TRIPOD DATA SYSTEMS, INC.

TDS-48GX

Surveying Card User's Manual

TDS-48GX

Surveying Card

User's Manual

For use with the HP-48GX

TABLE OF CONTENTS

CONTENT

CONTENT

REFERENCE MANUAL

CONTENT

CONTENT

CONTENT

CONTENT

1. INTRODUCTION

In this chapter, you will become familiar with the TDS-48GX Surveying Card; you will install the card in your HP-48GX Handheld Computer; you will learn about its general features and capabilities; and you will be introduced to the organization and content of this manual. Those users that already own a TDS-48SX or are familiar with its use should at least review the section on the differences between the 48-SX and 48-GX and the beginning of chapter 2.

WELCOME TO THE TDS-48GX

The TDS-48GX is an IC (Integrated Circuit) Card for the HP-48GX 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-48GX 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 certainly true for the typical land surveyor. By using the TDS-48GX Surveying Card in conjunction with your HP-48GX, you will be able to take advantage of all of the hardware features of the 48GX in your day-to-day surveying work without having to open the 48GX manuals. This TDS-48GX Manual contains all of the information you need to experience the productivity improvements in your work afforded by this technology. The TDS-48GX converts your HP-48GX into a powerful field computer that provides four basic functions needed by the professional land surveyor:

1) The TDS-48GX may be used to collect raw data observations in the field either manually by keying them in or automatically by connecting the product to an electronic total station that uses an RS232 interface. These observations are converted to three dimensional coordinates as they are obtained.

2) Since the coordinates of your observed points are available in the field, 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) You may use the TDS-48GX to stake out your design points in any of several modes. Points may be staked by point number, by station and offset from a center line of a right-of-way, or by slope staking.

4) 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 and TFR-Link™ programs also give you the ability to convert your coordinate data (TFR) and raw data (TFR-Link) 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-48GX is the following:

1) 1 HP-48GX Scientific Expandable Calculator.

2) 1 TDS-48GX Surveying Card.

3) 1 TDS-48GX Keyboard Overlay.

4) One of the following:
    - TDS 128k-byte GX RAM Card
    - TDS 256k-byte GX RAM Card
    - TDS 512k-byte GX RAM Card
    - TDS 256k-byte Multi-Memory™ Card
    - TDS 512k-byte Multi-Memory™ Card
    - HP-82215A 128k-byte RAM Card

In addition, if you want to connect your TDS-48GX to your office PC, you will need:

5) 1 TDS PC to HP-48 cable or HP-82208A opt.1AW Cable.

6) 1 TDS TFR PC Program (see note below).

If you want to connect your TDS-48GX to your electronic total station, you will need:

7) 1 TDS-48 Instrument Cable.

8) 1 TDS-48 Tripod Bracket.

NOTE:

> The TDS TFR PC Program will provide for data communication between your PC and your TDS-48GX. 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.

INSTALLING YOUR TDS-48GX SURVEYING CARD

Installation of your TDS-48GX Surveying Card and the associated RAM Card is simple and straight-forward. However, you should follow these installation instructions exactly as they are presented here:

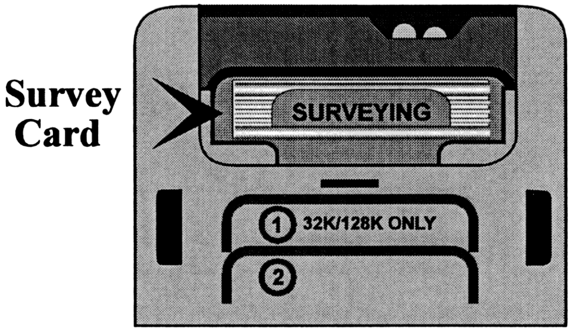
Be certain that you have three AAA alkaline battery cells properly installed in your HP-48GX before you begin the card installation process. If you have no cards plugged into your HP-48GX, you may go to step 3.

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

Step 2: Remove any IC cards you may have plugged into your 48. **This will cause a system memory loss if your plug-in RAM is configured as part of the main system RAM.**

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

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

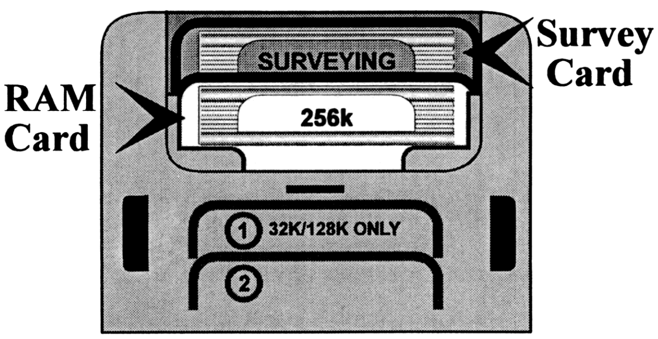


Step 5: Turn the 48 **[ON]** & enter α α **T D S 4 8** **[Enter]**.

Step 6: The following messages will appear on the display as the installation is taking place:

"Installing Library"
"Completed"
"Now insert RAM card"

Step 7: When prompted to insert your RAM Card, turn your HP-48GX **OFF** and remove the Surveying Card from Port 2. Insert the **Surveying Card** in port 1 and the **RAM card** in port 2. Turn your 48 **[ON]**. You should now have the TDS-48GX survey card in port 1 and a RAM card in port 2.



Step 8: Re-enter α α **T D S 4 8** **[Enter]**. Your TDS-48GX should now be properly configured and running.

Step 9: Place the TDS-48GX Keyboard Overlay on the HP-48GX's keyboard. The small tabs on the edges of the overlay fit into slots on the keyboard.

NOTE:

> You will need to repeat this installation procedure whenever your HP-48GX experiences a memory loss. Perform steps 3 through 8. It is advisable to carry the installation card with your TDS-48GX system in the event that you incur a memory loss.

Step 10: The first time that you install a RAM card which has not been used previously with TDS-48GX, the unit will prompt you with the message "**Can I erase all data in port 2? [Y/N]**". Be certain that you do not want any information. All data stored on this card will be lost when you press **[Y]**. In order for the program to continue you must enter **[Y]**.

Step 11: 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-48GX. If you have installed the RAM card properly and you get a "No RAM card in port 2" error message, you probably have the write protect switch on you RAM card set. Try adjusting this switch which is located on the top edge of the card.

NOTE:

> For the remainder of this manual, we will adopt the convention of using the term TDS-48GX to refer to the combination of a TDS-48GX Surveying Card installed in an HP-48GX with a RAM Card.

USE OF THE TDS-48GX SURVEYING CARD WITH TDS MULTI-MEMORY™ RAM CARDS

Hewlett-Packard makes available RAM cards for the 48GX in two sizes, 128k-bytes and 1M-bytes. In addition, TDS has 128k, 256kand 512k RAM Cards. With the TDS-48GX, you can also use Multi-Memory™ RAM cards from Tripod Data Systems that are made for the HP-48SX. Multi-Memory™ Cards come in either one of two sizes, 256k-bytes or 512k-bytes. These cards will accommodate up to 6000 or 12,000 three dimensional points with descriptors, respectively.

When used with the TDS-48GX software, the Multi-Memory™ RAM Cards is the same as other RAM cards. When prompted to insert a RAM card, simply install the Multi-Memory™ RAM Card in port 2 of your HP-48GX. The software will complete the configuration. It is not necessary for you to manipulate the bank switching functions as described in the instructions that come with your Multi-Memory™ Card . ***However, be sure to read the note below.*** For users who have both an HP-48SX and an HP-48GX there is an other advantage to the . Multi-Memory™ RAM Cards can be swapped between the 48GX and the 48SX with full use of the data in both systems. This applies only to the Multi-Memory™ RAM Card and not the TDS-48GX survey program ROM cards. The ROM cards can only be used in the 48 for which they were programmed. The following table will help in determining compatible memory cards:

TYPES OF RAM CARDS:	**COMPATIBLE SYSTEMS:** (when using the TDS surveying software)	
128k RAM cards (all manufactures)	**HP-48GX**	**HP-48SX**
256k and 512k Multi-Memory™ RAM cards (TDS)	**HP-48GX**	**HP-48SX**
256K and 512k GX RAM cards (TDS)	**HP-48GX**	

NOTE:

The HP-48SX Multi-Memory™ Card **cannot** be used in the HP-48GX with software other than the TDS-48GX surveying program. **The HP-48GX system is only aware of 128k of a Multi-Memory™ RAM Card at any one time.**

INTRODUCTION

** Caution **

Any memory card that has TDS-48GX Survey data stored on it, should not be used by any other 48 software. If you store anything from the HP-48GX system, to a Memory Card that has been used by the TDS-48GX software, it will clear all TDS-48GX survey data from the card.

RUNNING THE TDS-48GX

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

When the TDS-48GX Surveying 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-48GX, 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.

NOTE:

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-48GX, 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-48GX in the next chapter: Getting Started.

Now, in alpha mode, type **[T] [D] [S] [4] [8] [ENTER]**.
Use of the **[ENTER]** key will clear alpha mode.

You should now see the Main Menu of the TDS-48GX.

```
  < Select G to S >
G Open/Edit a job
H Setup menu
I Stake out
J Traverse/Side shot
K Show directory
L Trig. leveling
```

MORE					EXIT

Once you have activated the TDS-48GX software, the TDS-48GX will remain in control of the system until you intentionally return to the standard HP-48GX 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-48GX

If you wish to exit from the TDS-48GX and return control of the system to the standard HP-48GX 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-48GX stack; entering **[N]** will return you to the TDS-48GX main menu. If you exit the program, you may return by repeating the instructions on running the TDS-48GX, given in the previous section.

NOTE:

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

SPECIAL NOTICE
FOR USERS OF TDS-48SX SURVEYING CARDS:
Differences between the 48SX and the 48GX

The TDS-48GX Surveying Card that came with this manual is Version 4.0 or later. Because of some fundamental differences between the Memory in the HP-48GX and the HP-48SX, the GX Surveying Card is not compatible with earlier versions. While Version 4.0 can recognize data files created by any vintage of Surveying Card, TDS-48GX Surveying Cards cannot be used in a HP-48SX.

In the TDS-48GX, a number of new functions have been added. The following are global in scope or are available wherever they are applicable throughout the program:

Direct Access keys:	Each key on the HP-48GX has been assigned a function from within the TDS-48GX program. By pressing the purple shift key and a specific Direct Access key, the program will jump directly to that function. See Chapter 2 for more details.
Auto Inverse:	When a field is expecting a direction, (azimuth or bearing), a distance or an angle, you can enter point numbers to define the parameter and the TDS-48GX will calculate the value needed. For direction or distance, enter two end points separated by a "-" (i.e. 2-53). For an angle, enter the first end point, the center point and the other end point separated by "-"s (i.e. 3-16-4). See Chapter 2 for more details.
Edit Descriptor Lines:	This adds the ability to scroll through and edit the prompted descriptor field. It *will not* edit a screen descriptor field. With the alpha [α] key off, the [←] and [→] keys will scroll you back and forth in the descriptor line. Turn the [α] on, and you can insert text at that point. See Chapter 3 for more details.

The Following capabilities have also been added:

Delete points:	The ability to delete a point or a range of points has been added.
Rename job:	A job, stored within the TDS-48GX, can now be renamed.
Survey Adjustments	
Change scale:	The ability to change the scale of a job.
Angle Adjustment:	An Angle adjustment routine.
Curve solutions	
Known PI & Tangt:	This routine will solve for the PC and PT if given a PI and Forward tangent.
Through 3 points:	You can solve for a curve given three points on the curve or the two end points and its radius point.
Compute radius pt:	This routine will compute the radius point when given the PC, PT and the radius.
Traverse / Sideshot	
Repetition Shots	Two new repetition routine have been added:
Shoot from 2 ends:	A Shoot from two ends function lets you take average reading from each end of a foresight.
Radial Sideshots:	The Radial Sideshots routine lets you take direct and reverse shots at a series of foresights.
Record Mode:	The TDS-48GX can be set as a data logger, controlled by the total station.
Prompt for an HI:	When you change occupied pts. the TDS-48GX will prompt for a new HI.
Collimation:	You can enter or calculate the collimation error of your instrument and adjust your observations accordingly.
Suggest next point #:	The TDS-48GX will automatically suggest an unused point when a new point number is needed.

INTRODUCTION

The Following routine have been changed:

Off center shots:	The Off center shot routines, now use a menu/screen convention. This gives the user more flexibility and control over the order in which data is collected.
Slope stake:	Greater flexibility has been added to the staking and storing of reference points.
2 Pt resection:	The ability to flop the scope and take reverse readings was added.
Prompt for HR:	The TDS-48GX will allow you to be prompted for the height of rod after a shot has been taken
Compass rule:	The compass rule is modified to allow it to adjust the elevations of a traverse as well as the coordinates.

HOW TO LEARN THE SYSTEM AND HOW TO USE THIS MANUAL

The best way to learn the TDS-48GX 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-48GX which has been widely accepted within the surveying community. The TDS-48GX utilizes a combined "Menu"-and-"Screen" user interface. Screens make appropriate use of the HP-48GX's "softkeys". These six keys across the top of the keyboard are defined as is appropriate to each job. A one word explication 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-48GX is to go ahead and press some keys. See what happens. You can't hurt the TDS-48GX.

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-48GX 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-48GX. It is organized by class of function. Having mastered the basic operation of the TDS-48GX by learning the "rules of the road" and by following the example problems, you should then need to use the Reference Manual only to answer specific questions about detailed operations of a particular function.

The Tutorial is designed with three types of users in mind: the user who is already familiar with a TDS data collector product and simply wishes to learn the new features of the TDS-48GX; the user who wants to spend a limited time learning only the data collection functions and get into the field to use his new tool. This person, of course, is committed to spending his evenings to cover the rest of the field computer features. And, the user who has a desire to be familiar with the entire capability and power of the TDS-48GX.

Let's address each of these: first the experienced TDS user who has just received his TDS-48GX. You could use the TDS-48GX just as you used your TDS-48SX but you would miss out on several powerful features that have been added to this new software. Go back to the section in this chapter on the differences between the 48SX and the 48GX and look up the reference at the end of each description to familiarize yourself with each change.

For those who need to get out and collecting data in the field immediately, Study chapters 1,2 and 3 to get an overview of the layout of TDS's software and a introduction to field work. It is strongly recommended that you take the time to complete the remainder of the tutorial as soon as possible so you will be familiar with all the capabilities of your new tool. If you are not aware of all of the TDS-48GX's capabilities, you will be less likely to use them when the need arises. In addition, if you wait until you are in need of a feature before learning about its function, you are less likely to have the time to learn it then.

INTRODUCTION

Lastly, for you who want to learn the whole system, simply run through the entire tutorial. We strongly recommend this approach. The tutorial is set up to be most efficient when used in order from chapter one to the end. However, after the first three chapters, the remainder of the tutorial can be used by chapter in any order you wish.

The tutorial will not cover every screen or routine in the TDS-48GX; 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-48GX is the best way to learn it.

For TDS-48GX users who find that they would like to maximize the use of their data collector by using a companion software in a PC, Tripod Data Systems offers **Easy Survey**. **Easy Survey** looks and acts as your TDS-48GX Survey 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-48GX Survey 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-48GX. You will initialize the unit by setting the correct time and date and by selecting the various devices with which your TDS-48GX will communicate. You will learn how the features and functions in the TDS-48GX 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-48GX your batteries and your TDS-48GX Surveying Card; have initialized the libraries; and, have installed a RAM Card. For installation instructions see Chapter 1 - Introduction.

RUNNING YOUR TDS-48GX

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

```
{ HOME }
4:
3:
2:
1:
```

Now press **[α] [α] [T] [D] [S] [4] [8] [ENTER]**. The TDS-48GX Surveying Card has now taken over control of the machine. You will see the MAIN MENU of the system which looks like:

```
  < Select G to S >
G Open/Edit a job
H Setup menu
I Stake out
J Traverse/Side shot
K Show directory
L Trig. leveling
MORE                    EXIT
```

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-48GX 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-48GX 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-48GX 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-48GX, 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-48GX returns to the previous MENU in the MENU "tree". Finally, you arrive back at the first display of the MAIN MENU.

NOTE:

In the HP-48GX, 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-48GX 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:

```
                          Solving Horiz Curve
          Radius /
   Degree / Delta =>     >Radius  :  100.000

elta / Length / Chord => >Delta   :  135.000
  / Tangent / Mid ord
                         Definition:> Arc           <= Arc / Chord
                 | SOLVE |      | LAYOU |      |      | EXIT |
```

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
```

					EXIT

NOTE:

> All angles in the TDS-48GX 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 **[EXIT]** will show you the last computed curve parameter, the mid-ordinate (61.732). Press **[EXIT]** again 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.

```
Radius   : 114.592
Length   : 200.000
Chord    : 175.564
Degree   : 50.0000
Delta    : 100.0000
Tangent  : 136.565
External: 63.681
                                        EXIT
```

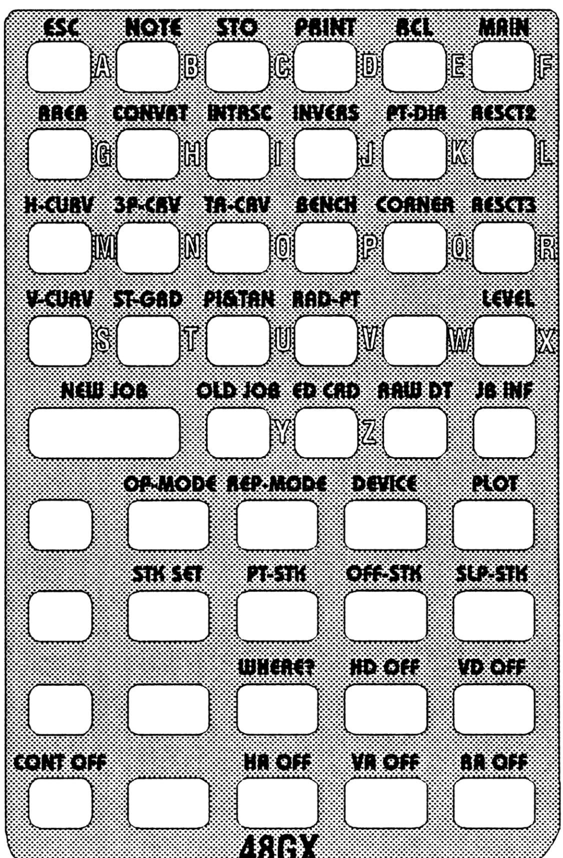
NOTE:

A ">" character in front of any prompt in a TDS-48GX screen allows you to change the prompt to another option by scrolling through options with the horizontal cursor keys.

THE KEYBOARD OVERLAY

Your TDS-48GX 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 function on the 48 which are not used by the TDS-48GX. The overlay also displays the shifted function of each key (in purple) for direct access to many of TDS-48GX's most-used routines. The overlay appears as shown:

Overlay for TDS-48GX:



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-48GX 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-48GX and a simple description of what each does:

Key	Function	Description
A	**ESC**	Escape temporarily from the TDS-48GX program and return to the main operating system of the HP-48GX. S the **ON** or **CONT** key to return to the TDS-48GX
B	**NOTE**	Enter a NOTE in the Raw Data file.
C	**STORE**	Store a value to the Clipboard register.
D	**PRINT**	Print the current screen to an Infrared Printer.
E	**RECALL**	Recall a value from the Clipboard.
F	**MAIN**	Return to the Main Menu from wherever you are in the TDS-48GX.
G	**AREA**	Compute the area of a parcel of land.
H	**CONVRT**	Convert Azimuths to Bearings or Vertical angle and Slope distance to Horiz. distance and change in elevation.
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	ST-GRD	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		
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	RAW DT	Provide a mechanism for reviewing the raw data file.
←	JB INF	Provide for a way of reviewing many of the important parameters of the currently active job.
9	DEVICE	Establish manual input or communication with an electronic total station.
8	REP-MODE	Establish the technique to be used in acquiring angles and distances in your survey.
7	OP-MODE	Set the operating modes.
6	OFF-STK	Stakeout a right-of-way by specifying the station on the center line and offset distance from the center line.
5	PT-STK	Interact with your gun and your rod man to performing a radial stakeout.
4	STK SET	Establish the setup parameters of the offset stakeout.

3	HD OFF	From Traverse, enter the horizontal distance offset mod
2	WHERE?	Help the rod man to quickly find the next point, relative to his own point of view, during a point stake.
1		
0		
÷	PLOT	View a plot of a block of points in the TDS-48GX screen display.
*	SLP-STK	Slope stake a road.
-	VD OFF	From Traverse, enter the Vertical distance offset mode.
+	RA OFF	From Traverse, enter the Right angle offset mode.
ON	CONT	Return to the TDS-48GX program after ESC to the operating system of the HP-48GX.
•	HA OFF	From Traverse, enter the Horizontal angle offset mode.
SPC	VA OFF	From Traverse, enter the Vertical angle offset mode.

TOP-ROW SHIFTED FUNCTION KEYS

The six 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]**, **[NOTE]**, **[STORE]**, **[PRINT]**, **[RECALL]** 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-48GX program and return to the main operating system of the HP-48GX. This function will also "bring with it" the value of the field at the current cursor location and loads this value into the HP-48GX 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-48GX, 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-48GX to the operating system of the 48GX. 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-48GX, 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.

NOTE:

> 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]** keys. If **HALT** is not displayed, you must have accidentally **[EXITed]** the program; Rerun the TDS-48GX program by entering α α T D S 4 8.

[NOTE] - **[B]** The **[NOTE]** function will allow you to key in arbitrary text information into the raw data file of the active job. At any time during your work, if you would like to record a note, such as the date, names of your crew or any other pertinent information, press **[B]**. You will then be able to key in text information which will be stored in the raw data file as a note.

[STORE] - **[C]** The **[STORE]** 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 **[STORE]** or **[C]** keys. The value can be moved to another field using the **[RECALL]** key (see below). This function is useful in transferring data from one screen to an other. 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 **[STORE]** 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-48GX at any time that you want a hard copy of your work.

[RECALL] - ↩ **[E]** The **[RECALL]** 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 **[RECALL]** 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-48GX. 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-48GX and identify the kinds of surveying problems that can be solved with the TDS-48GX, 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-48GX 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-48GX 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

N

NW=4	NE=1
SW=3	SE=2

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.

When you are prompted for a descriptor you can edit the text interactively. When the prompt first appears, the cursor sits on the first character of the field, and the HP-48 will be in the alpha mode. If you enter text while the cursor is on the first character, the existing descriptor, if there is one, will be removed and the text you enter will be all that is left. On the other hand, if you press the alpha key to take the HP-48 out of alpha mode and then press the [←] or [→] arrow keys, you can scroll within the field. At this point, the text in the descriptor field is fixed. If you scroll to the middle of a descriptor and put the HP-48 back in alpha mode, as you enter a character it will be inserted at that point. All characters to the right will be move one place to the right. You can switch in and out of alpha mode to enter text or use the cursor keys as often as you like.

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-48GX is to set up the data collector 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-48GX as soon as possible. The present section of the manual will illustrate the use of the menus and screens by taking you through some of the common setup routines. At the end of this section, you should have the unit set up for your particular equipment and application. Just as importantly, you should be familiar with the way menus and screens in the TDS-48GX interact.

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

You should now see the Setup Menu which appears as:

```
Setup Menu
G Time / Date
H Devices
I Operating modes
J Repetition modes
K Select control file
L Deselect control F
```

					EXIT

SET THE TIME AND DATE

Sooner or later you will need to set the time and date in the machine.

Path:	Press [G] and see the Time and Date Screen:

```
  Set Date and Time
Date: ##-##-####
Time: ##:##:##
Hours to GMT:    0
Time + sec:   0.00
```

SET	T+S		CLCK		EXIT

NOTE:

> Throughout this manual we will use the convention of displaying the "#" character in any field on the screen where it is not possible to predict what your particular unit will show. In the screen above, your unit will "wake up" with some time and date shown in the top two lines, but not the #s that are used in this example.

Like all of the other screens, the time and date screen is discussed in detail in the Reference Manual. However, this screen is included here to reinforce your understanding of the format of screens in general, and, in particular, how they work in conjunction with the four cursor keys and the six "soft" keys.

Notice in this screen that you cannot move the scroll bar to either of the top two rows. These rows display the *results of computations* . They are not fields that may be modified *directly* from keyboard entries. In the screen above, the other

two data entry fields will accept numeric input from the keyboard. With the vertical cursor keys, move the scroll bar to the appropriate field and key in the desired numeric data from the keyboard. These particular fields will accept numeric data only. If you attempt to key in alpha data, the TDS-48GX will reject it. This is another important feature of the unit. Only acceptable data types are permitted in any data field in the machine.

Now, explore the "SOFT" keys. The "SOFT" keys are actually commands to tell the TDS-48GX to perform some calculation or function and report the results in the answer-field in the screen. To set the date and time, press **[SET]** and follow the prompts in the screen.

Step 1: First key in the current date as MM.DDYYYY, where MM is the month; DD is the Day; and, YYYY is the year. Then press **[ENTER].**

Step 2: Next, key in the time in 24-hour format as HH.MMSSSS, where HH is the hour; MM is the minute; and, SSSS is the seconds. Press **[ENTER].**

The TDS-48GX will display the new date and time in the top two rows of the screen. Now press **[CLCK]**. The time will now be updated continuously. If you intend to do sun shots, you should check this time against a precise time standard and note how many seconds and fraction of seconds to add to bring the machine's time in synchronization with precise actual time. Then, press a key to break the continuous display.

Step 3: Move the scroll bar to the Time + sec : data line. Key in the time to be added. If you need to subtract time, key in a negative number by using the "-" key. Press the **[T+S]** "soft" key.

Step 4: Repeat this process until you have an accurate time being displayed in the screen.

This procedure of accurately setting the time in the HP-48GX should be done just before doing a sun shot due to the fact that the HP-48GX clock is not accurate over a long period of time.

Step 5: Finally, move the scroll bar to the Hours to GMT data field. Key in the number of hours that would have to be added to the time in your time zone to equal Greenwich Meridian Time. Press **[ENTER]**. This parameter is required if you plan on using your TDS-48GX for doing sun shots in the field.

NOTE:

> All dates are entered in the format MM.DDYYYY where MM is the month; DD is the day; and, YYYY is the year. Time is entered in the format HH.MMSS where HH is hours; MM is minutes; and, SS is seconds.

Now you have set the proper time and date into your TDS-48GX. When you are finished, press **[EXIT]** to return to the Setup Menu. Next, you'll use the Device Setup Menu.

DEVICE SETUP

Path: From the Setup Menu, press **[H]** and you'll see:

