of the port and may prevents TFR from seeing incoming data. 4. Do not allow your HP-48, nor its cable t sit over a digitizer. A digitizer emits a powerful electromagnetic field that will interrupt communications and can cours memory loss or other serious problems i the 48. If your TDS-COGO48 or its PC cable passes near a digitizer, move them and retry your transfer.

5. The HP-48 has a built in self test that can indicate a problem with the RS232 port. Press the **[ON]** and the **[D]** keys a the same time. When you release them the 48 screen should blank except for 3 vertical lines. Now short together the center two pins of the 48s RS232 port with a metal object. With the center pins shorted press the **[H]** key. The short should be maintained until the result is displayed. A display of "**U_LB 20000**" indicates that, either the short was not properly made or the HP-48 has a problem with its port. Yo should short the pins together and press **[H]** several more time, in an attempt to get a "OK" response. A display of "**U_LB OK**" indicates that the loop back test has past. This is not proof positive that the 48s port is working properly but is a good indicator that it is OK. To return to the normal operation, hold down **[ON]** and **[C]** at the same time. This should return you to the **HOME** screen.

6. Your cable should be tested for shorts, to see if all necessary wires are still connected. A continuity meter can be used for this purpose or the cable can be taken to an electronics repair shop. If you have a 9 pin connector on the PC end of your cable, then pins 2,3 and 5 should go to one and only one pin on the 4 pin HP-48 end. If you have a 25 pin connector into your PC then pins 2,3 and 7 should go to one and only one pin on the 4 pin HP-48 end.

   Care should be taken when plugging the cable into the HP-48. The 4 pins in the 48 can slip between the rubber housing and the plastic plug itself. When you look at the end of the 4 pin connector, if you can see 4 small indents on one side of the connector you have slid the pins into the side. In the future be sure that the connector is directly in line with the pins before pushing the connector in place.

7. The TFR program stores a number of system variables and parameters in a file called SETTINGS. If this file becomes corrupted, TFR will act erratic. You can delete this file and TFR will regenerate it when it finds it is no longer there.

If the above solutions do not solve your communication problems, the indication would be that your problem is with your PCs RS232 port. You should test that port by sending data to another RS232 device or by taking your PC to a computer repair shop.

TROUBLE SHOOTING

If you are using Kermit as your communication software, TDS cannot support your interface difficulties that are attributed to configuring Kermit. It is the users responsibility to properly configure Kermit for his system. It is difficult to determine where a communication problem is coming from when a system is improperly setup. TFR takes care of most of these difficulties.	Some helpful tips when using Kermit: • Set all Comm. parameters that are displayed in the TDS-COGO48 transfer screen, to the same values, in both the HP-48 and Kermit. • Use the transfer screen within the TDS-COGO48 program. Do not try to use Kermit that is built into the HP-48 operating system. When sending from the PC to the 48: • The file must have a POINT #, NORTHING, EASTING, ELEVATION, NOTE. All fields must be there, separated by a coma. There cannot be any other fields or data. No header, tailer, or formatting information in the file. The file must look just like it would if it was down loaded from the TDS-COGO48. • The file must have a suffix of .CR5. The "CR" must be entered in upper case. If you are still having problems, see your dealer about getting the TFR program. Most communication parameters and system problems are taken care of by TFR.

HP-48 HARDWARE (Reset / Batteries / Memory cards)

Your Problem	Solutions to Try
The HP-48 system is not responding Pressing the **[ON]** or **CANCEL** key will not bring it back to life. Try the solutions to the right stating a the top:	**KEYBOARD RESET:** Hold down the **[ON]** key and press the **[C]** key; Then release them both. Both the **[ON]** and **[C]** key must be depressed at the same time and then be release before the reset will occur. The calculator screen will blank and the **{HOME}** system stack should be displayed.
WARNING Several of the following suggestions can cause the HP-48 to a memory.loss. Do to the fact that the coordinate data is stored in the main memory, you should atempt to recover memory. If you see the mesage "Try to recover Memory Yes/No" press [A] for Yes first. If the HP-48 dose not return from trying to recover memory or if the data is corrupted you may need to say NO the the above prompt but all the data will be lost. Allways back up your data frequently!	
	HARDWARE RESET: On the back of the HP-48 there are 4 rubber pads that can be removed by gentle prying on there edge, with a fingernail. Under the upper right pad (as you look at the back of the 48) will be a hole with the letter R next to it. Straighten one end of a metal paper cli and insert it into this hole as far as it will go. Hold for one second and remove. Press the **[ON]** key. You may also need to execute a Keyboard reset at this time.
The TDS-COGO48 program is not functioning as it once did or one routine is acting incorrectly. Try the Solutions to the right one at a time, starting at **SYSTEM SHUTDOWN**	**SYSTEM SHUTDOWN:** This will shut the 48 OFF in such a way as to reset the operating system. No memory should be effected. Hold down the **[ON]** and the **[SPC]** keys at the same time. When you release them the calculator should turn itself OFF.