```
  Device Setup
Instrmnt: ><<Manual>>
  Model  : >
Instr dist unit:>Feet     <= Feet / Meter
Dist measur:>Single       <= Single / Averaging

| | COLLI | | FAST | | EXIT |
```

This is the menu from which you will establish the brand and model of the gun to which the TDS-48GX will be connected. You can also establish the units used by the total station and measurement mode of the gun; single shot or averaging mode.

In this particular screen, notice that all of the data fields have the ">" symbol in the actual data field itself. This indicates that these particular input fields allow only a limited number of input values, and that, rather than keying them in, you may review and select the proper one by using the horizontal cursor keys. Note that the Instrument name and Model lines of the screen are interactive. With the scroll bar on the Instrument line, pressing the **[➔]** key will scroll through the instrument name choices. Also, the list of model number options in a particular Model line will be restricted to those that go with the particular brand of instrument.

Step 1: With the scroll bar at the instrument line, press **[➔]** repeatedly to see the selections. When you have the proper brand name of total station in the display, press **[↓]** or **[ENTER]** to move to the Model line.

Step 2: You may now scroll and select the proper model of your brand of total station.

After you have completed the Device Setup Screen, press **[EXIT]** to return to the Setup Menu.

OPERATING MODES

The operating modes screen is used to allow you to establish different conditions that are used in the management of the TDS-48.

Path: From the Setup Menu, press [I] and you'll see:

```
  Operating Modes
Azimuth: >N. azimuth        <= N. azimuth / S. azimuth
Scale factor:1.0000000
Earth curve adj.:>OFF       <= OFF / ON
Storing pause:   >OFF       <= OFF / ON
Dist unit: >Feet            <= Feet / Meter
Angle unit: >Degree         <= Degree / Grad
MORE |  |  |  |  | EXIT
```

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

Step 5: 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 data collector to any combination you need. e.g. your gun reads in feet but you want it stored in meters.

Step 6: Pressing **[MORE]** will bring up the following screen. There you can set a switch that determines whether the data collector will prompt you for a rod height after each shot. We will demonstrate this in an example so set the Prompt for rod Ht: to YES

```
  OP Modes (cont.)
Beeper:> ON                      <= ON / OFF
Prompt for rod Ht:>Yes           <= Yes / No
Prompt for description
 in sideshot:      >Yes          <= Yes / No

|     |     |     |     |     | EXIT |
```

REPETITION MODES

After you have completed the Operating Modes Screen, press **[EXIT]** to return to the Setup Menu. The next screen is the Repetition Modes screen which allows you to set the sequence to be used in acquiring angles and distances in your survey.

Path:	From the Setup Menu, press **[J]** for the Repetition Modes Screen. You can access also this screen from the Traverse/ Side Shot Screen by pressing **[REP]** Repetition Modes Men and then **[K]**. The following screen is displayed:

```
Horiz angle mode:                Single / Directional /
       >Single                <= Accumulation
Vert angle: >Single           <= Single / Multiple
Dist mode:  >Single           <= Single / Multiple
Number of sets:  0
Angle tol(sec):    0.00
Dist tol(ft)   :   0.00
| MORE |     |     |     |     | EXIT |
```

Step 1: Horizontal angle mode can be set to one of three modes:

- *Single* - a single horizontal angle shot will be taken.
- *Directional* - the sequence of shots to determine the horizontal angle for each point is as follows: direct to the backsight; direct to the foresight; reverse (flop) the scope; reverse to the backsight; reverse to the foresight.

- *Accumulation* - multiple angles (windings) are taken to determine each horizontal angle. The value of the circle angle from each foresight reading is used as the circle angle for the next backsight; thus, accumulating the readings.

Step 2: Vertical angle may be set as either single or multiple readings to be averaged to determine the vertical or zenith angle for each point.

Step 3: Distance mode may be set to take either single or multiple distances to be averaged in the TDS-48 for each point.

Step 4: Number of sets is where you specify the number of readings to be taken for each multiple mode. If you choose a multiple mode, the number of sets must be entered as 1 or more. If you want to switch to single mode you need only set the number of sets to 0.

Step 5: Angle err (sec) and Dist. err (Ft) lets you specify the error among multiple shots that will be tolerated before you are alerted by the TDS-48GX that an error has occurred. When the units are feet, the distance tolerance is in feet. When the units are meters, the distance tolerance is in centimeters.

Step 6: Pressing **[MORE]** will allow you to set the order of the directional repetition shots. The sequence start with a direct to the Backsight then direct to the Foresight. You can select between taking a reverse to the Backsight then to the Foresight or taking a reverse to the Foresight then the Backsight second.

NOTE: To use the accumulation mode for horizontal angles, you must have a gun that has a lower motion screw or some other device that will allow you to move the gun through a horizontal angle without changing the circle angle reading.

Once your TDS-48GX has been set up, it is not necessary to set it up again unless you want to change one or more of the settings. You may change any of the settings at any time, even in the middle of a surveying job. TO RESET: locate the proper Setup Screen. Change the appropriate setup options. Proceed with the job in progress.

CREATING YOUR FIRST JOB

The TDS-48GX 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 to begin by pressing **[G]**.

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

This will present the New Job screen:

```
   New Job
Job name: SMITH
Raw data: >ON          <= ON / OFF
Start point: 1
Northing:5000.0000
Easting :5000.0000
Elev    :100.0000
```

CREAT					EXIT

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.

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-48GX 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-48GX *will* maintain a distinction between them. For example, name this job **SMITH.** The TDS-48GX 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: As you work in the field, the TDS-48GX will collect your field measurements and compute the coordinates (northing, easting, and elevation) of each of the points that you survey. These coordinates are computed automatically from the raw field data. The coordinates are then stored in the TDS-48GX under the job name you have set up; in this case, SMITH. However, you also have the option of having your TDS-48GX record your raw data. If you would like the TDS-48GX to record your raw data, just move the scroll bar past the raw data line of the display. If you do not want the raw data to be stored, move the scroll bar to the raw data line and press **[→]**. This will set the raw data field to OFF.

NOTE:

> The coordinates and the raw data are actually stored in different parts of the HP-48GX's memory. The coordinates may be viewed, modified, adjusted, overwritten, erased, used in CO-GO calculations, etc. On the other hand, the *raw data* may only be viewed, printed out, or transferred to an office computer. They may not be edited or modified in the field (only **deleted** *in full* if **RAW DATA** is turned **OFF**). Once a field measurement is taken, the raw data record is updated with the measurement. It may not be altered in the TDS-48GX.
>
> Because of this, it is recommended that you always have the raw data feature **ON** every time that you survey. With access to the raw data in the office, it will always be possible for you to recreate the original survey without returning to the field. This will be true no matter how altered the *coordinates* may have become.

Step 3: 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-48GX 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 4: 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 5: As you will learn when you examine a coordinate file, each point also may have a point descriptor or annotation of up to sixteen characters. The default descriptor for the staring point is START. If you would like to use something else, you may simply type in a new one. You will learn more on how to do this in the section on editing coordinates.

Step 6: Once you have the New Job screen properly configured, press **[CREAT]**. This command instructs the TDS-48GX to create the SMITH job as you have specified it in the screen.

NOTE:

> 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-48GX 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-48GX 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-48GX will establish the job SMITH. The TDS-48GX 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.

GETTING STARTED

OTHER JOB RELATED FUNCTIONS

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

```
    Job Menu
G Create new job
H Open existing job
I Current job info
J Edit coordinates
K Raw data file
L Delete job
M Rename File
N Delete points
MORE |  |  |  |  | EXIT
```

The number of jobs that you can store in your TDS-48GX 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:

```
   Point Data

Point    : 20
Northing: 5050.2860
Easting : 4550.8059
Elev     : 233.7100
Desc:BACKSIGHT
PT+ | PT- | STORE | RCL | UNUSE | EXIT
```

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] Raw data file** option brings up a menu that allows you to view Raw Data and create (turn on) or delete (turn off) Raw Data. In addition, this menu allows you to view, create or delete a descriptor file.

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

The **[M] Rename File** selection lets you rename a file. The first line prompts for the type of file When a CR5 file type is selected, rename will change the file name of both the CR5 (coordinate file) and RW5 (raw data file), if there is one, for the job named. The next two lines prompt for, the job to be renamed and the name it is to be changed to (See below). You can select a file from those stored within the HP-48GX's memory by pressing the **[FILE] [B]** softkey.

```
  Rename File
File type:> Coord.      <= Coord / PtLst / Text
Old Name:TEST
New Name:ABC

| START |  |  |  |  | EXIT |
```

The last option, **[N] Delete points,** lets you delete a group of points. The array of points can either be a range of sequential points entered with a starting and an ending point (see Below) or you can define a set of non-sequential points using a Point List. A Point List is a special file where you enter a list of points to be used by one of TDS-48's functions. We will discuss the use of Point Lists more in a later chapter.

```
Delete Points
>From point: 143
 To point: 156

| DEL | PTLST |  |  |  | EXIT |
```

3. SURVEY FIELD WORK

The first section of this chapter is designed to introduce you to the use of your TDS-48GX as a data collector. We will discuss in a general way how to collect data using the TDS-48GX. Then, you will survey the SMITH job in several ways using manual input. You will perform a boundary survey with single and repetitively observed points. You will learn how to do resections in the field. You will see how a topographic survey can be done with the TDS-48GX. This chapter also covers the field use of the TDS-48GX in doing sunshots.

INTRODUCTION

This chapter is designed as a introduction to the field use of the TDS-48GX. It assumes that you understand and have a working knowledge of your particular total station. This Manual will cover how to use the TDS-48GX to collect data from a total station in a general way. 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 you gun. (See Appendix B)

In this first section, we will discuss field work with a data collector, in a general way. With out going into detail we will look at collection data for a topo or traverse and radial stakeout for setting design points. Then, in the sections that follow we will review in greater detail, examples of each of the above. Due to the inability to perform different field exercises and still have uniform data, the examples in this section will be entered manually. We will try to tell you how manual entry will differ from the actual field work, but the data entry for the examples is designed to be done in the office.

This chapter is also a first introduction to field work. When you are familiar with the functions covered in this chapter, there are advanced field work chapters which cover auto linework and the stakeout routines. For your convenience, the chapters that follow this introduction to field work are designed to be stand-alone tutorials. They are used most efficiently when carried out in order, but you can review those that are of interest in any order. We recommend that you examine all the chapters in this Manual so you become familiar with all the capabilities of the TDS-48GX field computer.

QUICK START: an Overview of FIELD WORK

There are a couple of concepts related to the use of TDS-48GX that you should be aware of. First, the TDS-48GX is a 3-dimensional, coordinate geometry field computer with data collection capabilities. It has the option of storing or not storing Raw Data, but it always stores the coordinate data. This gives you the ability to perform various calculations and layout design in the field. This is important to understand: you can turn off raw data, but you cannot turn off coordinate data. In addition, you cannot turn off elevations.

Second, when entering field data manually 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. But, when gathering data from a total station, the gun must be sending and the data collector set to receive, Horizontal angle, Zenith angle and Slope distance. With modern surveying equipment, this is the form that the field data is originally observed in and is manipulated from there. Collecting this data gives the data collector the greatest accuracy and flexibility.

Data Collection

When beginning a traverse, topo or any field data collection the setup is the same. The first thing we need to establish is an occupied point. The coordinates for this point must be in the current job of the data collector. They can be assumed coordinates, a bench mark, calculated from an adjacent job or arrived at from any other source you may have. The TDS-48GX will support a control file which contains reference points that can be occupied or back-sighted. We will discuss more about this toward the end of this chapter. If the point you wish to occupy is not in the current job, you need to go to the Edit coordinate screen; **[ED CRD]** or & **[Z]**; and enter it. Any point in the current job can be an occupied point.

NOTE:

> If you have two or more points in your job file but you do not want to occupy any of them, you can set up your instrument on a convenient point and determine the coordinates of your occupied point using the 2-pt or-3 pt resection routine (**[RESCT2] [L]** or **[RESCT3] [R]**).
>
> Also, if you have assumed an elevation for your occupied point and have a bench mark or other known elevation in sight, you can use the Benchmark routine **[BENCH]** or & **[P]** to adjust the elevation of your currently occupied point. We will discuss each of these in detail later in this chapter.

The second reference we need is a backsight direction. This can be in the form of an azimuth, bearing or a second point stored in the job file. Due to the fact that the TDS-48GX collects a relative angle in the horizontal plane, angle right, you must specify a backsight direction. You can approximate or assume a backsight direction or you can use the sun shot routine to establish an accurate backsight. In the scenarios below, we will describe three different possibilities for defining a backsight.

Scenario:	**Solution:**
You have found two points on your lot and know the azimuth between them. But, you do not have coordinates for either.	Occupy one of them with assumed coordinates. Enter the azimuth between them as the backsight. Sight the other point and zero your instrument. Frequently, you may want to shoot the backsight point as your first foresight point so that you have coordinates for it. Simply proceed as explained above and take a shot at the backsight as the first foresight. The Angle right will be zero.
You have one point established on your lot but you know the azimuth to an observable reference.	Again, simply occupy your known point and enter the azimuth in the backsight. Sight the reference and zero your instrument. At this point you turn to your foresight and you are ready to shoot.

Scenario:	Solution:
You have only one known point on this job.	Here you have several options. One, you can simply assume an azimuth for the backsight and rotate the job at a later time when you have determined its orientation. Secondly, you could approximate a backsight and again rotate later. Or you can use the sun shot routine to determine an azimuth.

The foresight simply needs a point number under which it will be stored for future reference. At this point, you should also enter the height of instrument. The height of rod and descriptor can be entered now or after you fire the gun depending on how you set up your data collector.

Now, with this overview, typically you would set up on the occupied point and sight your backsight. Enter your backsight; then, zero your gun on the backsight; and, turn to the foresight. With your instrument sighted on your foresight, you simply press **[SIDES]** (the **[A]** key) or **[TRAV]** (**[D]**) to fire your gun and download your data to the TDS-48GX. (Some instruments require a key to be pressed on the total station. If this is the case with your instrument, you will be prompted to press a key on you gun. Simply follow the prompts.)

The **[TRAV]** key expects that you will be occupying your present foresight before taking another shot. It will set the OC, FS and BS point numbers accordingly. The **[SIDES]** key, on the

other hand, will only increment the foresight. As you traverse, if you use your immediately preceding occupied point as a backsight, the data collector will calculate the backsight direction for you.

NOTE:

If you cannot easily zero your gun on the backsight or if you want to orient your instrument to a true azimuth, you need to enter a backsight circle before turning to your foresight. Press **[BACK]** or **[C]** to move to the backsight screen and enter the backsight direction or point number as you normally would. Then, while pointing at your backsight, enter the circle reading of the gun or press **[CIRCL]** or **[E]** to electronically download the circle reading from the gun. You then, proceed with the process of taking a foresight as you would normally. When a shot is taken, the TDS-48GX will subtract the BS circle from the circle reading sent by the gun, resulting in an angle right.

TDS-48GX has the ability to adapt to the way you do surveying in several modes. The device setup, lets you specify your particular instrument and its distance and angle units. The operation modes setup allows you to specify the distance and angle units to be used in the data collector and several other parameters modifying the interaction between you and the data collector. The Repetition Modes screen and **[REP]** or **[B]** key in the Traverse/Sideshot screen let you set the type and number of repetitions you wish to take in obtaining a foresight. In the Traverse/Sideshot screen, the **[OFFCT]** or **[E]** key lets you pick from a selection of Off Center routines. These routines permit you to take foresight shots to point where you cannot set a rod.

Stakeout

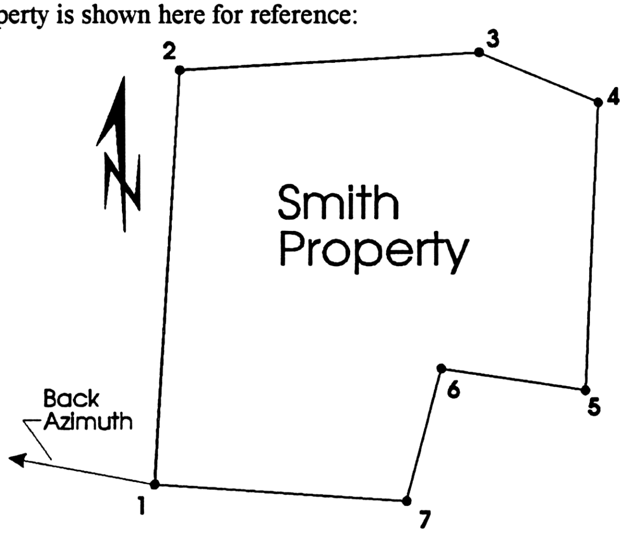
When setting up for a stakeout, the requirements are nearly the same as for data collection. You need an occupied point, a backsight direction (or point), and a foresight point number. The only real setup difference is that you need coordinates for each foresight stored in the current job. With stakeout, you setup on the occupied point; turn to the backsight; and, zero your instrument. At this point, the TDS-48GX will tell you the circle angle to turn to and how far out your rod man should go. With the rod placed at an approximation of this point you can shoot this point as many times as necessary to close in on the exact point. Between each shot, we give you a come or go distance that the rod man needs to move in order to zero in on the point to be staked.

TRAVERSING THE BOUNDARY OF THE SMITH PROPERTY

The remainder of this chapter covers several examples of the use of the TDS-48 in the field. As with other sections of this Manual, the general approach is cover some basic material and deal with both the theory of the operation of the TDS-48 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. 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. During actual use of the TDS-48 in the field, you would collect angle and distance data automatically from your electronic total station. Where appropriate, differences in procedure are presented in this chapter.

You are now somewhat familiar with the TDS-48GX. You have the unit set up for your equipment and methods of surveying. It's time to get started by working through a sample job called SMITH. It's the one that you created in the Chapter 2: "Getting Started". 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.

Your first task is to perform a 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 gun 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: (You will traverse the last three points using multiple horizontal angles.)

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

*The known *back azimuth* is 276^{o} 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
Desc:START
HI:  0.000 HR:   0.000
```

SIDES	REP	BACK	TRAV	OFFCT	EXIT

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

NOTE:

> If you have your TDS-48 set up to communicate with a total station, you should disable this automatic mode by selecting **[DEVICE]** or [9] for the Device setup screen; then use the horizontal cursor keys to adjust the Instrument scrolling prompt to **<<MANUAL>>**. This will allow you to enter your field data manually.

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	CHECK		FAST	CIRCLE	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 gun 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 Screen. Finish filling out this screen with:

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

taken from the table above.

The screen apperar 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
Desc:PT2
HI:   5.320 HR:   6.000
```

SIDES	REP	BACK	TRAV	OFFCT	EXIT

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

If you were collecting data electronically, you would be prompted for a descriptor. At this prompt, suppose "START" is in the display. If you simply enter "PT2", "START" would first be removed and you would left with only "PT2".

If you have set Prompt for HR to ON (in Operating mode screen) you would also be prompted for the rod height.

By filling out the screen and pressing **[TRAV]**, the TDS-48 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-48 will also display the coordinates for you.
Next, the TDS-48 will add these coordinates, along with the point descriptor, to the SMITH coordinate file. Next, it will add the raw data information from your Traverse / Sideshot Screen to the SMITH raw data file. The machine will 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-48 assumes that this is the continuing mode of operation and will build the screen after each shot accordingly.

NOTE:

> If you were in the field actually taking data automatically from your electronic total station, you would not key in the horizontal angle, zenith angle, or slope distance. Instead, you would build the rest of the screen (point numbers, and rod and instrument height) and then press **[TRAV]**. From the gun selected in the Setup Screen, the TDS-48 will collect the angles and distance before computing the coordinates and doing the other functions listed above. In this mode, the TDS-48 will prompt you to key in the point descriptor after the gun has taken the shot, but before the coordinates are computed and stored. Depending on the settings in your data collector, the TDS-48GX can prompt for the rod height as well.

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.

```
OC:2         FS:3
BS pt:1
>Ang right :262.5448
>Zenith ang:89.3236
 Slope dist:457.760
Desc:PT3
HI:5.43     HR:6.000
```

SIDES	REP	BACK	TRAV	OFFCT	EXIT

NOTE:

> From the standpoint of the TDS-48GX, the only difference between the **[TRAV]** and **[SIDES]** keys is that, after a sideshot, the data collector 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 next two corners into the SMITH job file. This will complet FS. Points 2 to 5. The last three traverse points will be entered using multiple readings.

TRAVERSING WITH MULTIPLE READINGS AND AVERAGING

To improve survey accuracy, you will often take multiple readings at each station and then average the results before computing coordinates. The TDS-48 will do this automatically for you with any one of the several commonly-used averaging techniques. The techniques supported include averaging horizontal angles - direct and reversed (flopped scope); accumulated horizontal angles (windings); direct and reversed zenith angles; and multiple distances. These techniques may be used individually or in combination. If you are connected to an electronic total station in the field, the TDS-48 will prompt you with the proper field procedure. It will also trigger the gun to take the appropriate readings at the proper time. To illustrate the techniques for taking multiple readings, let's finish the Smith job using directional multiple readings.

Step 1: First, set up the TDS-48 to use the directional method of recording horizontal angles. You can use the Repetition Mode Screen accessed from the Setup Menu or from the Traverse / Sideshot screen; press **[REP] [B]** and then **[L] Set Rep. mode**. Set your TDS-48 to read one set of angles for each shot. You will be taking a direct shot at the backsight then the foresight, and then a reverse shot at the backsight then the foresight. Altogether these shots constitute one set. Therefore, the number of sets is one. Be certain the second line of the screen reads "directional" and <u>not</u> "single" or "accumulation". You will employ a 30-second tolerance between angle readings. The distance error (tolerance) is immaterial because you will only use one distance reading for each point. The screen should now appear as:

```
Horiz angle mode:                Single / Directional /
       >Directional           <= Accumulation
Vert angle: >Single           <= Single / Multiple
Dist mode:  >Single           <= Single / Multiple
Number of sets: 1
Angle tol(sec): 30.00
Dist tol(ft)  : 0.50
[    ][    ][    ][    ][    ][EXIT]
```

Field Work

The last half of the field observations with multiple angles is shown in the table below. Let us take the rest of the traverse shots from this table in order to understand how the TDS-48GX works with multiple readings.

Back Sight Obser. [BS]	Occu -pied Point [OC]	Fore Sight [FS]	Height of Instru. [HI]	Height of Rod [HR]	Horizontal Angle (angle right) [HA]	Zenith Angle [ZA]	Slope Dist. [SD]	Note
0	5	6	5.35	6.0	277.4835	90.2926	223.98	PT 6
180.0012					97.4854			
0	6	7	5.40	6.0	92.4143	90.2746	233.88	PT 7
180.0009					272.4144			
0	7	8	5.42	6.0	261.2756	91.4405	387.25	Close
179.5946					81.2748			to PT 1

Step 2: Next, set up the Traverse /Sideshot Screen, using data for point 6. Before pressing **[TRAV]**, you only need to enter the OC, FS and BS points and the HR. The multiple reading routine will prompt you for the Angle right, Zenith angle, Slope Distance and HI in the proper sequence. Now, press **[TRAV]** and enter the data as you are prompted.

The sequence is important. In the field and using your total station to gather the data automatically, the gun has to be turned and/or flopped during the gathering of multiple data. Key in the required information in response to the prompts.

Step 3: You are first prompted for the direct backsight:

BS DIR 1:

Enter "0".

Step 4: Next, you enter the three foresight measurements in the direct orientation:

BS DIR 1: 0
FS DIR 1:
Slope dist: 223.98 [ENTER]
Horiz ang: 277.4835 [ENTER]
Zenith ang: 90.2926 [ENTER]

Step 5: The screen will clear and you enter the reverse orientation measurements:

Reverse!!
BS Rev 1: 180.0012 [ENTER]
FS Rev 1:
Horiz ang: 97.4854 [ENTER]

Step 6: At this time, you will be prompted for a descriptor and a default of "PT5" is displayed. Let us edit this default descriptor. Press the [α] key to turn off the alpha mode; use the [➔] to scroll to the "5". Now, press [α] to return to alpha and enter "6" and a **[Del]** to remove the "5". You have edited the descriptor.

```
Reverse!!
BS Rev 1: 180.0021
FS Rev 1: 97.4854
Set scope up right
Desc: PT5
```

SIDES	REP	BACK	TRAV	OFFCT	EXIT

Step 7: Prior to pressing **[ENTER]** after the descriptor, the screen should appear as shown above. At this point, the two angle-rights are averaged and point 6 is stored.

NOTE:

If you were connected to an electronic total station, the multiple angles and distances would again be collected automatically. However, the prompts are similar to the above example in order to inform you as to when to flip your scope.

Step 8: Continue entering the remaining two shots. The repetition routine will prompt you for all the data that is needed. You will not need to entered anything in the Traverse / Sideshot screen. When you come to the last (closing) shot, the TDS-48 will have the screen set up with point 8 as the foresight point. Even though you are closing back to point 1, you should enter the last shot as point 8. If you reset the foresight point as point 1, the TDS-48 will alert you to the fact that point 1 is already used; that is, it already has coordinates assigned to it. It will ask you if you want to overwrite these coordinates. By storing the closing point as point 8, you will be able to compare the ending and beginning coordinates to determine, among other things, the precision of the survey. You will also need these points stored separately to do a traverse adjustment. You will be doing adjustments in Chapter 6.

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-48 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 =>

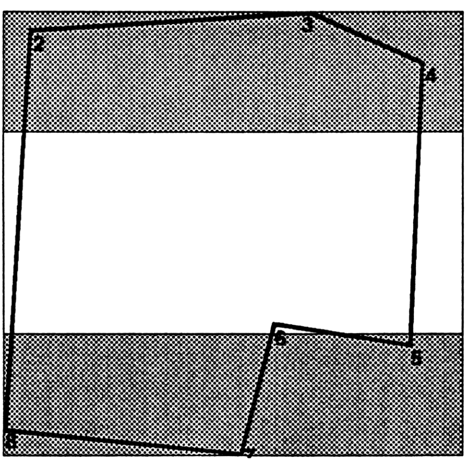
```
   Screen Plot
>From point: 1
To point   : 8

Plot pt number: >Yes
```

<= Yes / No

POINT	PTLST	LINES	SCALE	PRINT	EXIT

Step 1: Specify points from point 1 to point 7.

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 alows you to turn ON or OFF, the ploting 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-48 will automatically set the scale for all screen plots for that job. The TDS-48 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 AND RAW DATA

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:

```
   Point Data

Point    :1
Northing:5000.0000
Easting :5000.0000
Elev    :100.0000
Desc:START
```

PT +	PT -	STORE	RCL	UNUS	EXIT

You can use the **[PT +]** and **[PT -]** keys to review coordinates.

At this time, you may wish to see how the TDS-48 has stored your raw data. Press **[RAW DT] [DEL]** and then **[G] View R. Data**. Then, press **[TOP]** to move to the top of the raw data file. Your screen should look like:

```
JB,NMSMITH,DT5-3-1993,
MO,AD0,UN1,SF1.000000...
SP,PN1,N 5000.0000,E ...
OC,OP1,N 5000.0000,E ...
BK,OP1,BP0,BS276.2315...
LS,HI5.320,HR6.000
TR,OP1,FP2,AR86.5412,...
```

TOP	PGUP	PGDN	VIEW	NOTE	EXIT

Each line of the display is the first part of a complete line of a raw data entry. To see the complete line, use the vertical cursor keys to move the scroll bar to the line you want to view and press the **[VIEW]** key. The other lines of data will be temporarily removed, and the complete data line in question will be displayed.

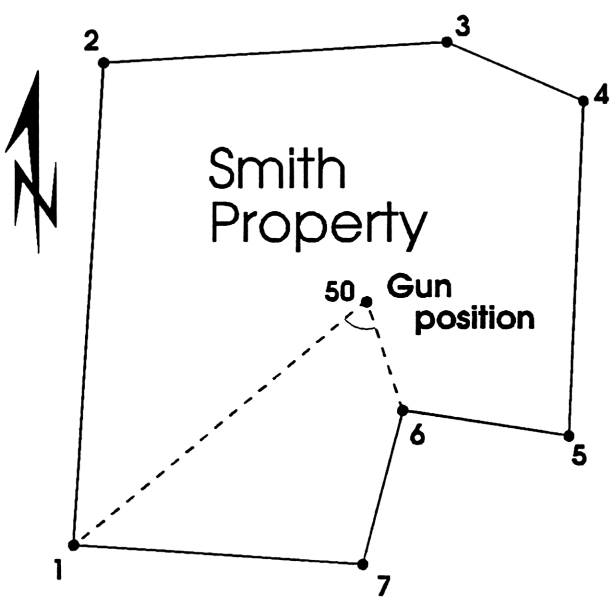
As you can see, the raw data file is rather cryptic. It consists of a series of two letter codes and data entries separated by commas. Each code indicates the nature of the data which follows it. Codes are used in the interest of conserving memory in your TDS-48. If you would like to decode your raw data screen, you will find a complete list of the codes in Appendix D of this Manual. Also, if you transfer your job to a personal computer and then print out your raw data file using the TFR software that is available from Tripod Data Systems, the codes will be decoded automatically. The raw data printout will then be much less cryptic.

If you would like to add arbitrary text information to your raw data file in the form of a note, press **[NOTE]**. You may also add notes to the raw data file from any other screen in the TDS-48 by pressing the global note function **[NOTE]** or **[B]**. The raw data file is a sequentially stored file. When any data, including a Note, is added, it is appended to the end. You cannot insert a note into the middle of a raw data file.

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 gun 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 gun 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) gun 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-48 can determine the coordinates of the gun position and store this information in the SMITH coordinate file. The figure below depicts the situation.



Field Work

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-48 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
```

Step 3: Again, press **[SOLVE]** from this screen. The TDS-48 will compute the coordinates of the new gun 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.

NOTE:

> As in the Traverse/Sideshot Screen, if you are connected to an electronic total station, pressing **[SHOT]** from each Resection Screen will trigger the total station to take the measurements. The data will be automatically loaded into the TDS-48GX.

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**.

```
                          Shoot Benchmark
                        Option: >Direct only      <= Direct & Rev /
   FS elev / FS pt =>   >FS elev: 281.372             Direct only
Zenith / Chng elev =>   >Zenith ang:87.2544
                        Slope dist:982.473
   OC elev / OC pt =>   >OC elev:237.879
                        HI: 5.420  HR: 6.000
                     SOLVE |     | FSELV |     |     | EXIT
```

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.

NOTE: 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.

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]	Note
6	50	51	5.42	6.0	77.2701	91.0638	350.43	PT 51
6	50	52	5.42	6.0	98.3511	90.2829	106.23	PT 52
6	50	53	5.42	6.0	166.4557	90.4605	378.20	PT 53
6	50	54	5.42	6.0	221.0823	90.2225	237.72	PT 54
6	50	55	5.42	6.0	252.4512	90.4518	55.39	PT 55
6	50	56	5.42	6.0	319.5833	88.5442	287.43	PT 56
6	50	57	5.42	6.0	4.1315	88.3356	99.02	PT 57
6	50	58	5.42	6.0	25.0702	89.3258	253.09	PT 58
6	50	59	5.42	6.0	56.4200	90.2459	182.14	PT 59

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]**.

NOTE:

> Be sure to set the repetition mode off before pressing **[SIDES]** or you will be prompted for multiple horizontal angles. Press **[REP]** **[B]** to bring up the Repetition menu, then **[L]** Set Rep. mode to display the Rep Mode screen. Enter "0" in the number of sets field and the repetition mode is turned off. You do not need to set the Horiz angle mode to single, 0 set means there is no repetition.

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

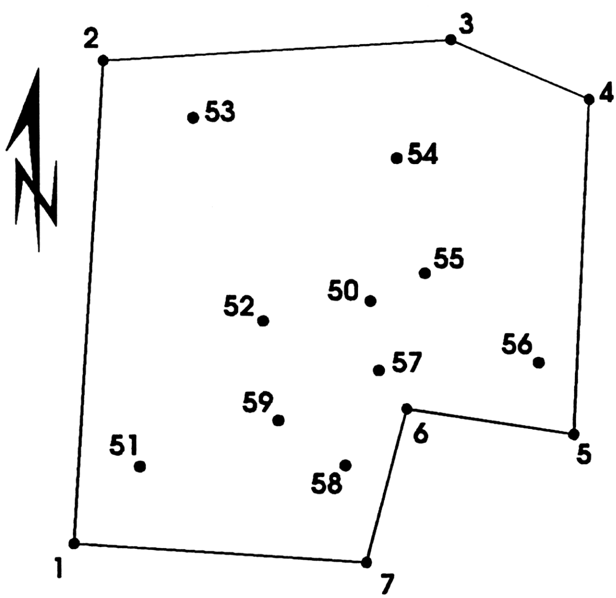
```
OC:50        FS:51
BS pt:6
>Ang right  :77.2701
>Zenith ang:91.0638
 Slope dist:350.430
Desc:PT51
HI:5.420    HR:6.000
```

SIDES	REP	BACK	TRAV	OFFCT	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.



SUNSHOTS

The next section in this chapter on Field Work will cover the use of the TDS-48 in helping you determine the true azimuth of a backsight in the field by solar observations. The TDS-48GX has two methods built into its software. The first is called the *Ephemeris* method. It assumes that you have an ephemeris with you and will prompt you to key in the appropriate values from it. The other method is called the *Almanac* method. In it, the TDS-48GX will approximate the values from the ephemeris based on the known date and time information which you provided during the date and time setup routine. The ephemeris method is capable of being more accurate in determining the azimuth.

> ****Warning****
> **Direct viewing of the sun without a solar filter can cause serious and permanent eye damage. Also, sighting your electronic total station toward the sun without an objective lens filter can cause damage to your EDM.**

Once the method has been chosen and the setup procedure completed, the field procedures are the same for either method. Since the Ephemeris method is slightly more complicated, this section of the manual will use it for an example. The method used is the hour-angle technique.

Path:	From the Main Menu, press **[O] Sunshots** and then **[G] Ephemeris Method**. The Ephemeris Data Screen is shown Below:

```
  Ephemeris Data
GHA 0 :    176.27599
GHA 24:    176.28581
Decl 0 :   -12.24453
Decl 24:   -12.03539
Semi DIA:  0.16129
```

SOLVE					EXIT

Step 1: The GHA 0 represents the Greenwich Hour Angle of the sun at zero hour Universal Time, Greenwich, on the current date. GHA 24 represents the Greenwich Hour Angle of the sun at zero hour Universal time, Greenwich, on the next date (24 hours later).

Step 2: Likewise Decl 0 and Decl 24 represent the declination of the sun on the current date and next date respectively. Finally, Semi Dia is the semi-diameter of the sun expressed in minutes and seconds.

All of this may be obtained from an Ephemeris for the current year and should be keyed into each data field as requested.

Step 3: The screen should be filled out as displayed above. Now press **[SOLVE]**. You will see the Sun Shot Setup Screen as:

```
  Sunshot Setup
Lat :    37.2700>N      <= N / S
Long:    98.3108>W      <= W / E
Sun: >Left trail        <= Left trail /
Number of sets:  3         Right trail / Center
C long :   0.0000
Z const: 0.000000
```

SOLVE					EXIT

Step 4: Lat and Long represent the latitude and longitude of the gun position which may be scaled from a map such as a U.S.G.S. 7.5 minute quadrangle sheet.

Step 5: The Sun prompt indicates which part of the sun will be sighted at the vertical cross hair. Our example will use the Left trailing edge. (The Right trailing edge is for the southern hemisphere.) The Center setting can be used in either hemisphere or for star shots.

Step 6: The number of sets indicates the number of complete sets of observations that will be taken. Each set consists of two sightings on the sun - one direct and one reversed. (At the time you are prompted to flip the scope, you can cancel the reverse observations.) A complete sun shot requires all of the sets of sightings on the sun and two sightings on the backsight (see below). Obviously, if more sets are taken, individual isolated errors will be minimized in the final averaged computations.

Step 7: If you want your azimuths reported in state plane coordinates rather than true azimuths, you should key in the values of the central meridian longitude and the zone latitudinal constant for your state. These values are printed in Appendices E and F in this Manual.

Step 8: When this screen has been filled out as displayed above, press **[SOLVE]**.

NOTE:

> The Hour-Angle method of solar observations requires that you have the time recorded very accurately. You should be sure that the time has been checked against a precise time standard such as WWV and that the number of hours to GMT is correct.

A table of the solar observations and resulting azimuths is displayed below:

	Time	Angle	Computed Line Azimuth	
Direct	Backsight	0.0000		
Direct	15.12253	241.4352		241.12304
Direct	15.13071	241.5118		241.13067
Direct	15.13392	241.5736		241.12475
Reverse	15.16217	62.2922		241.12067
Reverse	15.16582	62.3548		241.12405
Reverse	15.17410	62.4405		241.12368
Reverse	Backsight	180.0005	Average	241.1237

After pressing **[SOLVE]**, the sun shot routine will prompt you through the proper field procedure. The procedure is to take a direct sighting on the backsight; then a direct sighting on the sun. Then, reverse (flop) your scope and take a reverse reading on the sun. The direct and reversed sightings on the sun are repeated for each of the sets specified in the Setup Screen. For each sighting of the sun, you must record the time of the reading. If you are connected to an electronic total station, the TDS-48 will take all readings automatically, including the time, as you trigger the machine.

Step 9: Enter the data for the prompts as follows:

Local date:	2.121989
BS dir cir:	0
Dir Time 1:	15.12253
Dir Cir 1:	241.4352
Dir Time 2:	15.13071
Dir Cir 2:	241.5118
Dir Time 3:	15.13392
Dir Cir 3:	241.5736

Step 10: You will then be asked:

Do you wish to take
reverse shots?[Y/N]_

Answer "Y" and enter the reverse observations as prompted:

Reverse!!

Rev Time 1:	15.16217
Rev Cir 1:	62.4852
Rev Time 2:	15.16582
Rev Cir 2:	62.3548
Rev Time 3:	15.17410
Rev Cir 3:	62.4405

Finally observe the backsight with the scope reversed:

BS Rev Cir: 180.0005

Step 11: After the last data has been entered, the TDS-48GX will compute and display the individual back azimuths from each reading.

Line Az 1: 241.12304
Line Az 2: 241.12598
Line Az 3: 241.12475
Line Az 4: 240.52367
Line Az 5: 241.12405
Line Az 6: 241.12368

Pressing a key one more time will display the following message:

```
The next screen will
let you delete bad
azimuth from the set.
Enter 0 to accept all
or a number to DEL

<Any key to continue>
```

SOLVE					EXIT

Again hit a key and you can delete any shot from the set. As you can see shot number 4 is out of the grouping and therefore would appear to be somewhat less accurate that the rest. To delete it from the average type "4" and [ENTER]. Now there are only five sets.

```
1-241.1230 2-241.1260
3-241.1248 4-240.5237
5-241.1241 6-241.1237



Enter 0 or n to DEL █
```

SOLVE					EXIT

The default entry is always 0 and therefore you may simple press [ENTER] to accept the remaining shots. The average will then be displayed.

Avg Line Az = 241.12430

Depending upon whether or not you used state grid constants in the Sun Shot Setup Screen, these azimuths will be relative either to the state grid coordinate system or to true north.

CONTROL FILES

Frequently on a job, you might like to differentiate between control points and survey points. One way to do this is by point numbering; i.e. control points numbered below one hundred, and survey points numbered from three hundred and above. However, the TDS-48 will allot memory for all of the unused point numbers between the highest numbered control point and the lowest-numbered survey point. This restricts the number of points that can be surveyed within a given job. Perhaps more importantly, if you divided a project into more than one job file and want to use the same control points, the points must be copied into each job. By separating control points into a Control File, we resolve these problems.

The concept is quite simple. The control points can be stored in a separate job file with a distinct name. Then, any job that needs access to these points can select this as its control file from the Setup Menu. During operation of the TDS-48, whenever a point is referenced by point number, the TDS-48 will *first search* for a point with that number in the *main job file*. If there is, that point will be used. However, if the point number specified is less than the smallest point in the main job file, then the TDS-48 will search for that point in the selected control file. If a point exists there, then that point is used. If the specified point number does not occur in either file, then an error message is displayed.

Care needs to be taken in designing projects that will use control files. The TDS-48GX will only look for control points that are less than the smallest point possible in the main job file. Therefore, the control points should be low numbers. **The main job must be created with a starting point that is larger than the largest control point you wish to access.** If your control points were numbered between one and one hundred, then your main job file must be created with a starting point greater than one hundred.

Control point numbers may be used in any screen location in which read only point numbers are legal. They can be used as occupied points or backsight points in surveys and they may be used in coordinate geometry calculations. They cannot be used where a point will be created or modified. They cannot be used as a Foresight Point or as the Store pt: in Intersection or Pt-in-Dir. For example, you may want to inverse between a point in the main job and one of your control points. Go to the inverse screen and use it as you would for any other inverse, specifying the point numbers where required.

The Setup Menu has two choices that relate to control files: **[K]** Select control file and **[L]** Deselect control file. The Select Control File Screen works like the screen to open an existing job. Move the cursor to the appropriate file name and press **[SELECT]**. To deselect the control file, merely press **[L]** from the Setup Menu.

DESCRIPTOR CODE TABLES

One of the best ways of improving the productivity of data collecting is to speed up the process of keying in point descriptors. The Descriptor Code Table is provided for this purpose. Basically, the Descriptor Code Table is a designated file in the TDS-48GX's memory that consists of a table of commonly-used point descriptors connected with codes or abbreviations that may be keyed into the descriptor field in place of the full descriptor. When one of these codes is found in a descriptor field, the TDS-48GX will replace the code with its associated descriptor. Once the TDS-48GX user has establish a Code Table of commonly-used descriptors, then whenever the descriptor prompt appears in the TDS-48 program, a code may be keyed in. The TDS-48 will insert the complete descriptor from the code table in the place of the code in the Coordinate and Raw Data files.

The Code Table is actually a special text file in the TDS-48. It requires the unique name "DESCRIPT" and it will appear in the Directory as "DESCRIPT.TXT". The Code Table itself is composed of a series of lines of text. Each line of text consists of the code followed by the full descriptor separated by exactly one space. A typical Code Table would appear as:

```
1 POB
02 HUB
CB CURB
T4 OAK TREE
POB PT. OF BEGINNING
F FENCE
f FENCE
.....(etc.)
```

Codes may be up to seven characters in length and may be numeric, alphabetic or alpha-numeric. Examples of each of these are: 17, ABC, B17. The code is case sensitive, which means that the "F" and "f" codes are not the same and could have different descriptors. If you want an upper or lower case "F" to be interpreted as FENCE you need to enter it twice (as above). The code and the descriptor are separated by one space, and the remainder of the line is the descriptor that is linked to this code. The descriptor may contain alpha-numerics, spaces, punctuation or symbols; basically any thing that can be typed into a descriptor manually.

During a survey, when the TDS-48 requests a descriptor (typically after the electronic total station has taken a shot), you may key in the full descriptor such as CURB; or, you may key in the corresponding code, such as CB, as a "shorthand" notation to indicate the CURB. In either case, the full descriptor CURB will be stored in the job file. If the data is being collected manually, the code may be keyed into the descriptor line of the Traverse/Sideshot Screen before the **[TRAV]** or **[SIDES]** softkeys are pressed. As above, the TDS-48 will store the full descriptor from the table into the job file.

Using Codes With Keyed In Descriptors And Combining Codes

Often during a survey, you want to use a descriptor from the Code Table, but you would like to add additional characters to the descriptor from the keyboard. As an example, suppose you wanted to use the descriptors "NE 1/4 CORNER", "SE 1/4 CORNER", etc. Lets assume that the descriptor "1/4 CORNER" has been keyed into a Code Table under the code "15". To combine text and codes from the Code Table , use the "+" key in the following way: when the descriptor prompt appears in the display and you want the descriptor to read "NE 1/4 CORNER", key in "NE+15". The TDS-48 will combine the keyed-in descriptor "NE" with the descriptor associated with code 15 to create the complete descriptor "NE 1/4 CORNER".

Codes may also be concatenated with keyed in descriptors. For example, if you wanted a series of points with descriptors TOP OF CURB A1, TOP OF CURB A2, TOP OF CURB A3, etc., You would set up TOP OF CURB in a Descriptor Code Table with say code 23. Then, in response to the descriptor prompt, key in 23+A1, 23+A2, 23+A3, etc.

Codes may also be concatenated with other codes. Assume you have code-descriptor pairs for: T TREE, T1 PINE, T2 OAK and T3 MAPLE. The result of the following entries: T1+T; T2+T; T3+T; would be: PINE TREE; OAK TREE and MAPLE TREE This technique may be used to concatenate up to three descriptor codes or text segments.

Setting Up And Deleting A Code Table In The TDS-48GX

To establish a code table in the TDS-48, you should proceed as follows:

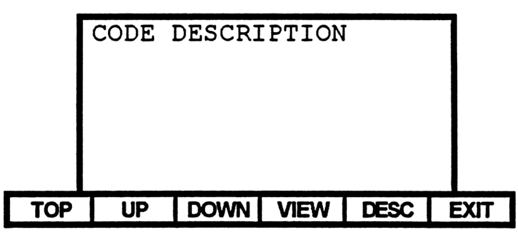
Path:	From the Main Menu, Press **[G]** Job Menu, **[K]** Raw Data File Menu, **[K]** Create descriptors.

This key sequence will establish the file DESCRIPT.TXT in the TDS-48GX's memory. If the file already exists, you will get an error message. There can only be one Descriptor Code Table resident in the TDS-48 at a time.

Likewise, the keystrokes **[G]** Job Menu, **[K]** Raw Data File Menu, **[L]** Delete descriptors will delete the Descriptor Code Table.

Viewing And Adding To The Descriptor Code Table

To view the Descriptor Code Table or to add codes to the table, you need to access the Descriptor Code Table Screen. From the Main Menu, press **[G]**, **[K]**, and then **[J]**. You will see the current Code Descriptor Table, if one exists. If the descript file does not exist, then create one as described above.



To add a descriptor to the code table, press **[DESC]**. Then, enter the new entry by keying in the code followed by **exactly** one space and then the descriptor; e.g. 7 [space] MAN HOLE COVER.

NOTE:

> The code can be a maximum of 7 characters. Descriptors may be any length that is left, but only the first 16 characters will be stored in the coordinate file when the code is invoked. The **total length of a line** must be no more than 29 characters.

NOTE:

> Within the TDS-48, your options are limited to creating a code table, deleting a code table or adding individual descriptors to an existent table. It is not possible to delete or edit individual entries in a code table from within the TDS-48. For this reason, code tables are usually created and modified on a PC and then downloaded to the TDS-48 for use in the field. The procedure for doing this is described in the next section.

Building And Editing The Descriptor Code Table In A PC

While it is possible to set up a Code-Table from the TDS-48GX's keyboard, the difficulty associated with "typing" a long list into the TDS-48 directly makes it desirable to use a PC to create the Code Table. Also, it is not possible to edit or delete a code from the TDS-48. To facilitate this process, you should use your favorite editor software or word processor. Since most word processors use special characters to control the appearance of the documents they create, you should develop your Code Table in your word processor's "Non-Document" mode or store it to an ASCII file format. The file should be named "DESCRIPT.TXT" and should consist of the following elements keyed on each line.

"CODE" {exactly one space} "DESCRIPTOR" ENTER (or RETURN).

The completed "DESCRIPT.TXT" file may then be downloaded to your TDS-48 by using your TFR software. In the TFR Main Menu, selected the "Send file to data collector" option. Change the file type to "TEXT" and enter the file name as DESCRIPT.TXT.

NOTE:

> If your TFR, is ver 4.3 or older, then use the "Send Text File to TDS-500" option. Even though this option refers to the TDS-500, the routine will also transfer a text file to the TDS-48GX.

4. 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-48GX'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-48GX, 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 133.7136 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:

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

Azimuth / Bearing =>

```
     Translate Job
>From point: 1
To point   : 8
>Azimuth   : 0
Horiz dist: 0
Elevation+-: 127.53
```

SOLVE	PTLST	INVRS			EXIT

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 you 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-48GX 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-48GX will rotate all of the coordinates around point "1" by the difference between the two bearings.

TRAVERSE 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 Adjustment Screen appears as:

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

```
    Angle Adjustment
>*Using point list*

Angle error: -0.0026
 [AUTO] computes
  angle error
SOLVE | PTLST |       | ERROR |       | EXIT
```

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 the two 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 boundary points; 50 to 59 as sideshots of point 6; and, 7 to 8 again as boundary 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-48GX 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-48GX, 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 the **[ERROR]** or **[D]** key to move to the **Compute Angular Error** screen. The Polygon rule calculates the angul 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. Press **[SOLVE]** to compute the angular error.

```
  Compute Angular Err
Option:>Polygon rule
Computed azm:
Correct azm:

Angular err: -0.0026
```

SOLVE					EXIT

<= Polygon rule / Closing azm

The Closing azimuth method of solving for the angular error involves simply entering the closing azimuth computed from the traverse observations and the corrected closing azimuth. The difference between these two is the angular error. The computed azm and Correct azm fields are ignored when using the Polygon rule.

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

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.

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:

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

```
       Compass Rule
>*Using point list*


     CLOSE TRAVERSE
Include vertical
  closure: >YES
```

<= YES / NO

SOLVE	PTLST	OPEN	PRECI		EXIT

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.

After the compass rule adjustment, your coordinates should appear as in the table below:

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
8	5000.0000	5000.0000	227.53	Close to PT1
50	5338.7259	5366.1916	237.88	PT50
51	5115.2403	5096.3597	230.51	PT51
52	5305.0254	5265.4527	236.42	PT52
53	5627.0670	5121.5103	232.23	PT53
54	5569.3228	5423.9275	235.75	PT54
55	5377.4284	5405.8102	236.57	PT55
56	5226.9342	5630.9345	242.76	PT56
57	5247.5134	5404.6506	239.78	PT57
58	5085.7927	5374.8738	239.29	PT58
59	5180.3867	5276.1809	235.98	PT59

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 **[A] 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.

5. PRACTICE WITH CO-GO and CURVES

Working with the coordinates of the SMITH job you will:

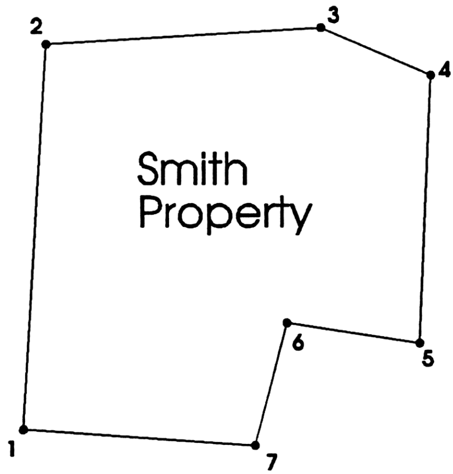
- **Create new points using various Coordinate Geometry (CO-GO) routines.**
- **Explore various Curve Screens of the TDS-48GX and practice integrating the curve capabilities into the CO-GO routines.**

In this chapter, you will continue to do work on the SMITH job. Make sure that the SMITH file is the currently 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	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

If you did not adjust your SMITH survey as described in Chapter 4, the results in this chapter will be different, but you can continue (or else re-enter the coordinates from the table above). Here is a picture of the Smith's property.