If the above solutions will not bring your 48 back to life try removing the 3 AAA batteries from the 48 and let it set over night with the batteries out. In the morning test the batteries and replace if necessary. Ifyour 48 is still dead contact HP for repairs.	**CLEAR MEMORY: When using the TDS-COGO48 software, all survey data is stored to the main memory and therefore will be be lost by a MEMORY CLEAR.**The Memory Clear function will erase all of the main system memory and any memory card that is merged with it. It will, also, clear the system libraries and erase all TDS-COGO48 setup parameters. You will need to re-enter the set up parameters. The procedure for clearing memory is to hold down the **[ON]** the **[A]** and the **[F]** keys all at the same time. Release them all and the 48 will display "**`Try to Recover Memory`**". Press **[A]** for YES and the 48 will try to recover the memory and a clear will not be performed. If you respond with an **[F]** for NO this will clear all calculator main memory.
The 48 expansion card is not recognized or is having a problems. You may be receiving one of the following prompts: **"WARNING Invalid Card Data"** **"No RAM Card in Port 2"** **"Low Battery in Port 2"**	Try the following: • Cleaning the gold contacts on the end of the card. If the card has a stainless steel plate it will slide up under the cards case to reveal the gold contacts. Clean these contacts with an alcohol damp (not wet) cotton swab. • With the HP-48 OFF, remove the card and reinstall it, making sure it is well seated in the port.

Battery	Recommended replacement schedule
HP-48 Main (AAA)	Typically, every 30 days when used as a data collector.
RAM card (Lithium)	Once a year.

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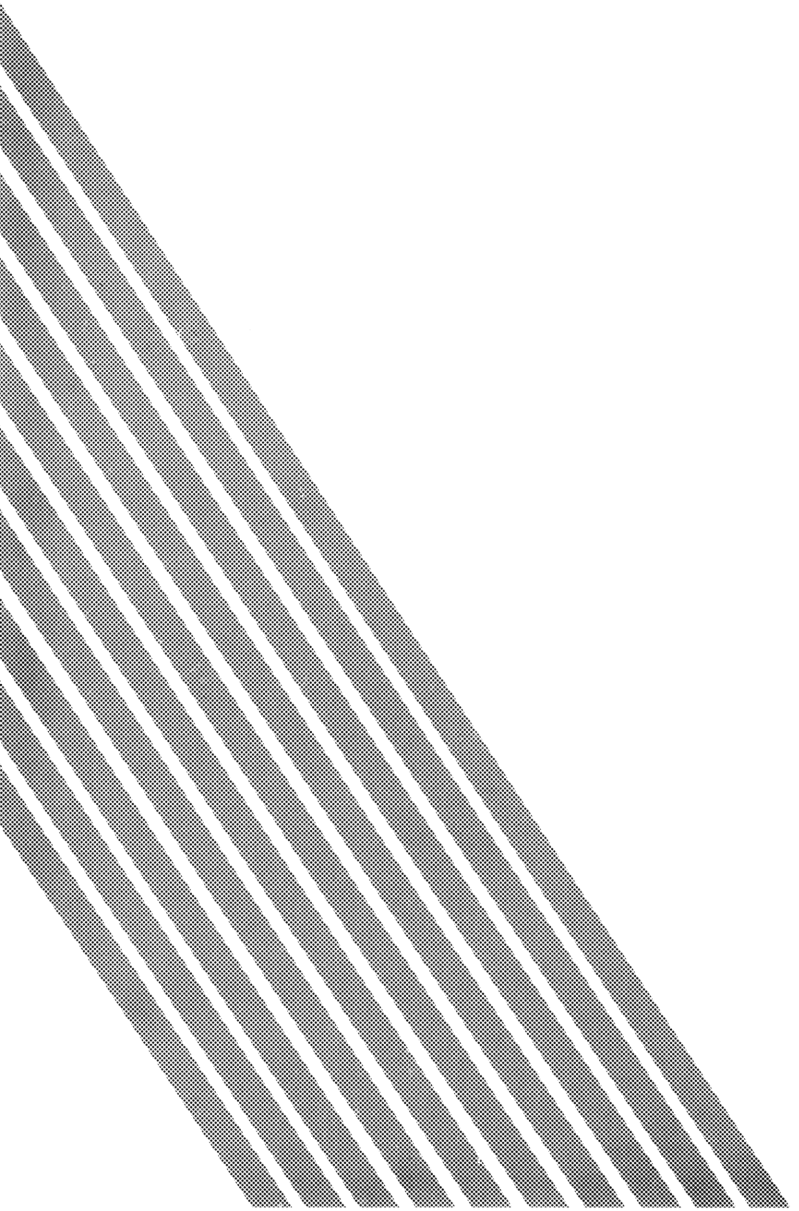

TRIPOD DATA SYSTEMS, INC.
1853 S.W. Airport Road, P.O. Box 947 • Corvallis, Oregon 97339-0947
(503) 753-9322 / **(800) 426-8026**