CO-GO & CURVES



Coordinates in the TDS-48GX may have come from several sources:

- collected from field data during a survey.
- computed by the CO-GO functions in the data collector.
- up loaded from a PC.
- keyed into the coordinate editor.

No matter how a point's coordinates get into the TDS-48, they can be used by any of the functions of the TDS-48GX field 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 CO-GO

To illustrate this point, take a few minutes now to practice with some of the CO-GO functions on the SMITH job. From the Main Menu, press **[M].** The CO-GO Menu is displayed. You'll see ten different coordinate geometry functions in the menu: 6 in the first screen and 4 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 3, 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 CO-GO 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

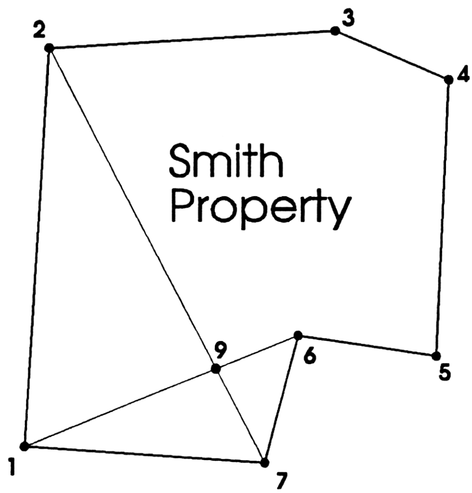
Like all of the screens in the TDS-48, the use of this one is straight-forward. Move the scroll bar to the field in which you want to enter data and key in the data. Then move the scroll bar to another field, key in that data, etc. When you have built the screen to be representative of the problem that 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 CO-GO 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-48GX will compute the inverse for you. Simply enter "1-6" and press **[ENTER]** or **[↓]** to move to the next field. The TDS-48 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-48GX will calculate a distance. If the field is expecting an angle, you can enter three point numbers separated by hyphens. The TDS-48GX 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-48 will give you an opportunity to specify an elevation and a descriptor 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 Data

Point    :9
Northing:5136.2764
Easting :5308.4618
Elev    :227.5300
Desc:PT9
```

PT +	PT -	STORE	RCL	UNUS	EXIT

CO-GO & CURVES

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

Azimuth / Bearing =>

```
  Point in Direction
Occupy pt: 1
>Azimuth   : 3.4730
Horiz dist: 100.000
+/- ang : 0.0000
Store pt:    10
```

SOLVE	DFDIR				EXIT

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-48 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.

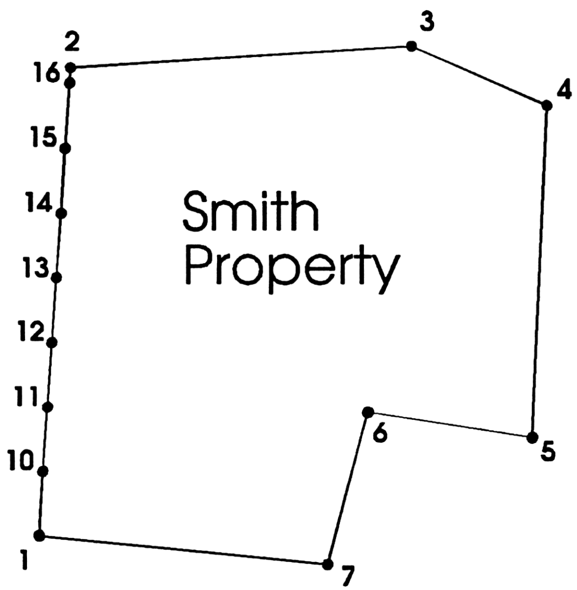
Step 3: Now, press **[SOLVE]** to get the coordinates of your first point that is 100 ft from point 1. This will be stored as point 10. A new screen will prompt you for an elevation. You can enter an elevation here, but, let's use the one displayed for you (227.53 ft in this case) by pressing **[ENTER]**. Next, the TDS-48 will prompt you for a descriptor. Key in a descriptor, such as PT 10, and press **[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.

NOTE:

> 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-48GX 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 CO-GO Menu, press **[G]** to select the Acreage 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

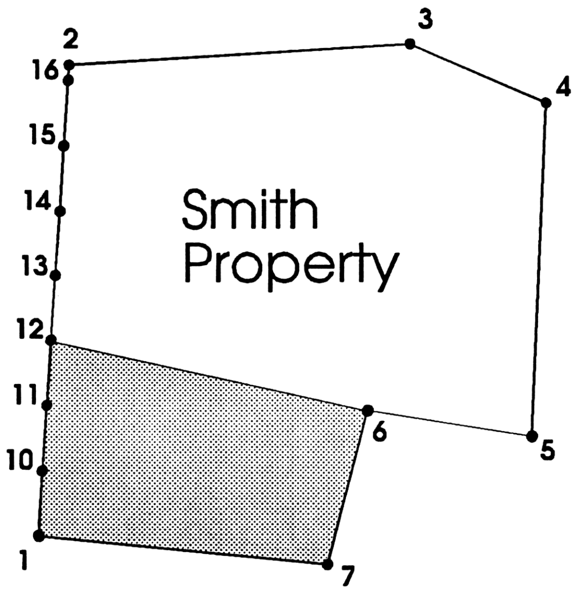
Step 1: Load the first and last corners of the survey into the "From point" and "To point" fields of the screen: 1 and 7. To compute the acreage in acres and square feet and the perimeter in feet, press **[SOLVE]**.

When you use the "From point" and "To point" fields, the TDS-48 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.

NOTE:

When the distance units of the TDS-48GX 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-48 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:

```
NXT PT?
```

CURVE	END	DEL	EDIT	PENU	EXIT

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 =>

```
   Acreage
> *Using point list*

Acreage :   2.495
Perimeter: 1354.012
Square ft: 108688.44
```

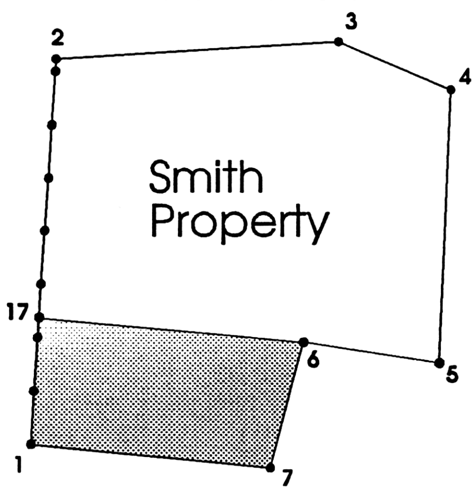
SOLVE	PTLST				EXIT

NOTE:

> The Point List is used throughout the TDS-48GX 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-48GX, 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-48GX 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 CO-GO Menu, select **[P]: Pre-Determined Area.**

Acre / Square ft =>	`>Acre       : 2.00`
From point - To point => / Using point list	`> *Using point list *`
Pt on line / Bearing =>	`>Pt on line: 2`
	`Store pt   : 17`
	`Line brg   : N89.2806W`
	`Line dist  : 426.872`

SOLVE | PTLST | DFDIR | PARAL | | EXIT

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 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?

NOTE:

> 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".

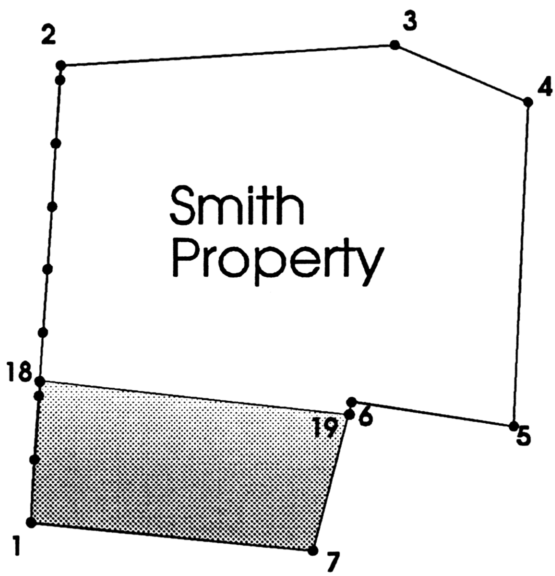
Step 5: Enter "17" as the point number whose coordinates are to be calculated and stored in the SMITH job file.

Step 6: Press **[SOLVE]** or **[G]** to do the actual computation. Again, TDS-48GX will prompt you for an elevation and descriptor for the point. 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 CO-GO Menu, select **[P] Pre-Determined Area** . Then press **[PARAL]** or **[D]** to bring up the Parallel screen

```
Acre / Square ft =>   >Acre       : 2.00
                      Side 1: pt 1:1
pt 2 / Bearing =>     >       pt 2:2
                      Side 2: pt 1:7
pt 2 / Bearing =>     >       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-48GX 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 and descriptor for each new point. Input the data and press **[ENTER]** for each point.

TDS-48GX 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

Next 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.

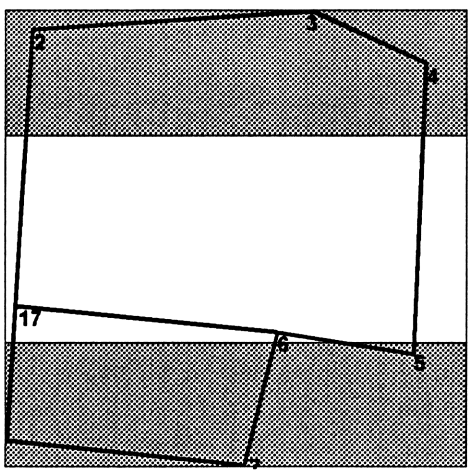
Press **[PLOT]** or [÷] and then **[PTLST]**. Press **[H]** to clear the existing list and then press **[G]** to edit a new one. You may connect points 1 to 7 in sequence by keying in "1-7" in the first NXT PT? line of the list. In a Point List, 1-7 means a range of points (from one to seven) and not 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:

```
PT 1-7
PT 1
PEN UP
PT 6
PT 17
NXT PT?
```

CURVE	END	DEL	EDIT	PENU	EXIT

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

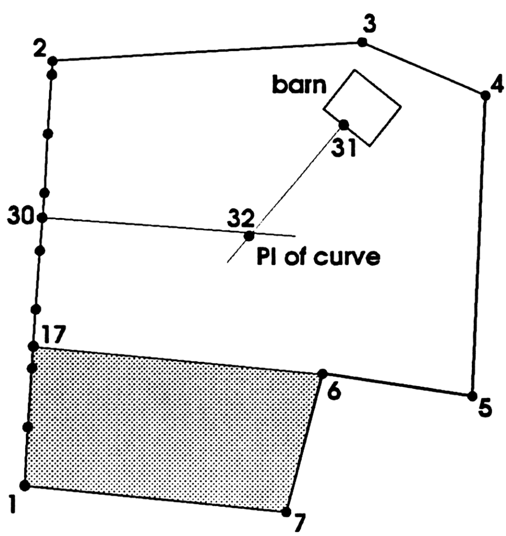


You should see a portion of the desired plot in the screen. Remember to use the **[↑]** and **[↓]** keys to see the rest of the plot. Don't forget to press the **[ON]** key to return back to the Screen Plot screen.

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.



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:

Azimuth / Bearing / Distance =>

Azimuth / Bearing => / Distance

```
   Intersection
 Point 1 : 30
>Bearing : S86.1230E
 Point 2 : 31
>Bearing : S44.5957W
 Store pt: 32
```

SOLVE	DFDIR				EXIT

Call this intersection point: 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.

```
                                Solving Horiz Curve
Radius / Degree /
                     Delta =>  >Radius  : 150.000

Delta / Length / Chord =>      >Delta   : 48.5238
  Tangent / Mid ord
                               Definition:> Arc            <= Arc / Chord
                          | SOLVE |     | LAYOU |     |     | EXIT |
```

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-48GX will compute the angle of the PC-PI-PT by entering "30-32-31" and pressing **[ENTER]**.

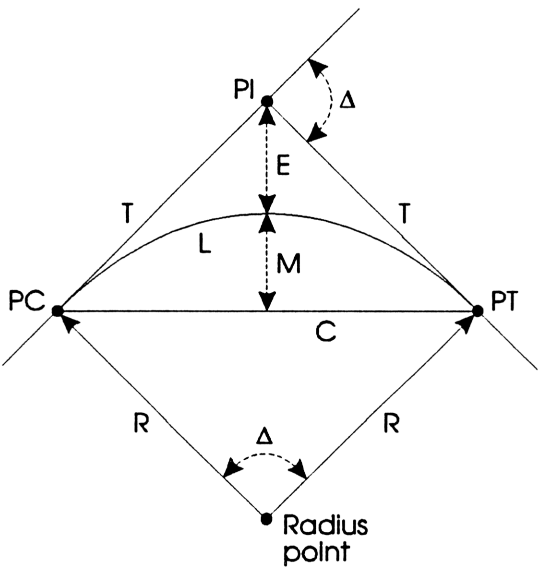
Next, you need to subtract this result from 180°. Highlight the Delta angle field and press **[ESC]** or [⬅] **[A]**. You should now be in the HP-48GX stack with "131.1227" in line 1. Press the **[+/-]** key. Now, enter "180" and press **[+]**. The result is the delta in decimal form. To convert to Degree, 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-48GX 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:

```
Radius   : 150.000
Length   : 127.960
Chord    : 124.116
Degree   : 38.1150
Delta    : 48.5238
Tangent  : 68.165
External: 14.762
```

MORE					EXIT

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 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.

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 CO-GO functions, but TDS-48GX 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.**

Azimuth / Bearing => (>Azm PI->PC)
Azimuth / Bearing => (>Azm PI->PT)

```
 PI & Tangents known
 PI point:32
>Azm PI->PC:273.4730
>Azm PI->PT:44.5957
Radius:       150.000
PC sto pt:       33
Radius pt:       35
```

SOLVE		LAYOU	CURV		EXIT

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-48GX will display the results of the radius, PI and tangent. Then, it will prompt you to give an elevation and description for the next three store points. Press enter to accept the default elevations and enter descriptors. TDS-48GX 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.**

```
 Compute Radius Pt
PC point: 33
PT point: 34
Curve >Left              <= Right / Left
Sto radius:35
Radius : 150.000
SOLVE |      |      | CURV |      | EXIT
```

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.**

```
                               Through 3 Points
Radius point / 1st point =>   >Radius point: 35
                              2nd point:     34
                              3rd point:     33
                              Sto radius pt: 0
                              Radius:   150.000
                              Length:   126.736
                       SOLVE | DATA | LAYOU | TRAV |      | EXIT
```

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.

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.

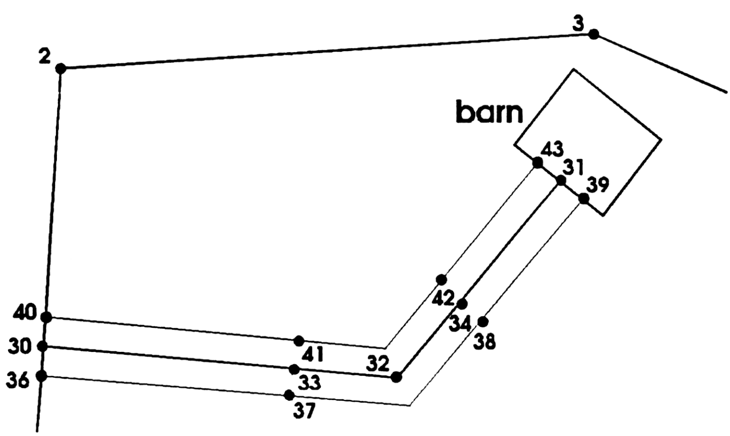
Enter "0" as the Sto radius pt:

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

Step 3: Press **[SOLVE]** or **[A]**. TDS-48GX 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 CO-GO 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]**.

```
        Horiz/Vert Curve
          P1: 37     P2: 38
Radius => >Radius : 160.0000
          Turn: >Left                  <= Right / Left
          Arc:  >Small                 <= Small / Large
          Beg grade(%):  0.000
          End grade(%):  0.000
```

ENTR					EXIT

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

Press **[ENTER].**

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

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

```
CR 37-38,160.000,L,S,...
PT 39
PT 43
PT 42
CR 41-42,140.000,R,S,...
PT 40
NXT PT?
```

CURVE	END	DEL	EDIT	PENU	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 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-48GX.

6: STAKEOUT

This chapter is designed to familiarize you with the TDS-48GX's staking programs. The three stakeout routines are:

- **Point stake (or radial stake).**
- **Offset stake.**
- **Slope stake.**

We will cover each of these and take an in-depth look at using a point list to define a center line.

In this chapter, you will explore the different stakeout routines. You will see how to stake the center line of the Smith driveway using the *point stake* capability. You will also see how to stakeout the right-of-way for the driveway using the *offset stake* capability. And, finally, you will use the Slope Staking routine on this driveway.

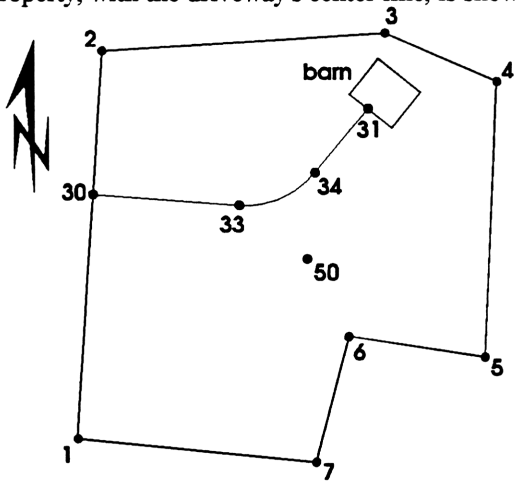
If you have not done the Field Work from chapter 3 or no longer have the SMITH job available, you can create a new job file and enter the coordinates from the table below. Your coordinate file should look as follows:

PT NUM	NORTHING	EASTING	ELE.	NOTE
1	5000.0000	5000.0000	227.53	START
2	5709.8469	5047.0433	230.82	PT 2
3	5736.1695	5504.0370	233.90	PT 3
4	5649.0185	5685.4911	235.75	PT 4
5	5152.6326	5660.0409	244.89	PT 5
6	5194.3888	5439.9992	242.32	PT 6
7	4966.9177	5385.6510	239.83	PT 7
30	5449.0151	5029.7574	229.74	WEST END
31	5553.3876	5488.3254	235.31	FRT. OF BARN
32	5427.0004	5361.9419	227.53	PI OF CURVE
33	5431.4991	5294.0597	227.53	PC OF CURVE
34	5475.1063	5410.0464	227.53	PT OF CURVE
35	5581.1708	5303.9788	227.53	RAD OF CURVE
50	5338.7259	5366.1916	237.88	PT50

If you have done the survey of the SMITH property in chapter 3 but have not set up the driveway from chapter 5, you should only need to enter points 30-35 and 50.

STAKEOUT

The Smith property, with the driveway's center line, is shown below:



POINT or RADIAL STAKEOUT

Before you begin staking, you need to set a couple of parameters. These affect all the stakeout routines.

Path: From the Main Menu, press **[I] Stakeout Menu**. Then, press **[J]** to select **Set Stakeout Mode**.

```
     Set Stakeout Mode

Store cut sheet: >ON        <= OFF / ON
HA tolerance(sec):30.0
Slope stk tol(ft):0.50

|     |     |     |     |     | EXIT |
```

When set to ON, the first choice in this screen allows you to store cut/fill data in the raw data file. This information can then be extracted using the TDS TFR program on your PC to print a cut sheet. The other two parameters establish an error tolerance for the horizontal angle: enter 30.0 sec.; and set a slope stake tolerance: enter 0.50. If a stakeout computation creates a error greater than the established tolerance, the TDS-48GX will display a warning. Press **[EXIT]** to return to the Stakeout Menu.

Now, let us start by staking the center line of the SMITH driveway using Point Stake.

Path: From the Stakeout Menu, press **[G] Points Stake**.

BS pt / BS azm / BS brg =>

```
    Point Stake
Occupy pt: 50
>BS pt : 6
FS pt   :30
Store pt:80
Circular  : 135.1400
Horiz dist: 350.050
```

SOLVE	STAKE	CIR-0	FS+1	LOCAT	EXIT

Step 1: Let's assume that you reestablish your gun on point 50 and that you will again use point 6 as your backsight. Remember to scroll the prompt in line 3 of the display to "BS pt" and set it to "6". Specify point 30 at one end of the center line of the driveway as your foresight.

Step 2: The Store pt is the point number where you can store the actual staked coordinates. In this way, you can have a record of the locations of the stakes to compare with the designed points. The display given above is what your Points Stake Screen should look like.

Step 3: Now, by pressing **[SOLVE]**, the TDS-48GX will compute the circle angle and the horizontal distance from point 50 to point 30. The numbers are 135°14'00" for the circle angle and 354.050 for the horizontal distance. If point 50 was not previously the occupied point and you have just changed the OC pt. to 50, you will be prompted for a new HI.

Step 4: You would have your rod man pace off the distance; keep him on line with the gun; and, while he is getting set, press **[STAKE]**. The Stake Shots Screen is displayed. The Stake Shots Screen provides you with an opportunity to change the gun and/or rod height.

```
     Stake Shot
Horiz dist: 354.050
HI: 5.420  HR: 6.000
Zenith ang:91.1158
Slope dist:352.58
Go  :1.548
Cut :0.179 Elv:229.92
```

GRADE	SHOT	STORE	FAST		EXIT

If you were working manually, you would take a shot and key in the zenith angle and slope distance. Then, press **[SHOT]**. If you are connected to your gun, just press **[SHOT]**. The proper data will be gathered and transferred to your TDS-48GX automatically. Either way, the TDS-48GX will display a Come or Go distance for the rod man and a Cut or Fill.

Step 5: Key in the Zenith: 91.1158 and Slope dist: 352.58 and press **[SHOT]**. The TDS-48GX should tell you to Go 1.548 ft. The Stake Shot Screen is shown above, as it should appear after pressing **[SHOT]**.

Step 6: Your rod man would adjust and you shoot again. Enter a Slope dist of 354.16 and press **[SHOT]**. The Come/Go should read Come: 0.032. This process can continue as long as needed to place your rod on the stake point. Let's assume this is good enough.

Step 7: At this point, you can press **[STORE]**. The coordinates of the most recent shot will be stored in the file at the point number you set up in the Points Stake Screen, and the point number is incremented. This step is optional; if you don't want to store your as-built coordinates, simply skip the **[STORE]** key.

WHERE TO NEXT?

The TDS-48GX has a screen in the Stakeout Menu that may be used by the rod man to locate the next point to be staked. If your rod man has a TDS-48GX, (or the gun man may calculate this for him), he may use it at this time to determine the direction and distance that he should pace to locate the next point to be staked, point 33.

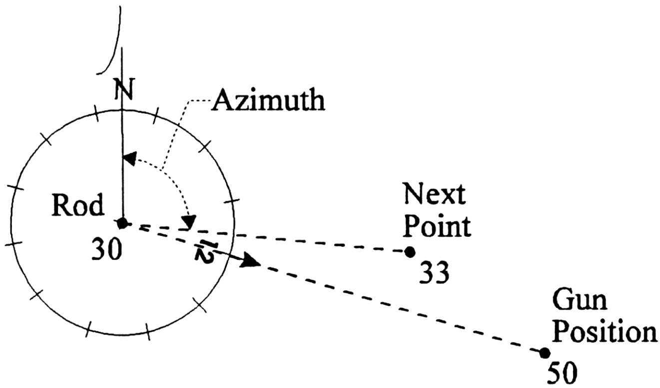
Path:	From wherever you are in the TDS-48GX press **[WHERE]** or [2]

You will see the Where is Next Point Screen which should be filled out as follows; then, press **[SOLVE]**. Use the gun location as a reference point. After pressing **[SOLVE]**, you will see the following:

```
  Where is Next Point
Rod pt:   30
Next pt: 33
Reference pt: 50
Direction: 12 O'clock
Horiz dist: 264.882
Azimuth:    93.4730
```

SOLVE			ADV		EXIT

By standing at point 30 and facing the gun (point 50) it can be determined that the next point is approximately in the 12 o'clock direction. Imagine a clock at the rod with 12 o'clock facing the gun. In this example the next point happens to be within 15° of the direction of your instrument and therefore results in a 12 o'clock reading. The rodman then turns to the 12 o'clock direction and pace off 261 ft to get close to point 33, the next point to be staked. If he has a compass, he can line up the direction to the next point, at an azimuth of approximately 93 degrees from north. Pressing **[EXIT]** will return you to the Stake Shot screen.



In a similar manner, let's stake point 33.

Step 8: From the Stake Shot Screen, press **[EXIT]** to return to the Point Stake Screen. If our points were in numerical order, you could simply press the **[FS+1]** key to increment the point to be staked and solve it. But, since our old FS pt was 30 and you now want 33, you need to enter "33" into the FS pt field. However, you used the WHERE? function, which set point 33 in the FS pt field, so press **[SOLVE]**.

Step 9: Press **[STAKE]** and enter:

Zenith: 93.4628
Slope dist: 119.82

Then, press **[SHOT]**.

Step 10: You would repeat the **[SHOT]** process until the Come/Go is close enough and press **[STORE]**.

You can stake the last two points on the center line of the driveway. The critical points along the center line are the beginning point, 30; the PC and PT of the curve, points 33 and 34; and the ending point, 31. You have just staked 30 and 33, so finish with points 34 and 31.

OFFSET STAKEOUT WITH BOTH HORIZONTAL AND VERTICAL CURVES

The TDS-48GX Offset Staking is set out along a center line. This center line is defined by a series of straight or curved segments. A segment can have both horizontal and vertical components. All changes in curve specification or direction along the center line must occur at a coordinate point. The center line profile definition can't change within a defined segment nor between two adjacent coordinate points in the Point List. This means, when curve features overlap, each point where the horizontal or vertical profile change, must be divided into separate segments. e.g. a vertical curve may overlap horizontal curves or straight sections along the way. The vertical curve must be defined into segments that match the horizontal sections. Of course, a horizontal curve overlapping vertical curves requires similar treatment. Both of these conditions are covered in the example below.

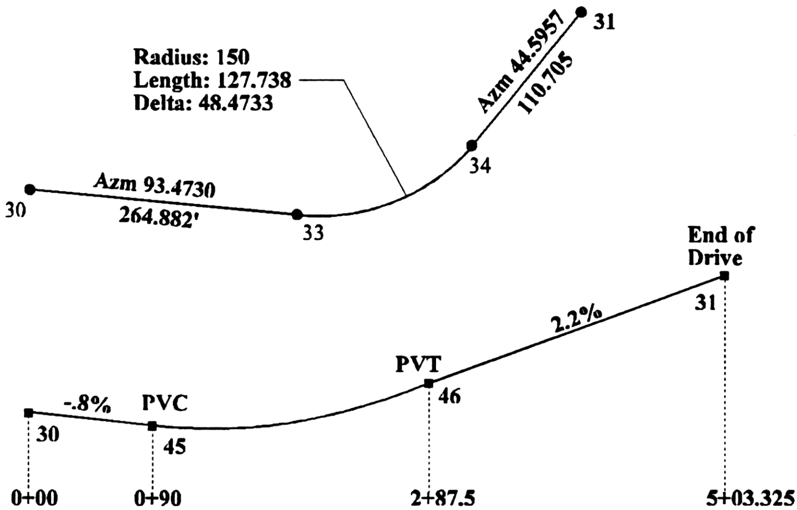
POINT LIST

The center line is described in a Point List. Straight segments are described by a sequence of coordinate points. Curved segments are described by the end points of the segment plus information about the shape of the curve. A horizontal curve is defined by its direction of curvature, its radius and whether it is the larger or smaller arc of the circle. A vertical curve requires the beginning and ending grade % of the curve. Setting the **Radius** line in the curve screen to **Straight vert curve** indicates that the horizontal component of a vertical curve is straight. A beginning and ending grade % of 0 indicates that there is no vertical curvature. Each segment can include data defining both the horizontal and vertical curve specification.

The example given below, is more elaborate than you would normally do in staking a simple driveway. However in order to illustrate overlapping horizontal and vertical curves, we are going to put a vertical curve into the SMITH driveway. To define the center line, you must have coordinate points defined for the beginning and ending of each horizontal or vertical curve and also at the point where a straight section changes direction. In addition, you must calculate the grade at each point along a vertical curve where the horizontal component changes.

STAKEOUT

The SMITH driveway starts with point 30. We will define this as station 0+00. The PC at point 33 is station 2+64.882; the PT is 3+92.62; and, the ending station at point 31 is 5+03.325. Below is a diagram of the horizontal and vertical profiles we will be using for the driveway.



Before we can enter the Point List we must calculate several grades and create the beginning and end of the vertical curve, points 45 and 46. Move to the Offset Stake Setup screen, and we will work from there.

Path:	From the Main Menu, press **[I]** Stakeout Menu. Press **[H]** Offset Stake screen and **[SETUP] [E]** for the Setup screen.

Step 1: To calculate the elevation for the Beginning of the vertical curve, we will use a function called Straight Grade. To get there, press **[ST-GRD]** or [⬅] **[T].**

```
   Straight Grade
Sta. 1: 0+   0.000
Elev 1: 229.74
Grad(%): -0.800
Sta.intvl: 0.000
Sta. 2: 0 + 90.000
Elev 2: 0.000
```

S->E	E->S	STA+			EXIT

Fill out the screen as shown above and press **[S->E]**. The elevation at station 0+90 along this straight grade is 229.02.

Step 2: Next, we will generate point 45, using the Point-In-Direction routine. Press **[PT-DIR]** or **[K]** and fill out the screen that appears with:

```
   Point in Direction
Occupy pt: 30
>Azimuth  : 93.4730
Horiz dist: 90
+/- ang : 0.0000
Store pt: 45
```

SOLVE	DFDIR				EXIT

As a shortcut the Azimuth can be entered as "30-33". With the screen filled as above, press **[SOLVE].** When the prompt asks you for the elevation enter 229.02. Enter a description when prompted and point 45 will be stored.

Step 3: Next, we will use the vertical curve layout function to calculate the elevation of the end of our vertical curve. Press **[V-CURV]** or **[S]**.

PVC sta. / PVI sta. =>

Length / Sta.- Elevation => / H/L El

```
     Vertical Curve
>PVC sta.:    0+90.000
 Elevation: 229.02
>Length: 197.50

 Beg grade(%): -0.800
 End grade(%): 2.200
```

SOLVE		LAYOU			EXIT

Fill out the screen as above and Press **[SOLVE]**. You will need the elevation at the end of the vertical curve; so, jot down the elevation at the PVT as 230.403. If this is not the result you get, re-check your Vertical Curve screen; especially see that the first line is prompting for the PVC and not the PVI. Press **[EXIT]** to get back to the vertical curve screen, then press **[LAYOUT]**. Next we need the grade at point 33. Enter the station of point 33 as 2+64.882.

```
  Vert. Curve Layout
Sta.intvl:    0.000
Station:   2 + 64.882
Elevation: 0.000
```

S->E	E->S	STA+			EXIT

Press **[S->E]**. The Screen will display:
Elevation: 229.944
Sta. Grade: 1.856 %
This grade of 1.856% will be needed later.

Step 4: Now you are ready to generate the end of the vertical curve, point 46. The Traverse on a Curve routine can be used for this. Press **[TR-CURV]** or [⇦] **[O]** and fill out the screen:

```
  Traverse on Curve
Radius: 150.000
Length: 27.25
PC point: 33
F tangent:##.####
Turn: >Left                <= Right / Left
PT point: 46
```

SOLVE		BACK			EXIT

Press **[BACK]** and enter BS point: "30"; then, press **[SOLVE]**. Exit from the Backsight screen and the F tangent should be set as 93.4730 by the backsight screen. Press **[SOLVE]**.

When the prompt asks you for the elevation, enter 230.403. Enter a descriptor when prompted and point 46 will be stored.

Step 5: We are now ready to build the Point List. Press **[EXIT]** until you return to the Offset Stake Setup screen. If you end up at the Main Menu press **[I]** for Stakeout, **[H]** for Offset Stake and then **[SETUP]**. Then press **[PTLST]** for the Point List Menu; press **[H]**, Clear Point List to delete any list that may be there. Then press **[G]** to Edit a Point List.

Step 6: The first segment is straight horizontally and vertically. It, therefore can be defined simply with its end-points. Enter the following list:

30 **[ENTER]**
45 **[ENTER]**

NOTE:

> When you have a segment that is defined simply by its end-point or by a curve that has zero in both the beginning and ending grades, the vertical change is taken from the change in elevation between the end points and is assumed to be linear.

Step 7: The next segment is the remainder of the horizontally straight segment, but now it has a vertical curve. Press **[CURVE]** or **[A]** which brings up the Curve Screen.

Radius / Straight vert curve =>

```
    Horiz/Vert Curve
P1:45       P2:33
>Straight vert curve
Turn: >Left
Arc:  >Small
Beg grade(%):-0.800
End grade(%):1.786
ENTR                    EXIT
```

<= Right / Left
<= Small / Large

Enter each field as displayed above. Use the **[←]** or **[→]** key to change the >Radius: prompt to read >Straight vert curve. This indicates that there is no horizontal curvature, but that it curves vertically only. When you get to the ending grade %, this is the grade at the beginning of the horizontal curve: point 33: which we just calculated. This screen now defines the remainder of the horizontally straight segment and the beginning of the vertical curve which overlap. Press **[ENTR] [A]** to store this segment to the Point List.

Step 8: Next, we define the overlapping beginning of the horizontal curve and the remainder of the vertical curve. Press **[CURVE]** or **[A]** again fill out as shown below. Be sure to put >Straight vert curve back to >Radius.

Radius / Straight vert curve =>

```
   Horiz/Vert Curve
P1:33        P2:46
>Radius :   150.000
Turn: >Left
Arc:  >Small
Beg grade(%):1.786
End grade(%):2.200
ENTR |  |  |  |  | EXIT
```

<= Right / Left
<= Small / Large

Due to the fact that this is a continuation of the same vertical curve, notice that the End grade (%): of the last segment is the Beg grade (%): here. When completed, press **[ENTR] [A]** to store.

Step 9: This has finished the vertical curve, but we still have the remainder of the horizontal curve that has a linear vertical component. Press **[CURVE] [A]** once again and fill it out as follows:

Radius / Straight vert curve =>

```
   Horiz/Vert Curve
P1:46        P2:34
>Radius :   150.000
Turn: >Left
Arc:  >Small
Beg grade(%):   0.000
End grade(%):   0.000
ENTR |  |  |  |  | EXIT
```

<= Right / Left
<= Small / Large

Press **[ENTR] [A]** to store.

Step 10: The final straight segment can be defined with just its ending point.

31 **[ENTER]**

You have now defined the center line for the SMITH driveway. Defining a roadway is no more complicated. You would probably have more segments, but they should not be any more difficult. The finished point list should look like this:

```
PT 30
PT 45
CR 45-33,0.000,L,S,-0...
CR 33-46,150.000,L,S,...
CR 46-34,150.000,L,S,...
PT 31
NXT PT?
```

OFFSET STAKEOUT

You are now ready to stake out the *offsets* to the center line. Let's say you have an offset of 10 ft. for the road way, a 4 ft. set back to the stake, and that you want to set a stake every 50 ft. The Offset Stakeout capability of the TDS-48GX makes this task easy and straight forward. Using this feature, you can stake an offset point along a center line by specifying a station and offset distance. The center line is always defined by the current Point List.

Step 1: After exiting from the Point List you should be back in the Offset Stakeout Setup screen. If not, from the Stakeout Menu choose **[H]** for the Offset Stakeout Screen, then press **[SETUP]**. The Setup Screen appears below properly filled out for this job. Mr. Smith's driveway will not have a cross section slope or a curb.

```
Occupy pt: 50
Begin sta:0   +0.000
Sta. intrvl(ft):50.0
Section width  :10.0
Cross slope(%) :0.00
Curb height(in):0.00
Ofst from curb :4.00
```

SOLVE	PTLST	BACK			EXIT

NOTE: When the units are feet, the station interval is in feet and the curb height is in inches. When the units are meters, the station interval is in meters and the curb height is in centimeters.

Step 2: Use the **[BACK]** key to check to be sure the backsight is still set on point 6. After pressing **[SOLVE]** in the backsight screen, press **[EXIT]** to return to the setup screen. Then, press **[SOLVE]** in the setup screen to compute the setup screen. A result screen will be displayed as shown below:

```
Starting Pt:   30
Backsight Pt: 6
Backsight Az: 152.5501
```

Step 3: Hit any key to exit this screen and return to the setup screen, then press **[EXIT]** to exit from the setup screen, back to the Offset Stakeout Screen. Set the Station to 0+00, the Offset: to read ">Right" and enter "100" for the store point. Press **[SOLVE]**. The TDS-48GX will provide the circle angle and horizontal distance for the first offset point to be staked. The screen should look like:

```
   Offset Stakeout
Station:    0 + 0.000
Offset : >Right            <= Center / Right / Left
Store pt:      100
Segment: Straight          ** Straight / H curve /
Circular  : 133.0104          V curve / H+V curv **
Horiz dist: 350.841
SOLVE | STAKE | CIR-0 | ADV | SETUP | EXIT
```

Step 4: Have your rod man pace the distance close to the point to be staked. Press **[STAKE]**. You will see the Stake Shot Screen:

```
    Stake Shot
Horiz dist: 350.841
HI: 5.420  HR: 6.000
Zenith ang: 91.2053
Slope dist: 348.69
Come: 2.247
Fill: 0.644 Elv:229.10
```

GRADE	SHOT	STORE	FAST		EXIT

Step 5: At this point, if you were connected to an electronic total station, you would press **[SHOT]**. The TDS-48GX would trigger the gun and collect the required data automatically. For this example, you must key in the zenith angle and slope distance to the rod and press **[SHOT]**. Enter:

Zenith: 91.2053
Slope dist: 348.69

Step 6: Move your rod man based on the Come or Go message and take another **[SHOT]**. Enter:

Slope dist: 350.72

Step 7: Repeat this process until you are close enough to the required stake point. Now, press **[STORE]** to store the coordinates of the actual stake point in the coordinate file at the specified store point in this screen.

Step 8: You have completed staking the first offset point. Press **[EXIT]** to return to the Offset Stakeout Screen. At this time there are several options on how to proceed:

Option 1: You can continue staking the right side of the driveway and return to the beginning to stake the left side when the right is completed. To proceed in this fashion simply press **[ADV]**. This key will advance the point to be staked to the next station along either the right or left offset depending on the contents of the offset field.

Option 2: To minimize the movement of the rod man, you may want to stake alternatively from right to left for each station. You may do this by using the horizontal cursor keys on the offset line of the display to change it to >Left; then, press **[SOLVE]**. After staking the left side, you can use **[ADV]** as in Option1; then change back to the >Right, etc.

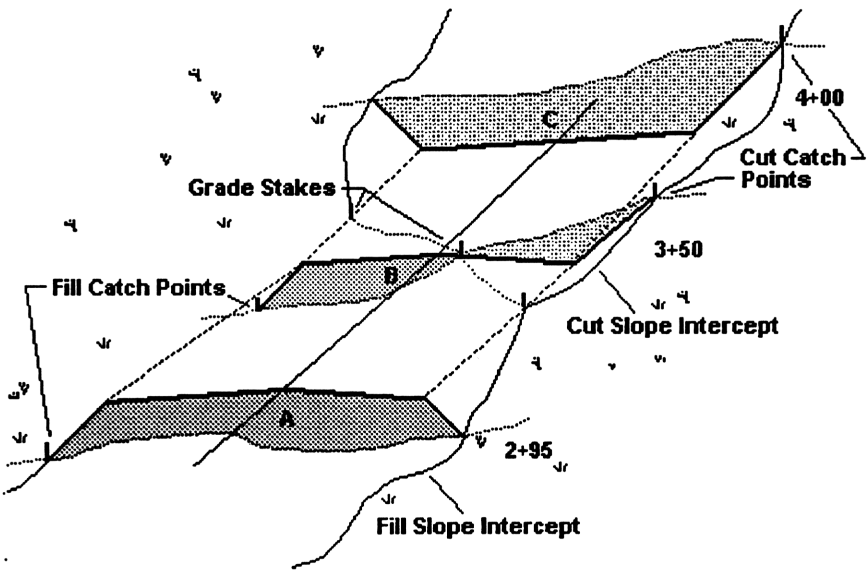
Option 3: At any time, you can stake an offset at a point that does not fall on a station interval by entering a new station on the first line. Then, press **[SOLVE]**. After staking this point, if you want to return to your regular interval stationing, you will need to enter the correct station. Pressing **[ADV]** simply adds the station interval to the last staked station and solves for this new station offset.

Option 4: You can stake the center line itself as you are proceeding down the driveway or by itself. To do this, select ">Center" as the Offset:. Any of the options described above are available while staking the center line.

Using these techniques, the entire driveway may be staked with the same field procedure, regardless of the curves encountered along the way.

SLOPE STAKE

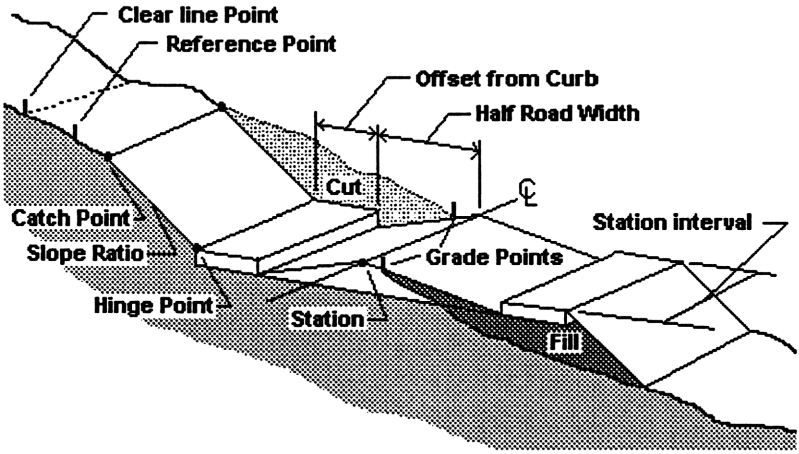
Slope Staking is a process used to establish the position of a road template on the physical terrain. After defining the width and crown of the road, the height of the curb, offset from curb, and other parameters of the road profile, Slope Staking lets you determine the position where you need to start to cut or the distance that fill must be placed to establish the desired road bed.



As you can see from the diagram above, the road may require fill to both sides (A); one side fill and one cut (B); or, a cut to both sides (C). In addition, the road template may have a slope and width that is symmetrical (B) or each side can be defined independently (A & C).

STAKEOUT

With the following diagram in mind, let us discuss several terms.



Catch Point: This is the point where the slope of the cut or fill needed to level the road bed meets the surface of the existing terrain.

Clear line point: This is a reference point staked at the line, beyond which construction should not disturb.

Grade Point: Is a point where the road profile and the existing terrain meet. Grade points are points where neither cut nor fill is required.

Half road width: Is the width of the road from the center line to the edge of pavement.

Hinge Point: Is the point where the road template and the cut or fill slope meet.

Reference Stake: Is a stake set some distance and elevational difference from the catch point.

Slope ratio(H / V): The slope of the cut or fill line. This is expressed as the horizontal component of the slope divided by the vertical component of slope.

Station: Is the point along the center line for which a catch point is currently being staked.

SLOPE STAKE: Setup

This example will use the SMITH driveway to approximate the field steps necessary to establish three catch points along our road way. The lay of the land used in this example is sloping, high from the north down across the driveway to the south and **does not match** the topo you may have done in an earlier chapter. The center line, defined for the Offset stake example, will be used here also. If you have not done the offset stake example, or do not have the Point List available, you will need to go back and generate the Point List.

Our first task is to establish our occupied point, the backsight point and the station information that will be used for staking. We now move to the Slope Stake Screen.

Path:	From the Main Menu, select **[I] Stake Out**, and, from the Stake out Menu, select **[I] Slope Stake**.

The Offset Staking Setup screen is the place this data is entered. Press the **[SETUP]** or **[E]** key to move there. The setup screen is the same here as it was for offset stakeout.

```
Occupy pt: 50
Begin sta:0   +0.000
Sta. intrvl(ft):50.0
Section width  :13.0
Cross slope(%) :-15.00
Curb height(in):0.00
Ofst from curb :0.00
```

SOLVE	PTLST	BACK			EXIT

Step 1: Enter "50" as the Occupy Pt:

NOTE: As with all stakeout routines, the occupied point can be any point in the current job or control files. A point on the center line could have been used just as well.

Step 2: To set the backsight point press **[BACK]** or **[C]**. This will bring up the backsight screen:

BS point /
BS azm / BS brg =>

```
   Backsight
>BS point: 6
 Circle:   0.0000

BS Azm: 152.5501
BS Brg: S27.0459E
```

SOLVE	CHECK		FAST	CIRCLE	EXIT

NOTE:

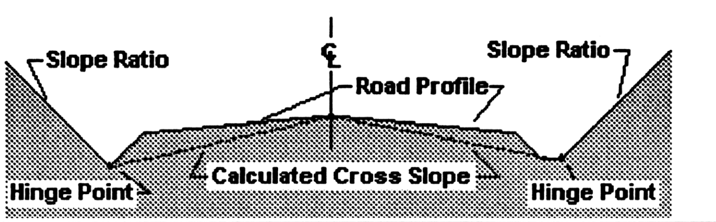
If the first data entry prompt does not read **>BS Point:**, use the left or right arrow keys to scroll to the desired prompt.

Enter "6" as the BS Pt:. The Back Circle should be set to "0". Press **[SOLVE]** to calculate the backsight Azimuth (152.5501) and Bearing (S27.0459E). Press **[EXIT]**.

Step 3: Enter the Begin Sta.:(0 + 00) and the Sta. Interval:(50). These entries are the station number where the Point List begins and how much the current station will increment, when you press the **[ADV]** or **[D]** key.

The next task is to define the road template. This involves defining the crown of the road, the height of curb, offset from curb to hinge point, and the slope ratio of the cut or fill line.

The Slope Stake routine will allow you to stake a street with curbs and sidewalks or you can stake a road profile with a ditch to one or both sides. To define a road with a ditch, simply calculate the slope and distance from the center line to the hinge point. Enter this information in the Section width: and Slope ratio: fields. Then, set the height of curb and offset to curb to "0". See the diagram below:



Step 4: Our driveway will have a V ditch on each side as shown on the left side of the above diagram. The cross slope and section width are 13ft. and -15%. Enter them here and finish filling out the screen as shown above.

Step 5: At this point we are finished with the setup screen. Press **[SOLVE]** or **[A]** to enter the values into the system. A result screen will be displayed as shown below:

```
Starting Pt:   30
Backsight Pt:  6
Backsight Az:  152.5501
```

Hit any key to exit this screen and return to the setup screen, then press **[EXIT]** to exit from the setup screen back to the Slope Stake Screen.

```
   Slope Staking
Station:   2 + 50.000
Segment: V curve
Section width   : 13.0
Slope ratio: 2.00
Estimated C/F: 0.50
Store pt: 130
```

	STAKE		ADV	SETUP	EXIT

** Straight / H curve / V curve / H+V curv **

NOTE: As a typical road progresses, some of these parameters may change. The slope of one or both sides may vary as in a super elevation or for drainage. The slope ratio may also change due to terrain or soil conditions. The road may widen or narrow for a passing lane or a narrow bridge. These changes should be made prior to staking the stations that they effect. In our example, the template is the same throughout the entire driveway.

Step 6: Let's enter "2" as the slope ratio. This is the horizontal distance over the vertical distance of the cut or fill line (2/1).

Step 7: The estimated cut or fill is a guess at the cut or fill needed at the center line. Enter "0.5"

NOTE:

> Since the TDS-48GX does not know the actual terrain features during slope staking, the process for locating a catch point is iterative. The estimated cut or fill is an optional entry designed to improve the TDS-48GX's ability to determine the catch point. You will arrive at the same catch point with or without entering the estimated cut or fill. But, the more accurate the estimation you enter for the cut or fill, the fewer iterations the system should take to get there.

Step 8: Type "130" in the Store Pt field.

The second line of this screen is a display-only line that informs you as to what type of a segment you are currently staking. This display can read: Straight, H-Curve, V-Curve, or H+V-Curve.

Step 9: Our last step in setting up our slope stake is to tell the system the station you want to stake. For our example, let us assume we have previously staked up to station 2+50. Enter "2" in the first field and "50" in the second.

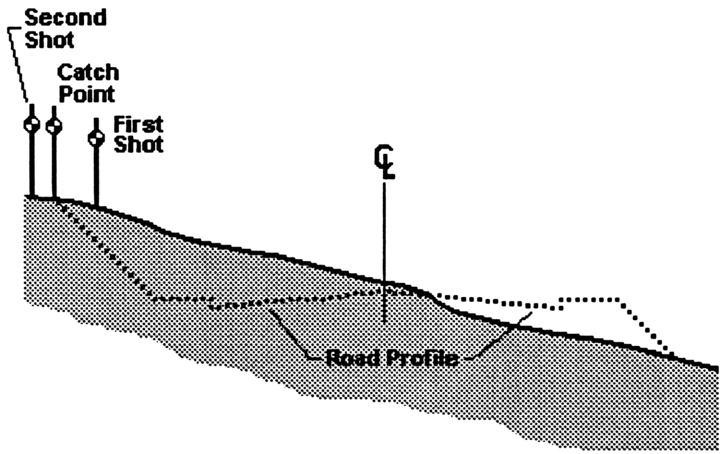
Start to Stake

Now you are ready to slope stake this example. At this point, press the **[STAKE]** or **[B]** key which brings up the following screen:

Zenith ang / Vert dist
Slope dist / Horiz dist =>

```
  Slope Stake Shot
Station: 2 + 50.000
HI: 5.380  HR: 6.000
Circular:169.2535
>Zenith ang:92.2745
 Slope dist:138.660
Go from C.L.:4.228
```

SIGHT	SHOT	STORE	FAST		EXIT



This is the screen from which slope staking takes place. At this point, if we were working in the field, you would occupy point 50 and zero your instrument on point 6 (the backsight). Your rod man would move to a point perpendicular to the station to be slope staked and where he estimates the catch point to be. The instrument man would then sight the rod and press **[SHOT]** or **[B]**, down loading the angles and distance to the TDS-48GX. Because this is an example, we need to enter this information manually.

Step 1: Enter "5.42" in the HI and "6.00" in the HR.

Step 2: Now, we imitate our first shot by entering:

Circle: 169.2535
Zenith: 92.2745
Slope Dist: 138.66

Press **[SHOT]** to simulate the shot and calculate the results.

As the results are analyzed, a prompt will inform you that the rod man is 1.29 feet to the right of perpendicular to the center line. When you return to the shot screen, the last line of the screen should display:

Go from C.L.: 4.228

From this display, we see that the rod man needs to go another 4.25 feet away from the center line. As the rod man moves to the new position, he should also move to his right 1.3 feet. Here we take a second shot.

NOTE: At any time after you have taken the first shot, you can view statistics about your shot by pressing **[SIGHT]**. This brings up the following screen:

```
1.29 ft off to right
Stake elev: 231.34
Stake to hinge: 3.09
Sight C.P. from gun:
 Circular: 170.1034
 Horiz dist: 142.61
 Cut : 3.66
```

SIGHT	SHOT	STORE	FAST		EXIT

Step 3: Now enter:
Circle: 169.5108
Zenith: 92.5734
Slope Dist: 142.09

Press **[SHOT]** or **[B]** to simulate the second shot.

The screen should display the repositioning information as:

Come to C.L.: 1.697

This time the rod man needs to go back about 1.5 foot toward the center line. He is now also closer to the perpendicular.

Step 4: Now enter:
Circle: 169.4629
Zenith: 92.5026
Slope Dist: 141.32

Press **[SHOT]** or **[B]** for the third shot.

Step 5: For the purpose of this survey, let's say the above shot is close enough. Now, we want to store this catch point. Press **[STORE]** or **[C]** to store this point.

The following screen will be displayed:

```
  Store/Stake Ref. PT
Ref. pt offset: 4.00
Desc:SLOPE REF 131
Store pt:131
Circular  : 170.4959
Horiz dist: 144.156
Elevation:  230.295
```

SOLVE	STAK	STORE			EXIT

Step 6: To store the catch point, enter "0" at the Ref. pt offset field. (If you did not want to store the catch point but only store the reference point, then you would skip to Step 7.) Then press **[STORE]** and the point will be stored.

Step 7: Now, you can set as many reference stakes as you would like. First you entering the offset distance, then stake the ref. point as you would in the offset stake routine. We will stake one reference point at four feet out from the catch point. Enter "4" as the offset and a descriptor, then press **[SOLVE]**. Now the rod man would place the rod four foot back and you shoot this point. The screen should appear as above. Now press **[STAK]** and the Stake Shot screen will be displayed:

```
  Stake Shot
Horiz dist: 144.156
HI:5.420  HR:6.000
zenith ang: 92.5436
Slope dist: 144.31
Go  : 0.032
Fil:0.232 Elv:229.97
```

GRAD	SHOT	STORE	FAST		EXIT

Step 8: Fill out the screen as above and press **[SHOT]**. A come or go will be calculated. Repeat the shot process as many times as necessary. When the come/go is within tolerances press the **[STORE]** key and the reference point will be stored.

We are now finished slope staking this side of this station. Press [EXIT] until you returned to the slope stake screen. If we were only staking one side of the road, we would press **[ADV]**; but, we will be staking the other side of the road. To stake the other side of the road, simply press **[STAKE]** again.

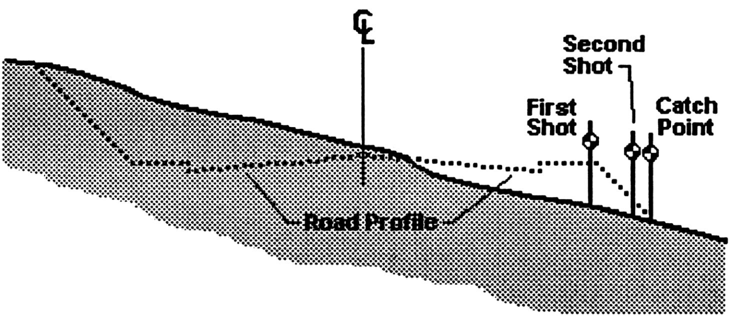
STAKEOUT

Stake other Side

Our example is designed such that the slope of the terrain is across the road. As we staked the left side, we were working with cuts, but the right side will be a fill.

NOTE:

> You do not need to tell the program which side of the road you will stake nor whether you are staking a cut or fill. If the rod is shot to the left of center, the program calculates the left catch point or vice versa. Also, if the rod elevation is above the road profile, it assumes a cut; if below, it assumes a fill.



For brevity, we will give only the data to be entered and keys to be pressed.

Step 1: Enter:
- Circle: 157.5506
- Zenith: 96.2947
- Slope Dist: 116.76

Press **[SHOT]** or **[B]** to simulate the first shot.

The screen should display the following results:

Go from C.L.: 2.271

The rod man goes out another 2 feet and we take a second shot.

Step 2: Now enter:
- Circle: 156.2327
- Zenith: 97.0745
- Slope Dist: 114.71

Press **[SHOT]** or **[B]**.

The following is displayed:

Go from C.L.: 0.561

The rod man goes another 1/2 foot out, and we take a third shot.

Step 3: Now enter the following and press **[SHOT]** or **[B]**.

Circle: 156.0103
Zenith: 97.1129
Slope Dist: 114.37

Step 4: Again, this last shot is close enough. To store this catch point, press **[STORE] [C]**. Enter "0" as the offset, then a descriptor and press **[STORE]**. Next set the reference stake at a 4 feet offset as you did with the last point.

Advance to next point

You have finished Staking both sides of the road at this station so returned to the Slope Stake Screen. We want to stake the next station so press **[ADV]**. This tries to adds 50 feet, the station interval we specified, to the current station which would be 3+00. Instead it has reached point 33, the beginning of the horizontal curve, station 2+64.882. For this example we want to continue staking at 50 foot intervals, with out staking the points along the center line, so enter 3+00 for the Station. You are ready to press **[STAKE]** again.

Step 1: Enter:

Circle: 187.2644
Zenith: 92.2053
Slope Dist: 121.05

Press **[SHOT]** or **[B]** to simulate a shot.

The screen should display the following results:

Go from C.L.: 1.491

The rod man goes out another 1.5 feet and we take a second shot.

Step 2: Now enter:

Circle: 187.2634
Zenith: 92.4122
Slope Dist: 122.47

Press **[SHOT]** or **[B]**.

Step 3: The above shot is close enough, so again, store this catch point the reference point.

NOTE:

> The number of iterations it will take to arrive at the catch point will vary from station to station. It will depend on a number of factors including:
>
> - The estimate of the cut or fill at the center line.
> - How the terrain varies.
> - The ability of the rod man to estimate the catch point on the first shot.

We have now finished slope staking this side of the road at this station and can returned to the slope stake screen.

Summary

This completes our Slope Staking example. If you were actually slope staking you would simply continue to stake catch points as we have done. Let us now go over some points to remember.

- You must define the center line with both horizontal and vertical profile information in order for the TDS-48GX to slope stake correctly.
- Directions for the rod man to Come or Go are perpendicular the center line.
- Estimate Cut or Fill is optional.
- Don't worry about informing the data collector which side of the road you are working on, or if it is to be a cut or fill. The system can establish this for itself.

7. ADVANCED FIELD WORK

In this chapter, you will learn about certain more specialized field functions of the TDS-48GX. You will look at several backsight functions and repetition routines in greater detail. A discussion of Off Center shots is provided as well as a look at Differential and Trig leveling.

The following routines are fairly specialized. Not every user will have need of all of them. We recommend that you glance through all of them so that you will be aware of their capabilities. Then spend more time with those that you will be using.

BACKSIGHT

The main function of the Backsight Screen is to set a direction of reference for the next series of shots. However, within the backsight screen, there are two softkeys which we have not yet covered: **[CHEC]** and **[CIRCL]**. Each bring up a Menu with two choices. The **[CHEC]** key allows two options. **[G]** will shoot the distance to the backsight point and compare the measured distance with the calculated distance to check for a incorrect backsight point. With selection **[H]** you can, while in the process of collecting sideshots, return to your backsight and check the circle reading.

The **[CIRCL]** key lets you read the circle reading from your gun into the backsight screen, or send the backsight circle value to your gun to calibrate its circle setting. Let's look at each of these options.

Path:	From the Traverse / Sideshot screen, press **[BACK]** to display the Backsight screen pictured below:

BS point / BS azm / BS brg =>

```
   Backsight
>BS point:27
 Circle:  0.0000

BS Azm:   76.5236
BS Brg:   N83.3645W
```

SOLVE	CHEC		FAST	CIRCL	EXIT

ADVANCED FIELDWORK

CONFIRM BACKSIGHT POINT

After you have entered a backsight point and pressed **[SOLVE]** to calculate the BS Azm and BS Brg, you can compare the measured and calculated distances to this backsight point in an effort to confirm that you are sighting the correct point. With your BS point solved press **[CHEC]** to bring up the following menu:

```
    Check Backsight

G Confirm BS point
  by shooting dist.
H Check BS circle
```

Selecting **[G] Confirm BS point** while connected to an electronic total station will prompt you with:

```
Shoot BS point
Hit a key when ready.
```

While sighting a prism on your backsight, pressing any key will fire the instrument and read the distance. The data collector will then compare this distance to the calculated distance between the occupied point and the point number entered in the backsight screen. It will then display the difference. This is not a guarantee that you are sighting the correct point but should detect nearly all missighted backsights.

NOTE:

The confirm BS point routine will only work when electronically connected to a total station. When in the manual mode, selecting **[G] Confirm BS point** will display **"Not applicable"**.

This function also requires a backsight point be used. If a **BS asm** or **BS Brg** are solved in the Backsight screen and then **[G] Confirm BS point** is selected, the prompt **"Error: BS point unknown"** will be displayed.

CHECK BS CIRCLE

At any time, as you take sideshots from a point, you can check your backsight circle reading. From the Traverse / Sideshot screen, press **[BACK]** and then **[CHEC]**. Select **[H] Check BS circle**. You will be prompted with:

```
BS circle
Hit a key when ready.
```

Point your scope at your backsight then press a key. The data collector will calculate the difference between the BS circle and the circle reading of your instrument displaying:

```
Angle error=#.####
```

This routine will accommodate any backsight direction entry method. BS point, BS azm and BS brg are all acceptable. It can also be used in the manual mode by keying in the circle reading of the gun. Pressing **[H] Check BS circle** will prompt you with:

```
BS circle
```

Enter the instrument's circle reading and press **[ENTER]**. The data collector will display the angle error.

READ BACKSIGHT CIRCLE FROM INSTRUMENT

The **[CIRCLE]** key allows you to download the instrument's circle reading from your gun or upload the backsight circle value into your gun. Pressing **[CIRCLE]** will display the following menu:

```
    Backsight Circle

G Read BS circle from
  instrument
H Send BS circle to
  instrument
```

Selecting **[G] Read BS circle** will query your instrument for its circle reading and place it in the backsight Circle field. If your TDS-48GX is in the manual mode, you will be prompted to enter the circle reading. If you are connected to a total station, the display of the 48GX will read:

```
Read BS circle:
Hit a key when ready.
```

While pointing at your backsight, press a key. The instrument's circle reading will be transferred to the backsight circle field.

SEND BACKSIGHT CIRCLE TO INSTRUMENT

Selecting **[H] Send BS circle** will set your instrument's circle to the backsight circle entry. Enter the value that you would like your total station's circle to be in the backsight circle field. Then press **[CIRCL]** and select **[H] Send BS circle**. The data collector will upload the circle value to the gun and set its circle reading.

NOTE: This routine cannot be used in the manual mode. If you receive the prompt, **"Can't set HA on gun"**, you are either in manual mode or are using an instrument that does not allow the circle to be set using a remote data collector.

TRAVERSE / SIDESHOT REPETITION MENU

The Repetition Menu allows you to establish a variety of repetition (repeated readings) modes for doing field work.

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

```
   TR/SS Repetition
G Horiz dir & rev
H Horiz accumulation
I Zenith dir & rev
J Multiple distances
K Radial sideshots
L Set Rep. mode
M Shoot from 2 ends
N Go to record mode
```

MORE					EXIT

Pressing **[REP]** from the Traverse/Sideshot Screen will display the menu choices shown above. Selecting **[G]**, **[H]**,**[I]** or **[J]** will prompt you for input, either manual or electronic, in the proper sequence to take repetitive readings. Depending on which menu choice you make, the TDS-48GX will direct you througha series of either multiple angle or distance reading and compute the average.

In each of the first four choices, you will be prompted for the number of sets or repetitions to be performed. For a dir & rev reading, one set is a shot with the scope direct and a shot with it reversed. This will result in a repetitive reading. With the accumulations or multiple distance options, one set is a single shot and needs to be have at least two sets to get repetitive readings.

Next, each routine will prompt for the different observations each requires to average a multiple reading. Let us step through an example using the **[G] Horiz dir & rev**.

Step 1: After pressing **[G],** you are prompted for the **Number of sets:**. With this selection, one set is a direct shot and a reverse shot. This is what we want; so, enter "1".

Step 2: Next, you are prompted for the **BS Dir 1:**. If you were connected to a total station, you would point at your backsight and hit a key. The data collector would gather the necessary data from the gun. Since we are working manually, enter a backsight of 0.

Step 3: Next, you are prompted for the **FS Dir 1:**. Again, if you were connected to a total station, you would point at your Foresight and collect the data from the gun. Manually, enter 42.5245.

Step 4: You are prompted for the:

Reverse!!
BS Rev 1:

Enter 180.0014. You are prompted for:

FS Rev 1:

Enter 222.5203. The screen will read:

Reverse!!
BS Rev 1:180.0014
FS Rev 1:222.5203
Set scope upright!!
Need to use [SIDES]/
[TRAV] to store pt
Hit a key to continue

Step 5: Press the **[EXIT]** twice to return to the Traverse / Sideshot screen. You should see that the Ang right is now 42.5238 or the average of the two shots.

You can select these four choices as many times as needed to gather your repetitive observations; e.g., you could press **[G]** Horiz dir & rev to shoot the horizontal angle. Then, select **[J] Multiple distances** and, finally, use **[I] Zenith dir & rev** to finish the shot. After exiting to the Traverse/Sideshot Screen, pressing **[SIDES]** or **[TRAV]** now will cause the TDS-48GX to take any observations, either angles or distance, for this point that were not collected using the repetition options. It will then compute the coordinates of the new point from a combination of average data and single readings depending on what was acquired by the TR/SS Repetition Menu choice.

Selecting **[L]** Set Rep. mode will transfer you to the Repetition Mode screen.

```
Horiz angle mode:                  Single / Directional /
      >Directional              <= Accumulation
Vert angle: >Single             <= Single / Multiple
Dist mode:  >Single             <= Single / Multiple
Number of sets: 1
Angle tol(sec): 30.00
Dist tol(ft)  : 0.50
MORE |  |  |  |  | EXIT
```

This screen lets you combine the choices listed above into a single series of observations. You can customize your repetitive shots so as to collect that data you want repetitively and the remainder singularly. Once the setup is determined, the TDS-48GX will collect all measurements necessary for the repetitive shots in one set of observations. This screen also sets the tolerances at which the data collector will warn you about errors. See the example in Chapter 3: Field Work.

NOTE:

If you have preset the Repetition Mode Screen with some number of "sets" other than zero, pressing **[SIDES]** or **[TRAV]** from the Traverse/Sideshot Screen will cause the TDS-48 to prompt you for input, either manual or electronic, in the proper sequence to take the repeated readings and compute the average angles and distances. If you want to set TDS-48GX back to a non-repetitive mode, you must enter zero in the **Number of sets:** field.

ADVANCED FIELDWORK

SHOOT FROM TWO ENDS

There is one more selection that can be combined with these first four to produce a foresight observation. This is Shoot From Two Ends. This routine lets you take zenith angle and distance measurements from both ends of a foresight line. You cannot program it into a single series of shots using the Repetition Mode screen but you can combine it with that series as long as the Shoot From Two Ends is performed last. The reason you use the Shoot From Two Ends second is so that the repetition series does not overwrite the zenith angle and slope distance gathered by the Shoot From Two Ends. You can also use selections **[G]** or **[H]**, before or after the Shoot from two ends, to collect the horizontal angle. For our example, let us assume that the Horizontal direct & reverse that we just completed was our horizontal angle for this Shoot From Two Ends.

The Shoot From Two Ends routine does not care which end you shoot from first. However, the horizontal angle will be computed from the forward occupied point and not the point occupied when shooting the backward observation. Typically, you would gather a horizontal angle first then shoot the forward zenith and slope distance. Then, you would occupy your foresight and shoot the backward zenith and slope distance. For our example, we will follow this pattern. We have gathered our horizontal angle in the above example and will now take the forward shot first. If you have not done the Previous Horiz. dir & rev example, simply enter the resulting angle right of 42.5238 in the Traverse / Sideshot screen .

Path:	From the Traverse/Sideshot Screen, press **[REP]**; then **[M]** **Shoot from 2 ends** for the following screen:

Direct only / Direct & Rev =>

```
  Shoot from 2 Ends
Option: >Direct only
-Use [FRWRD] & [BKWRD]
 to shoot from 2 ends.
-Then press [SOLVE]
 to average.
 HA is not affected.
```

SOLVE	FRWR		BKWR		EXIT

Step 1: Be sure that the Option line reads "Direct only". Press the **[FRWR]** key to bring up the Forward Shooting screen.

```
  Forward Shooting
HI:5.280   HR:6.000
Zenith ang:92.2548
Slp Dist:  374.39

[SHOOT] [ ] [ ] [ ] [ ] [EXIT]
```

Step 2: If you were collecting data electronically you would simply press **[SHOOT]**. For our manual example fill out the screen as above and the press **[SHOOT]**.

Step 3: Now press **[BKWR]** to display the Backward Shooting screen.

```
  Backward Shooting
HI:5.430   HR:6.000
Zenith ang:88.4416
Slp Dist:  374.46

[SHOOT] [ ] [ ] [ ] [ ] [EXIT]
```

Step 4: Again, fill out the screen as it is displayed above and press **[SHOOT]**. Be sure to change the HI.

Step 5: **Press [SOLVE]** to compute the average zenith and slope distance. The screen will prompt you that you must still press **[TRAV]** or **[SIDES]** to store the point.

Step 6: Now press **[EXIT]** twice to return to the Traverse / Sideshot screen. Notice that the Zenith angle is now 92.2543, and the Slope distance is 374.43. These are the correct data for our foresight, and we have collected a horizontal angle using a direct and reverse reading.

Step 7: At this time, all the data is collected. Pressing **[TRAV]** or **[SIDES]** will calculate the coordinates and store the point.

ADVANCED FIELDWORK

RADIAL SIDESHOTS

The last repetitive reading selection is the Radial Sideshots. It cannot be combined with any of the other repetitive routines, but collects all the data it needs in the routine itself. The procedure of the Radial Sideshots routine is to take a series of direct and reverse readings at the backsight. Then, take a series of direct and reverse readings at the first foresight; a series of direct and reverse readings at a second foresight; and so forth, for as many foresights as you want. Let's run through a few Radial Sideshots.

Path:	From the Traverse/Sideshot Screen, press **[REP], then [K] Radial Sideshots**.

```
   Radial Sideshots
HI:5.43    HR:6.000
Ang right:  193.1130
Zenith ang: 89.0321
Slope dist: 278.490
Horiz error: XXXXXX
Vert error:  XXXXXX
```

SIDES					EXIT

Step 1: When you press the **[K]** key for Radial Sideshots, you are prompted for the number of sets:

For each foresight,
Number of sets:

Enter "1" which will set the routine to take one set of, a direct and a reverse reading at each observed point, including the backsight.

Step 2: Next a prompt will ask for the backsight shot direct:

BS direct:

Let's assume that you have zeroed your instrument on the backsight; so, enter "0".

Step 3: Now you are prompted for the backsight shot reversed:

BS direct: 0
BS reverse:

You have now flipped your instrument on the backsight; so, enter "180.0009".

Step 4: The next prompt reads:

Ready to shoot FS pts.
1 sets of Dir & Rev
for each point

<Any key to continue>

Press a key. The Radial Sideshots screen will be displayed.

Step 5: The only data that needs to be entered in the screen itself is the HI and HR. The rest of the information will be prompted for. All the observed data would be collected electronically from your total station if you were working in the field. You are now ready to take the first foresight. Press **[SIDES]**.

Step 6: The data collector will prompt:

Set: 1
Shoot FS point
Hit a key when ready.

Hit a key; and, you are prompted for your observations:

Slope dist: 278.47
Horiz ang: 193.1128
Zenith ang: 89.3350

Enter the above data and press **[ENTER]** to bring up the next line.

Step 7: After the zenith angle is entered you are prompted for the reverse observations:

Reverse scope
Hit a key when ready.
Slope dist: 278.51
Horiz ang: 13.1141
Zenith ang: 271.2709

Again, hit a key; then, enter the data and press **[ENTER]**.

Step 8: You are now prompted for a descriptor. Enter "TEST PT" and press **[ENTER]**. The Radial Sideshots screen now displays the results of this sideshot and should match the display shown above.

Step 9: That completes one sideshot. Using the data below, press **[SIDES]** one more time and enter another sideshot.

Set: 1
Shoot FS point
Hit a key when ready.
Slope dist: 159.73
Horiz ang: 71.5133
Zenith ang: 89.2551

Reverse scope
Hit a key when ready.
Slope dist: 159.81
Horiz ang: 251.5147
Zenith ang: 271.3414

Step 10: You have just shot two sideshots with multiple horizontal angles, zenith angles and slope distances. This process can continue for as many foresights as you might have.

RECORD MODE.

The last option in the TR/SS Repetition menu is the Record Mode. This puts the TDS-48GX into a mode where you control the total station from its own keypad. The data collector simply logs points as they are received.

Path:	From the Main Menu, press **[J]** Traverse/Sideshot Screen; then **[REP]** then, **[N] Go to record mode** to bring up the following display.

```
The data collector is
now in recording mode.
Press appropriate key
on gun to take shots.


<Any key to continue>
```

					EXIT

Press a key and the data collector will prompt:

Enter descriptor for
all of the following
shots.
Desc:

Enter a descriptor that will be stored with all shots recorded in this mode. After pressing **[ENTER]**, you will see one or two more prompts telling you how to control your particular gun. Follow the prompts, collecting shots until you are finished. Press **[EXIT]** or the **[F]** key to return control to the TDS-48GX.

NOTE: The Record mode routine only supports certain instruments. If you receive the prompt: **"Record mode not supported."** after pressing the **[N] Go to Record mode** key, you are either in the Manual mode or your instrument is not supported.

OFF CENTER SHOT MENU

The following five screens are used when it is not practical or not possible for the rod to occupy the point to be shot. The Off Center Shot routines allow you to shoot points when you cannot place the rod target exactly on the point.

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

```
  Off Center Shot
G Horiz ang offset
H Horiz dist offset
I Vert ang offset
J Right ang offset
K Vert dist offset
L Benchmark
```

					EXIT

The Off Center Shot Menu covers five common situations that are encountered in the field when it is not convenient or not possible for the rod to occupy the point that needs to be stored. Those five situations are selected from the Off Center Shot menu. They are explained and illustrated in the paragraphs below.

If you were collecting data electronically, you would press the **[OFFCT]** key from the Traverse/Sideshot Screen and select the off-center routine needed. You would then press a softkey to take a shot to the rod. Finally, you would either move the scope and press a second key to read an off-center angle or enter an off-center distance depending on the data required for that situation. Then, you would press **[STORE]** to store the shot. In each of the Off Center screens, there is a **[HELP]** key that will prompt you as to the steps needed for that routine.

As an example, let us step through the Horizontal Angle Offset routine manually.

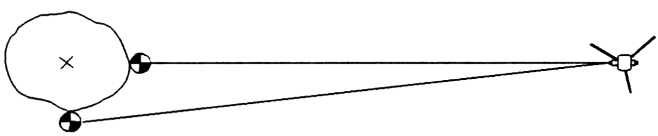
HORIZONTAL ANGLE OFFSET SCREEN

This screen allows you to shoot the center of a large object such as a big tree.

Path:	From the Main Menu, press **[J] Traverse / sideshot**; then press **[OFFCT] Off Center Shot Menu**; Finally, press **[G] Horizontal Angle Offset** to bring up the following screen:

```
  Horiz Ang Offset
FS point: 120
HI:5.260   HR:6.000
Side HA:       0.0000
Zenith:        0.0000
Slp dist:       0.000
Center HA:     0.0000
```

CNTR	SIDE	STORE		HELP	EXIT



Step 1: If you were in the middle of gathering data, the FS point, HI and HR fields in this screen would come from the Traverse / Sideshot screen and would probably be the numbers you would want. For our example, let's use "120" as a FS point. Also enter 5.26 as the HI and 6.00 as the HR.

Step 2: Next, if you were using a total station, you would shoot the rod at the side of the object by pressing the **[SIDE]** key. To manually simulate the data gathered by this shot, enter:

Side HA: 143.5543
Zenith: 89.2419
Slp dist: 257.82

Step 3: Now you want to shoot the rod in front of and at the center of the object. Electronically this would be done with the **[CNTR]** key. To simulate this, enter:

Center HA: 141.0029

Step 4: Press **[STORE]** and you will be prompted for a descriptor. Key in a descriptor, then press **[ENTER]**.

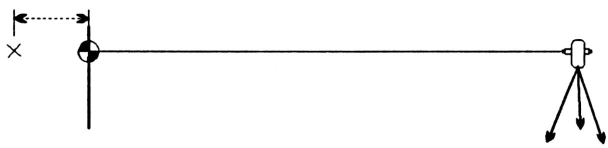
NOTE:

> The order in which you take the Off Center shots is up to you. In the example above, the **[CNTR]** shot could have been gathered before the **[SIDE]**. You simply need to have gathered all the data before pressing the **[STORE]** key.

Each of the other Off Center routines are briefly described below. For more details, see the Reference Section of this Manual.

HORIZONTAL DISTANCE OFFSET SCREEN

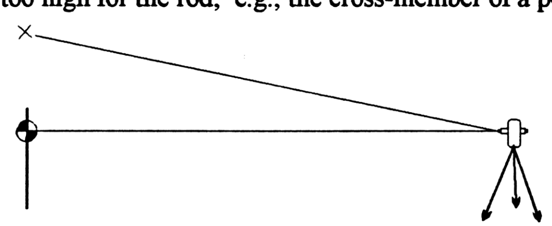
The Horizontal Distance Offset routine allows you to collect a point that is in-line with the rod but on which the rod man cannot occupy; e.g., the middle of a river.



To use this routine, place the rod inline with where the point should be placed. Shoot to the rod and enter the distance to add to the measured slope distance. Enter a negative distance to subtract from the slope distance.

VERTICAL ANGLE OFFSET SCREEN

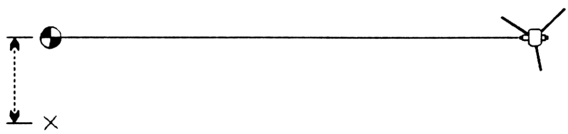
The purpose of the Vertical Angle Offset Screen is to allow you to store a point that is too high for the rod; e.g., the cross-member of a power pole.



This routine is used by placing the rod directly above or below the desired point and shooting the rod. Then, move the scope up or down to sight the true point, and press **[ZEN]** key to read the zenith angle.

RIGHT ANGLE OFFSET SCREEN

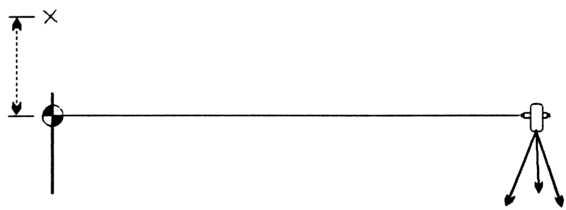
The Right Angle Offset Screen allows you to shoot a point that is at a right angle to your rod position; e.g., around the corner of a building.



Place the rod at a 90° offset to the point you want to store. Shoot the rod and enter the offset distance. From the Instrument man's point of view enter + for offsets to the right of the rod and - for offsets to the left of the rod.

VERTICAL DISTANCE OFFSET SCREEN

The purpose of the Vertical Distance Offset Screen is to allow you to collect a point for which you cannot sight the zenith angle, but to which you can measure the vertical distance; e.g., down a manhole.



Place the rod above or below the desired point and shoot the rod. Then enter the distance to the actual point: + for up and - for down.

ADVANCED FIELDWORK

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 **[L] Leveling Menu**; then, **[G] Differential Leveling** to bring up the following display:

BS pt / BS elev =>

```
 Differential Leveling
>BS elv:      132.820
BS rod reading: 24.380
FS rod reading: 3.110

Instr. elev: 157.200
FS elev:     154.0900
```

SOLVE		FS2BS			EXIT

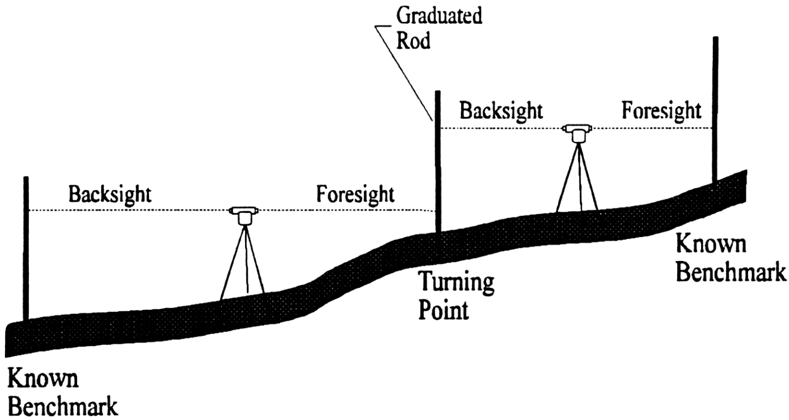
Step 1: Set up your instrument on a point where you can read your graduated rod on both the Backsight and the foresight. Enter the elevation or point number of the backsight point. In our example, enter 132.82.

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.



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 **[L] Leveling Menu**; then **[H] Trig Leveling** to display the following .

Station elv / Station pt =>

Zenith / Vert ang =>

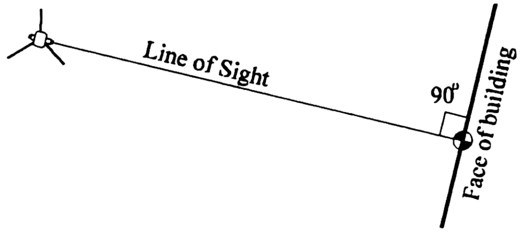
```
     Trig. Leveling
>Station elv:253.91
HI: 5.26
Horiz dist:  147.620
>Zenith:       86.5822
Target elv:  162.026
VD +- hor plan:2.676
```

SOLVE		HD			EXIT

ADVANCED FIELDWORK

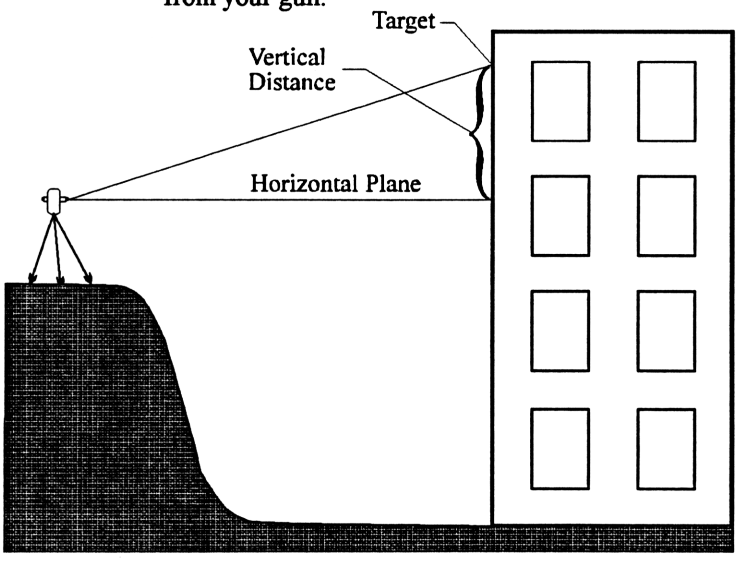
Step 1: Start by entering Station elv as 253.91 and the HI as 5.26.

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-48GX 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.



COLLIMATION

The Collimation screen lets you calculate your instrument's collimation error or simply enter it. This screen is also used to set a prism constant value and choose whether or not you want these corrections applied to your collected data.

Path:	From the Main Menu, press **[H] Setup menu**; then, **[H] Devices**; and finally, **[COLLI]** to display the following screen:

```
      Collimation
Apply collimation:>No    <= Yes / No

Horiz coll.:
Vert  coll.:

Prism constant:
SHOOT |      | STORE |      |      | EXIT
```

When you first press the **[SHOOT]** key, you will be asked, for the number of sets you wish to take. The **[SHOOT]** key will then read the instruments horizontal and vertical angles both from the direct and reversed scope positions, one set at a time. You can shoot at different points with significant horizontal and vertical separation to improve the collimation. The collimation errors will then be calculated, using the following formulas:

Horiz collimation = Direct HA - MOD 360(reverse HA +180)
Vert collimation = Direct ZE - (360 - reverse ZE)

Finally, the collimation errors are averaged and displayed on the screen.

If the Apply collimation selection is set to Yes, the following corrections will be applied to horizontal and vertical readings.

For direct measurements:
Corrected HA = Measured HA + Horiz collimation
Corrected ZE = Measured ZE + Vert collimation

For reverse measurements:
Corrected HA = Measured HA - Horiz collimation
Corrected ZE = Measured ZE - Vert collimation

The slope distance will also be adjusted by the following correction:

Adjusted slope distance = Measured slope distance + prism constant

8. INTEGRATING FIELD WORK WITH AUTO LINEWORK

In this chapter, you will learn how to add field codes to your data collection, thereby enabling EASY SURVEY to generate a map automatically. You will be introduced to Feature codes, which are used to group points, and to command codes, which instruct EASY SURVEY on how to map each group.

OVERVIEW

Auto linework is the ability to gather data in the field and, with limited input from the field crew, then have a PC generate an accurate drawing. Plotting is typically a desk top PC function. With auto linework, however the plotting instructions must be input at the time that the data is collected. The linework is completely a PC function, but the labels that group the points and the instructions on how to connect them, are entered by the field crew.

NOTE:

> This Chapter addresses linework with the assumption that you will be using Tripod Data System's EASY SURVEY to generate the plot. You can also use the TDS-48GX as a data collector, then transfer the data to TFR-Link and convert it to a form that a third party software could use to generate linework. The process of gathering data for use by some other software will be similar, but the codes used and the method or order in which the data is gathered may differ. See the TFR-Link Manual for advice on what conversions are available. Look to your third party PC software manual for information on the available codes and the form in which the data is needed.

LINEWORK

EASY SURVEY's auto linework uses surveyor-entered "feature codes" to group various shots in a survey. It also uses "command codes" that are entered while collecting data in the field that instruct EASY SURVEY how to treat these groups when it generates the lines or points. A code table is set up in EASY SURVEY to relate the feature codes to the line type, point marker, size, and color that the auto-mapping routine will use to generate the map on the screen.

Because points and lines are grouped under a feature code, it is usually not necessary to shoot points in a sequential order. EASY SURVEY takes the unordered points and groups them, then it generates points, lines and curves according to the directions of the command codes and the settings in the code table.

Due to the fact that this is a procedure that requires EASY SURVEY to generate the drawing, this chapter will deal mainly with the theory. The data generated in this example is not a complete plot, but only enough to explain the process.

INTEGRATING FIELD DATA WITH AUTO LINEWORK

Before we move on to some specific tasks, it is important to gain an understanding of how field data can be collected with the idea that auto linework will be used to generate a map from that data. The main elements of auto linework are the feature codes, command codes, and the code table.

Feature Codes

Feature codes are user-defined labels, placed in the descriptor field, that identify the kind of point you have shot; e.g. a fence, edge of pavement, etc. Feature codes are used to group similar points into features independent of marker or line types. All points that will be used to define a particular line must have the same feature code. For example you may have codes CENTER, CURB, SIDEWALK and TREE with coordinates that describe the center line , the curb, the edge of the sidewalk and the trees within a subdivision. The first three could then be connected by different line types and the trees might be defined with a distinctive marker. **The feature code is used only to group the points and does not have anything to do with how they are connected or displayed.**

The feature code can be up to 16 alpha-numeric characters or symbols. EASY SURVEY does not differentiate between case, so you can use either upper or lower case letters. Whether you enter a code as "curb" or "Curb," EASY SURVEY will see it as "CURB".

A feature code **cannot include a space** as part of the code. EASY SURVEY will only recognize the characters up to the first space as the feature code. So, if you want to join two words as a feature code, use the "-" or "_" keys between the words. For example, EASY SURVEY would see FENCE WIRE and FENCE WOOD as the same code : "FENCE". But, FENCE-WIRE or FENCE_WOOD are different, two-word feature codes.

The text after the space can be used as a descriptor. So, you could use TREE OAK, TREE PINE and TREE MAPLE in the descriptor field. They would all be grouped as a "TREE" feature, but you still have a descriptor that distinguishes the type of tree.

Feature codes are not job-specific. Any feature code used for one job can also be used on any other job.

LINEWORK

Command Codes

Command codes are system-defined instructions that tell the auto-map routine how to connect points to form the linework. They are entered as Notes in the raw data file just before the data that they act on. Command codes tell EASY SURVEY's auto-mapping routine when to pick up the pen; which points to join and where; where to start and end a line; which points to connect in a curve; and so on.

The command codes are system-defined as described below.

BEG	Starts a line segment. Lifts the pen at the previous point and lowers it at the next observed point.
C2 C2###.###	The next two points are the beginning and end points of a curve. When the radius [###.###] is not specified, the two points are assumed to be tangents (PC and PT of the curve). C2 does **not lift or lower** the pen (unless BEG is also specified).
C3	The next three points are the beginning, middle, and end points of a curve. C3 does **not lift or lower** the pen (unless BEG is also specified).
CP1 CP2 CP3	The first point of a 3-point curve. The second point of a 3-point curve. The third point of a 3-point curve. These commands produce the same kind of curve as a C3 command. The difference is that the 3 points do not have to be shot one after another. However the points must have the same feature code and be shot in order.
END	Ends the line segment and lifts the pen.
JFS	Joins the current point to the first point in the same feature code. JFS does not lift the pen.
JN	Joins the current point to the next observed point, regardless of the code, without lifting the pen.
JNS	Joins the current point to the nearest point of the same code, without lifting the pen.

JP####	Joins the next observed point to the specified [####] point regardless of the code. It lifts the pen to the specified point and lowers the pen to draw a line to the next observed point.
JPS	Joins the next observed point to the previous point of the same code. It lifts the pen to the previous point and lowers the pen to draw a line to the next observed point.
JT####	Joins the current point to the specified [####] point, regardless of the code, and does not lift the pen.
R3	The next three points are three consecutive points of a rectangle. Auto linework will draw the rectangle defined by these three points. R3 does **not lift or lower** the pen.
SS	Indicates a side shot, taken from the last point, to the point following the SS command. A line will be drawn between these two points and then continue with the linework from the point before the SS command.

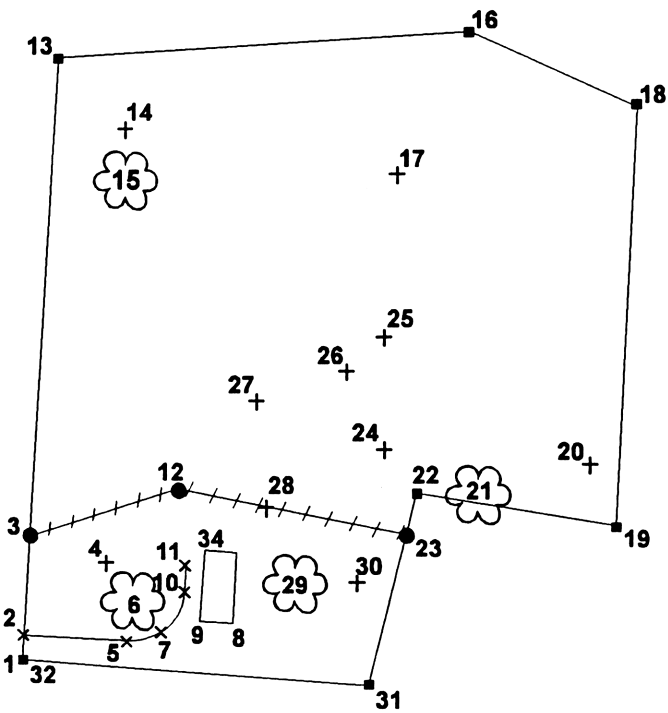
In summary, the feature codes tell how to group the points; the command codes tell how to connect the points; and finally, there is a *code table* in EASY SURVEY that tells whether linework is required for a group of points and how it is to be plotted: e.g. symbol type, color, size, etc. In the code table you assign each feature code or group of points a specific symbol, a line type and several other parameters. The code table is a function of the EASY SURVEY program and is discussed in detail in its Manual.

Auto linework proceeds as follows: You collect data, for the most part, as you would normally; then, add the feature and command codes to the field data. The feature codes classify each point into related groups. With the points linked to a particular group: fence, curb, house, tree, etc.; the command codes tell the auto-mapper how to connect the points to form lines: e.g. begin a fence line at point 3 and end it at point 23; begin a driveway at point 2; curve through points 6, 7, and 8; and end at point 10. The field data is then transferred to EASY SURVEY and, with the aid of the code table, the map is generated.

LINEWORK

FIELD SURVEY

We are now ready to walk through the field survey, explaining several survey shots in terms of the raw data that would be created. We pay particular attention to the feature codes and command codes entered in the raw data file. We will use the SMITH property for our example and approach it as if you collected the boundary, traverse, topo and other features in one pass.



A picture of the plotted SMITH job is shown here for reference. We will refer to parts of it frequently throughout this chapter.

LINEWORK

The field survey is performed basically as you would if you were not going to use auto linework except that the Command codes and Feature codes must be inserted in their proper places. As with the other examples, the field data can be collected electronically so that the data would not need to be entered manually. In this example, so that you understand how the feature codes and command codes are entered, we will go through the survey discussing the raw data and how it was generated, line by line.

This example will be a series of grouped sideshots taken from each traversed boundary point. Each shot would be recorded using the traverse / sideshot screen. Sideshots and traverses are taken and recorded in an identical manner. The only difference between the two types of shots is that sideshots are taken to all points that will *not* be occupied next. Traverses are taken only to those points that *will be* occupied next. Also, with a Traverse, the TDS-48GX increments the Occupy Point, Foresight Point, and the BS Azimuth fields in the Traverse / Sideshot screen.

Path:	From the Main Menu screen, select **[J] Traverse / Side Shot** to display the screen pictured below:

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

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

SIDES	REP	BACK	TRAV	OFFCT	EXIT

Printed below, we have a raw data file for the SMITH property which shows the shots, the feature codes and command codes for this example. Look over the raw data file now to get familiar with the survey. Then, we will go over it in detail.

LINEWORK

```
JB,NMSMITH_FW,DT09-14-1992,TM16:30:58
MO,AD0,UN0,SF1.000000,EC0,EO0.0000
SP,PN1,N 5000.0000,E 5000.0000,EL 100.0000,--BOUNDARY
OC,OP1,N 5000.0000,E 5000.0000,EL100.000,--BOUNDARY
BK,OP1,BP0,BS276.2315,BC0.0000
LS,HI5.32,HR6.00
--BEG
SS,OP1,FP2,AR86.541200,ZE87.285800,SD30.290000,--DRIVE
--BEG
SS,OP1,FP3,AR86.541200,ZE89.301600,SD148.690000,--FENCE
SS,OP1,FP4,AR123.011200,ZE88.363800,SD150.180000,--TOPO
--CP1
SS,OP1,FP5,AR162.152000,ZE87.221200,SD118.630000,--DRIVE
SS,OP1,FP6,AR144.210300,ZE87.563400,SD143.470000,--TREE
--CP2
SS,OP1,FP7,AR161.474200,ZE87.375100,SD154.140000,--DRIVE
--R3
SS,OP1,FP8,AR163.072100,ZE88.143500,SD283.650000,--HOUSE
SS,OP1,FP9,AR160.471800,ZE88.024200,SD204.820000,--HOUSE
SS,OP1,FP34,AR141.062900,ZE88.231300,SD242.560000,--HOUSE
--CP3
SS,OP1,FP10,AR149.245300,ZE88.030000,SD199.260000,--DRIVE
SS,OP1,FP11,AR142.190200,ZE88.081800,SD214.700000,--DRIVE
SS,OP1,FP12,AR124.054900,ZE88.411800,SD268.720000,--FENCE
TR,OP1,FP13,AR86.5412,ZE89.4050,SD711.420,--BOUNDARY
LS,HI5.43,HR6.00
SS,OP13,FP14,AR314.245700,ZE88.585900,SD111.150000,--TOPO
SS,OP13,FP15,AR329.081000,ZE89.174700,SD162.810000,--TREE
TR,OP13,FP16,AR262.544800,ZE89.323600,SD457.760000,--BOUNDARY
LS,HI5.40,HR6.00
SS,OP16,FP17,AR299.032600,ZE89.142300,SD185.140000,--TOPO
TR,OP16,FP18,AR208.571000,ZE89.180300,SD201.310000,--BOUNDARY
LS,HI5.39,HR6.00
TR,OP18,FP19,AR247.165700,ZE88.523500,SD497.120000,--BOUNDARY
LS,HI5.35,HR6.00
SS,OP19,FP20,AR335.405900,ZE91.041400,SD80.080000,--TOPO
SS,OP19,FP21,AR281.282600,ZE90.312400,SD157.690000,--TREE
TR,OP19,FP22,AR277.483500,ZE90.292600,SD223.980000,--BOUNDARY
--JNS
LS,HI5.40,HR6.00
SS,OP22,FP23,AR92.414300,ZE90.274600,SD50.340000,--FENCE
SS,OP22,FP24,AR225.350800,ZE92.173200,SD63.980000,--TOPO
SS,OP22,FP25,AR248.372000,ZE91.095600,SD187.370000,--TOPO
SS,OP22,FP26,AR232.084400,ZE91.342000,SD162.280000,--TOPO
SS,OP22,FP27,AR201.355300,ZE91.382200,SD206.840000,--TOPO
SS,OP22,FP28,AR164.215700,ZE92.124800,SD164.580000,--TOPO
SS,OP22,FP29,AR130.592600,ZE91.401100,SD171.630000,--TREE
SS,OP22,FP30,AR110.123600,ZE91.222900,SD126.600000,--TOPO
TR,OP22,FP31,AR92.414300,ZE90.274600,SD233.880000,--BOUNDARY
--JFS
LS,HI5.42,HR6.00
TR,OP31,FP32,AR261.275600,ZE91.440500,SD387.250000,--BOUNDARY
```

The first six lines of this file describe how this file was set up. These lines are generated when you create the job file and first set up the traverse/sideshot screen with the OC pt, BS Azm., HI and HR.

```
1  JB,NMSMITH_FW,DT09-14-1992,TM16:30:58
2  MO,AD0,UN0,SF1.000000,EC0,EO0.0000
3  SP,PN1,N 50000.0000,E 5000.0000,EL100.0000,--BOUNDARY
4  OC,OP1,N 5000.0000,E 5000.0000,EL100.000,--BOUNDARY
5  BK,OP1,BP0,BS276.2315,BC0.0000
6  LS,HI5.32,HR6.00
```

Line 1 Gives the job name (JB), date (DT), and time (TM).

Line 2 Gives the different job mode settings (MO).

Line 3 Gives the starting point (SP) as point 1 (PN1), and the north (N), east (E), and elevation (EL) coordinates for point 1. Also, point 1 has been identified as a boundary point by the feature code "BOUNDARY." This is *our first feature code.*

Line 4 States point 1 is the occupied point (OP).

Line 5 States a backsight (BK) was taken from point 1. It gives the back azimuth (BS) as 276.2315. The back circle (BC) is 0.0000.

Line 6 States the original line of sight (LS) taken. The Height of Instrument (HI) is 5.32. Height of Rod (HR) is 6.00.

Let's work through the steps you would complete if you were actually going to gather the data in the field in the manner the SMITH raw data file shows.

Sideshot to FP 2--Start of Driveway

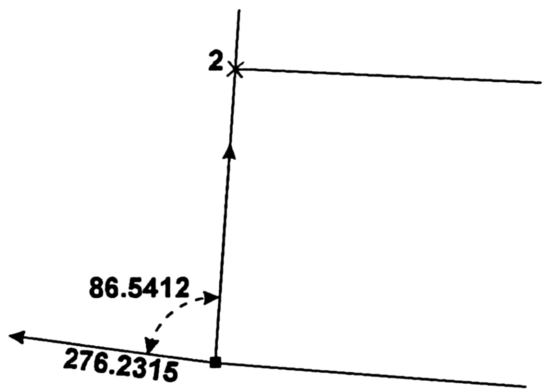
With the raw data file as a reference, let's use the first sideshot to explore how it was taken and how its feature code "DRIVE" and command code "BEG" were entered. This shot is represented by line 8 of the raw data file highlighted below.

```
5  BK,OP1,BP0,BS276.2315,BC0.0000
6  LS,HI5.32,HR6.00
7  --BEG
8  SS,OP1,FP2,AR86.541200,ZE87.285800,SD30.290000,--DRIVE
9  --BEG
10 SS,OP1,FP3,AR86.541200,ZE89.301600,SD148.690000,--FENCE
```

LINEWORK

In line 8, foresight point 2 (FP2) marks the beginning of the driveway. The driveway is indicated by the feature code "DRIVE". The "BEG" command code, inserted immediately prior to line 8, signals the map routine to begin a new line at this point.

NOTE: A command code is **always** inputted immediately prior to the point(s) to which it applies.



If you were to gather the field data as shown in line 8 and enter it into the Traverse/Sideshot screen, you would follow these steps:

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:87.2858
 Slope dist:30.290
Desc:DRIVE
HI: 5.320  HR: 6.000
```

SIDES	REP	BACK	TRAV	OFFCT	EXIT

Step 1: Press **[NOTE]** or **[B]** to enter "BEG." This identifies the next point you enter as having the command code "BEG" defined for it. **The command code must always be inserted prior to the point it affects.** Command codes are always entered with the **[NOTE]** or **[B]** softkey; feature codes are always entered in the Description field.

This step can be completed any time prior to pressing **[SIDE]** **[A]**, but it's a good habit to enter it first.

Step 2: Enter the Occupying Pt as "1."
Enter the Foresight Pt as "2."

Step 3: Press **[BACK]** **[C]** and use the scrolling prompt to select the BS Azimuth option. This allows you to set the back azimuth for your first shot.

Enter 276.2315.

BS point / BS azm / BS brg =>

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

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

SOLVE	CHEC		FAST	CIRCL	EXIT

The Circle prompt represents the horizontal circle reading of the gun while sighting on the backsight. This is customarily zero, but may be any value.

Step 4: Enter "DRIVE" in the Descriptor field. This identifies point 2 as having a feature code of "DRIVE."

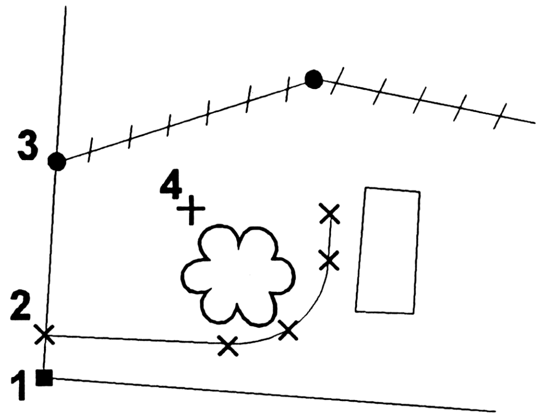
Step 5: Enter "86.5412" as the Angle Right.
Enter "87.2858 as the Zenith.
Enter "30.2900" as the Slope Distance.
(These values are shown in the raw data file.)

Step 6: At this point, you would press **[SIDE]** **[A]**. The TDS-48GX would compute the coordinates of your foresight point; in this case, point 2. The coordinates of the last stored point would be displayed at the bottom of the screen.

Now let's go through the remainder of the raw data file to discuss how survey data, including feature and command codes, are set up.

COMPLETE THE SURVEY
Sideshot to FP3--Start of Fence

The next shot taken was a sideshot to foresight point 3, as represented by line 10 of the raw data file.




```
6  LS,HI5.32,HR6.00
7  --BEG
8  SS,OP1,FP2,AR86.541200,ZE87.285800,SD30.290000,--DRIVE
9  --BEG
10 SS,OP1,FP3,AR86.541200,ZE89.301600,SD148.690000,--FENCE
11 SS,OP1,FP4,AR123.011200,ZE88.363800,SD150.180000,--TOPO
```

As you can see, another "BEG" command code was required to tell the map routine to begin a line at point 3. The feature code "FENCE" indicates that point 3 is a point on the fence line. See line 10 of the raw data file above.

The first thing you'd do is enter the "BEG" command code using **[NOTE]** or **[B]**. Again, although the command code can be added any time *prior* to pressing **[SIDES]** or **[A]**, it's a good idea to get used to entering it first.

You would then gather the data for point 3 just as the raw data file shows. To enter the feature code for point 3, you would enter "FENCE" in the Descriptor field.

Sideshot to FP4--Topo

The sideshot to point 4 is a topo pt. as shown in line 11 of the raw data file.

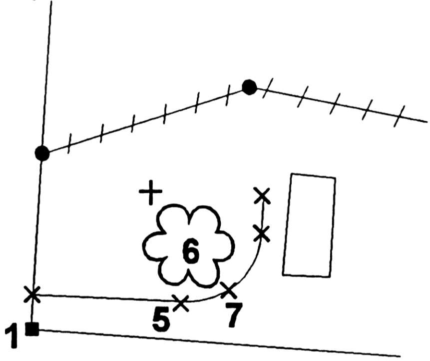
```
8  SS,OP1,FP2,AR86.541200,ZE87.285800,SD30.290000,--DRIVE
9  --BEG
10 SS,OP1,FP3,AR86.541200,ZE89.301600,SD148.690000,--FENCE
11 SS,OP1,FP4,AR123.011200,ZE88.363800,SD150.180000,--TOPO
12 --CP1
13 SS,OP1,FP5,AR162.152000,ZE87.221200,SD118.630000,--DRIVE
```

Notice that there is no "BEG" command in the raw data file prior to foresight point 4. The reason is that point 4 is a topo shot and topo points do not require linework. The linework field in the Code table would be "OFF" because it identifies a group of points that are to be displayed with a marker only. EASY SURVEY will *not* connect point 4 to point 3 because they have different feature codes i.e., the points belong to different groups. Point 4 will not be connected to the next topo point because the linework is off. Therefore, point 4 will be mapped as an individual point.

To enter this information, you would gather the data for point 4 as shown in the raw data file. The feature code "TOPO" would be entered as the point descriptor. You would **not enter a command code**.

Sideshot to FP5--Start of Driveway Curve

Still occupying point 1, the next shot was a sideshot to point 5. From the map, you can see that point 5 is the second point on the driveway and the start of the driveway's curve through points 7 and 10. This is reflected in the raw data file as well, by line 13.



```
SS,OP1,FP4,AR123.011200,ZE88.363800,SD150.180000,--TOPO
--CP1
SS,OP1,FP5,AR162.152000,ZE87.221200,SD118.630000,--DRIVE
SS,OP1,FP6,AR144.210300,ZE87.563400,SD143.470000,--TREE
--CP2
SS,OP1,FP7,AR161.474200,ZE87.375100,SD154.140000,--DRIVE
```

The "CP1" command code instructs EASY SURVEY to start a curved line beginning at the next point, then move through the point after "CP2" and end at the point following "CP3". These three points do not have to be shot together, but they must be recorded in order. You cannot shoot the middle point first or last; it must be in between the two end points. The CP1 command tells the map routine to begin a curve and use the next CP2 and CP3 points that have the same feature code to define it.

For point 5, you would enter the CP1 command by pressing **[NOTE]** or **[B]** and entering "CP1". The feature code "DRIVE" would be entered in the Description field. This defines point 5 as belonging to the same group as point 2 which is also defined by the feature code "DRIVE". Command codes are always entered with the **[NOTE]** or **[B]** softkey; feature codes are always entered in the Description field.

You will gather the data for point 7 and point 10 later. When the map routine generates the map, it will know to map points 2, 5, 7, and 10 with one continuous line of a specific type because: 1) all points have the same feature code; and 2) the command codes "BEG" and "CP*x*" say where to begin the line and draw the curve.

NOTE:

There are three other curve commands that could have been used to define this curve. Each has its advantage, depending on the data you wish to gather to define the curve. **C2** requires the PC and PT and uses the direction coming into the PC as the forward tangent. **C2###.###** requires the PC, PT and the radius of the curve. **C3** requires three points on the curve, as in CP1,CP2 and CP3, but the three points must be shot immediately after the C3 command. Review the curve commands in the command codes toward the front of this Chapter.

Sideshot to FP6--Tree

Here we have another sideshot. This sideshot defines a tree which is identified by the feature code "TREE" in line 14 of the raw data file. Again, we have no command code because no linework is needed for this group.

```
11 SS,OP1,FP4,AR123.011200,ZE88.363800,SD150.180000,--TOPO
12 --CP1
13 SS,OP1,FP5,AR162.152000,ZE87.221200,SD118.630000,--DRIVE
14 SS,OP1,FP6,AR144.210300,ZE87.563400,SD143.470000,--TREE
15 --CP2
16 SS,OP1,FP7,AR161.474200,ZE87.375100,SD154.140000,--DRIVE
```

For this shot, you would gather the data as shown in the raw data file and enter "TREE" as the point descriptor.

Sideshot to FP7--Mid point of Driveway Curve

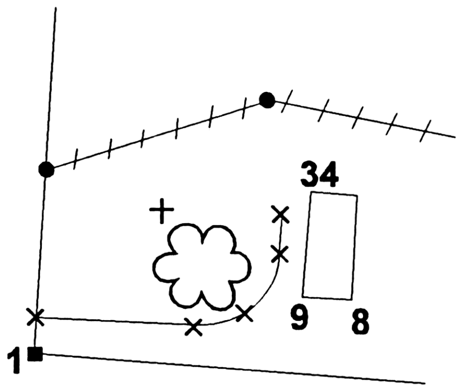
Here we have another sideshot. This sideshot is to the second point in the driveway curve. We enter CP2 as the command code by pressing **[NOTE]** or **[B]** and entering "CP2". The feature code DRIVE would be entered in the Description field.

```
13 SS,OP1,FP5,AR162.152000,ZE87.221200,SD118.630000,--DRIVE
14 SS,OP1,FP6,AR144.210300,ZE87.563400,SD143.470000,--TREE
15 --CP2
16 SS,OP1,FP7,AR161.474200,ZE87.375100,SD154.140000,--DRIVE
17 --R3
18 SS,OP1,FP8,AR163.072100,ZE88.143500,SD283.650000,--HOUSE
19 SS,OP1,FP9,AR160.471800,ZE88.024200,SD204.820000,--HOUSE
```

For this shot, you would gather the data as shown in line 16 of the raw data file, and enter "DRIVE" as the point descriptor.

Sideshots to FP8, 9 and 34--House

Here, another sideshot was taken, this time to point 8. It is illustrated on the map as a corner of the house. The R3 command was used to start a rectangle defined by the next three points to represent the house. Lines 18-20 of the raw data file shows us that these points are identified by the feature code "HOUSE."




```
16 SS,OP1,FP7,AR161.474200,ZE87.375100,SD154.140000,--DRIVE
17 --R3
18 SS,OP1,FP8,AR163.072100,ZE88.143500,SD283.650000,--HOUSE
19 SS,OP1,FP9,AR160.471800,ZE88.024200,SD204.820000,--HOUSE
20 SS,OP1,FP34,AR141.062900,ZE88.231300,SD242.560000,--HOUSE
21 --CP3
22 SS,OP1,FP10,AR149.245300,ZE88.030000,SD199.260000,--DRIVE
```

You would enter the R3 command code by pressing **[NOTE]** or **[B]**, then enter point 8 as the Foresight point and "HOUSE" as the feature code in the Description field. You would press **[SIDES] [A]** as you would have done for the other sideshots. The map routine will know to begin a rectangle at point 8 and use the next three points in the raw data file as three of the corners. The forth corner is generated by connecting the two ends with a right angle.

Points 9 and 34 were shot next and have no need for command codes because they are a part of the R3 command. Each one of them, however, needs to have the feature code of "HOUSE".

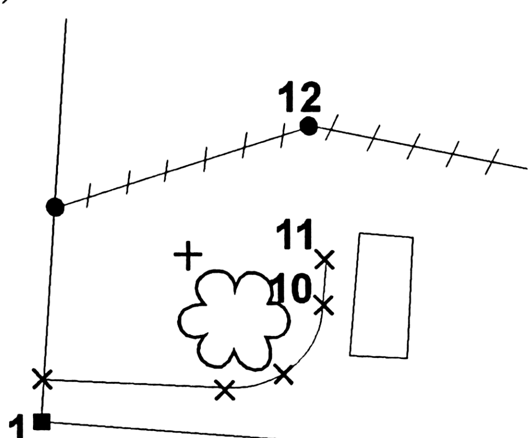
NOTE:

> We used point 34 as the final point in the HOUSE feature to illustrate a point. The ordering of the points is in their sequence in the raw data file and not their point numbers. Point numbers can follow any order you choose.

Now is a good time to point out that, during a field survey, points do not need to be shot in sequential order. After the starting point was established, point 2, the beginning of the driveway, was the next shot taken. Point 5 was not taken until points for the fence and topo had been shot. It is important to understand however, that when the R3, C3 or C2 commands are being used, all the points they will affect *must* be entered immediately following the command and must be entered in order.

Sideshots to FP10, 11, and 12--DRIVE and FENCE

Three more sideshots were taken at this time: the last point on the driveway curve (point 10); the end of the driveway (point 11); and the middle of the fence (point 12). See lines 22-24 below.

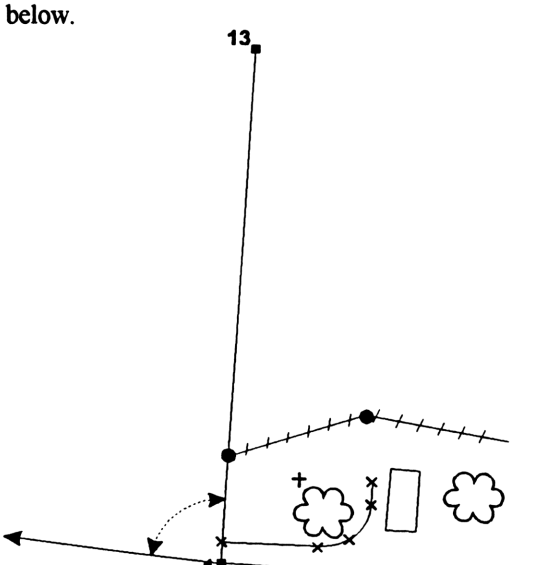


```
20 SS,OP1,FP34,AR141.062900,ZE88.231300,SD242.560000,--HOUSE
21 --CP3
22 SS,OP1,FP10,AR149.245300,ZE88.030000,SD199.260000,--DRIVE
23 SS,OP1,FP11,AR142.190200,ZE88.081800,SD214.700000,--DRIVE
24 SS,OP1,FP12,AR124.054900,ZE88.411800,SD268.720000,--FENCE
25 TR,OP1,FP13,AR86.5412,ZE89.4050,SD711.420,--BOUNDARY
```

To finish the curve the Command code "CP3" is needed before point 10. Commands have already been inserted for previous points identified with DRIVE and FENCE feature codes; therefore, it is not necessary to insert command codes for these last two shots. You would simply collect the data as you have in the previous shots, entering the appropriate feature code in the description field for each point.

Traverse to FP13--BOUNDARY

Line 25 of the raw data file indicates that the next shot was a traverse to point 13; it is shown on the map to be the upper left corner of the boundary. This is the last shot taken from occupied point 1. Point 13 will be the occupied point for the next several shots. See line 25 in the raw data file below.



```
22 SS,OP1,FP10,AR149.245300,ZE88.030000,SD199.260000,--DRIVE
23 SS,OP1,FP11,AR142.190200,ZE88.081800,SD214.700000,--DRIVE
24 SS,OP1,FP12,AR124.054900,ZE88.411800,SD268.720000,--FENCE
25 TR,OP1,FP13,AR86.5412,ZE89.4050,SD711.420,--BOUNDARY
26 LS,HI5.43,HR6.00
27 SS,OP13,FP14,AR314.245700,ZE88.585900,SD111.150000,--TOPO
```

The traverse data is entered exactly like the sideshot data. The feature code for point 13 would be entered as "BOUNDARY." This groups point 13 with point 1, the starting point. The only difference in entering data for a traverse is that you press **[TRAV] [D]** rather than **[SIDE] [A]** when you are ready to shoot.

When **[TRAV] [D]** is pressed, the traverse function operates just like the sideshot function, except that TDS-48GX knows to change the foresight point (Pt 13) to be the occupied point and the old occupied (Pt 1) to be the backsight point automatically. The foresight point is automatically incremented by one (see line 25 of raw data), and the back azimuth is changed to reflect the new backsight point.

Line-of-Sight

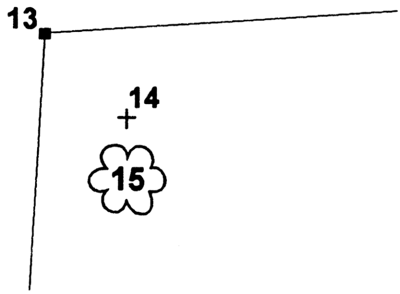
After the traverse was shot, the instrument was moved to occupy point 13. From here, the instrument height was measured and entered as shown in line 23 of the raw data file.

```
22 SS,OP1,FP10,AR149.245300,ZE88.030000,SD199.260000,--DRIVE
23 SS,OP1,FP11,AR142.190200,ZE88.081800,SD214.700000,--DRIVE
24 SS,OP1,FP12,AR124.054900,ZE88.411800,SD268.720000,--FENCE
25 TR,OP1,FP13,AR86.5412,ZE89.4050,SD711.420,--BOUNDARY
26 LS,HI5.43,HR6.00
27 SS,OP13,FP14,AR314.245700,ZE88.585900,SD111.150000,--TOPO
```

All you would need to do for the line-of-sight adjustment is enter the new value in the HI field and press **[ENTER]**. The TDS-48GX automatically makes the instrument adjustments to the screen and displays the new values for Occupy Pt, Foresight Pt, and BS azimuth.

Sideshots to FP14, FP15--TOPO & TREE

The next two shots taken from occupied point 13 were sideshots to FP14 and FP15. Point 14 is a topo feature, and point 15 is a tree. These points are illustrated on the map and are identified by their feature codes in the raw data file in lines 24 and 25.




```
25 TR,OP1,FP13,AR86.5412,ZE89.4050,SD711.420,--BOUNDARY
26 LS,HI5.43,H46.00
27 SS,OP13,FP14,AR314.245700,ZE88.585900,SD111.150000,--TOPO
28 SS,OP13,FP15,AR329.081000,ZE89.174700,SD162.810000,--TREE
29 TR,OP13,FP16,AR262.544800,ZE89.323600,.SD457.760000,--BOUNDARY
```

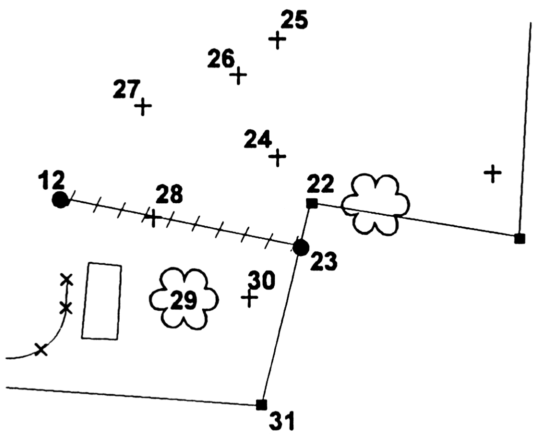
Again, we see the feature codes of "TOPO" and "TREE." These are points that do not require any linework and, thus, no command codes were issued for them. When the Traverse / Sideshot screen is filled in for each point and the feature code entered, you would press **[SIDE] [A]** again rather than **[TRAV] [D]** because the shots were taken as sideshots.

Traverse to FP16--BOUNDARY

From point 13, another traverse is performed to occupy point 16. From point 16, the way is clear to get another topo, point 17, and the other boundary points, 18 and 19, as the map and raw data file show. Another series of sideshots add points 20 and 21. Next is a traverse to point 22. Each time a traverse is made to shoot a boundary point, a new "line-of-sight" is taken to adjust the height of instrument. This is reflected in lines 30, 33, 36 and 40 of the raw data file. The new height is entered in the HI field, just as it was done previously for the traverse taken to point 13. As we begin the sideshots taken from point 22, there is a new code, **JNS**, at line 39.

```
SS,OP13,FP15,AR329.081000,ZE89.174700,SD162.810000,--TREE
TR,OP13,FP16,AR262.544800,ZE89.323600,.SD457.760000,--BOUNDARY
LS,HI5.40,HR6.00
SS,OP16,FP17,AR299.032600,ZE89.142300,SD185.140000,--TOPO
TR,OP16,FP18,AR208.571000,ZE89.180300,SD201.310000,--BOUNDARY
LS,HI5.39,HR6.00
TR,OP18,FP19,AR247.165700,ZE88.523500,SD497.120000,--BOUNDARY
LS,HI5.35,HR6.00
SS,OP19,FP20,AR335.405900,ZE91.041400,SD80.080000,--TOPO
SS,OP19,FP21,AR281.282600,ZE90.312400,SD157.690000,--TREE
TR,OP19,FP22,AR277.483500,ZE90.292600,SD223.980000,--BOUNDARY
--JNS
LS,HI5.40,HR6.00
SS,OP22,FP23,AR92.414300,ZE90.274600,SD50.340000,--FENCE
SS,OP22,FP24,AR225.350800,ZE92.173200,SD63.980000,--TOPO
```

The JNS command tells the map routine to join the next point entered to the nearest point with the same feature code. In other words, point 23 will be joined to point 12, the nearest point with the feature code "FENCE." Points 22 or 30 are the nearest point but neither have a feature code of "FENCE". The "TOPO" point 28 is on the fence line but only by coincidence and is not actually part of the line.



NOTE:

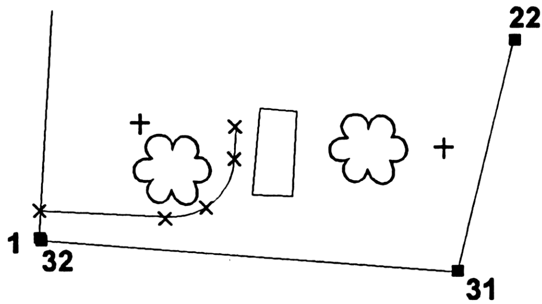
There are a number of **join command codes** that direct the Auto Linework routine to connect the current point with some other point in the survey. See JFS-Join First Point, JN-Join to Next, JP####-Join to Same Code number ####, JPS-Join to Previous and JT####-Join to Point number #### in the command codes toward the front of this Chapter.

LINEWORK

The survey continues in the same manner, taking sideshots and traversing to the next occupied point.

Traverse to FP34--Closing Point (BOUNDARY)

When the last (closing) shot was reached, the instrument was occupying point 31 and point 32 was the foresight point. Even though the survey will close back to point 1, the last shot taken was entered as point 32.




```
47 SS,OP22,FP29,AR130.592600,ZE91.401100,SD171.630000,--TREE
48 SS,OP22,FP30,AR110.123600,ZE91.222900,SD126.600000,--TOPO
49 TR,OP22,FP31,AR92.414300,ZE90.274600,SD233.880000,--BOUNDARY
50 --JFS
51 LS,HI5.42,HR6.00
52 TR,OP31,FP32,AR261.275600,ZE91.440500,SD387.250000,--BOUNDARY
```

By storing the closing point as point 32, you will have two sets of coördinates for virtually the same point. This will enable you to compare the ending and beginning coordinates to determine the precision of the survey. If you had reset the foresight point as point 1, the TDS-48GX would have alerted you to the fact that point 1 was already used; that is, it already had coordinates assigned to it. It would ask you if you want to overwrite these coordinates.

SUMMARY

We went through a number of exercises in this chapter to illustrate the idea of integrating your field work with the elements of auto linework. Feature codes are user-defined and group the points you shoot according to type. Command codes are system-defined and tell the map routine how to connect points according to group. Both feature and command codes are entered in the *raw data file* during the actual survey. To demonstrate this, we went through all the lines of the raw data file and explained how each point was shot; how its feature code was entered using the Description field; and, why each command code was entered using the **[NOTE]** or **[B]** softkey.

We have not discussed how feature code attributes can be defined or changed by editing the code table. This is done in EASY SURVEY and is explained in the EASY SURVEY Manual. The EASY SURVEY Manual also discusses how the auto linework is actually performed on your screen.

The use of "**descriptor codes**" can reduce the number of key strokes required to key in the feature codes. You can establish codes for the feature codes to shortcut their repetitive entry. See Chapter 3-Field Work for a complete discussion of descriptor codes.

9. PRINTING AND DATA COMM WITH YOUR TDS-48GX

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

PRINTING COORDINATES

Periodically during a job, you may wish to make a hard copy of your work by printing either the coordinate values of the points that you have surveyed or the raw data. The TDS-48GX can use the HP-48GX'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:

```
     Print Menu

G Print coordinates
H Print raw data
I Print setup

|    |    |    |    |    |EXIT|
```

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

```
    Print Setup
IR/wire:      >Wire        <= Wire / IR
Baud rate:    >9600        <= 9600 / 1200 / 2400 / 4800
Parity:       >None        <= None / Odd / Even

|      |      |      |      |      | EXIT |
```

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:

```
                            Print Points
From point - To point
  / Using point list =>  >From point: 0
                         To point   : 0

| PRINT | PTLST |      |      |      | EXIT |
```

As in other screens in the TDS-48GX, 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-48GX into your "wire" printer with the appropriate RS232 cable or configure your TDS-48GX 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-48GX 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:

```
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
```

NOTE:

> The output to the infrared printer is one-way communication only. Thus, there is no way for the TDS-48GX 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 RAW DATA

The process for printing raw data is similar. You have no control over the amount of raw data that you can print. The process, therefore, is to select (open) the job you want to print, as in printing coordinates above. Make sure that you have filled out the Print Setup Screen properly (see above) and have your specified printer properly configured . Then, select **[R]** from the MAIN Menu. Now press **[H]**, Print raw data, from the Print Menu. The Raw Data of the currently active job will be printed in its entirety as it is stored in the TDS-48GX. See sample below:

```
JOB : SMITH_FW    TIME:  09:56   DATE: 11-25-1992   Page 1
==========================================================
JB,NM,SMITH_FW,DT09-14-1992,TM,16:30:58
MO,AD0,UN0,SF1.000000,EC0,EO0.0000
SP,PN1,N 5000.000000,E 5000.000000,EL100.000000,--BOUNDARY
OC,OP1,N 5000.0000,E 5000.0000,EL100.000,--BOUNDARY
BK,OP1,BP0,BS276.2315,BC0.0000
LS,HI5.32,HR6.00
SS,OP1,FP2,AR86.5412,ZE87.2858,SD30.2900,--DRIVE EAST
SS,OP1,FP3,AR86.5412,ZE89.3016,SD148.6900,--FENCE WEST
SS,OP1,FP4,AR123.011200,ZE88.363800,SD150.180000,--TOPO
SS,OP1,FP5,AR144.210300,ZE87.563400,SD143.470000,--TREE
SS,OP1,FP6,AR162.1520,ZE87.2212,SD118.6300,--DRIVE EAST
SS,OP1,FP7,AR161.4742,ZE87.3751,SD154.1400,--DRIVE WEST
SS,OP1,FP8,AR149.2453,ZE88.0300,SD199.2600,--DRIVE WEST
SS,OP1,FP9,AR160.471800,ZE88.024200,SD204.820000,--HOUSE
SS,OP1,FP10,AR142.190200,ZE88.081800,SD214.700000,--DRIVE
SS,OP1,FP11,AR141.062900,ZE88.231300,SD242.560000,--HOUSE
SS,OP1,FP12,AR124.054900,ZE88.411800,SD268.720000,--FENCE
TR,OP1,FP13,AR86.5412,ZE89.4050,SD711.420,--BOUNDARY
```

See Appendix D for a listing of the meanings of the various abbreviations that you will see in the printout. You may obtain a printout of the raw data, with the codes expanded, by transferring the raw data file to your office PC and using the TDS TFR PC software to generate a printout of the raw data on your PC's printer. (Consult the TDS's TFR User's Manual.)

PRINTING SCREENS

At any time, you may print the contents of any screen in your TDS-48GX 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.

NOTE:

> 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-48GX is that you may transfer the coordinates and raw data that you collected in the field to your office personal computer. You may also transfer coordinates from your office PC back to your TDS-48GX for stakeout or other field work. The process for setting up your TDS-48GX to transfer a coordinate file to a PC running TFR, Tripod Data Systems communication and file convertion software, is as follows:

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

```
File type:   >CRD     <= CRD / RAW / PLST
IR/wire:     >Wire    <= Wire / IR
Baud rate:   >9600    <= 9600 / 1200 / 2400 / 4800
Parity:      >None    <= None / Odd /Even

Start pt:   0
End pt:     0
SEND | RECV | SBLK | GET |  | EXIT
```

Step 1: Move the cursor to the first line and, using the horizontal cursor keys, select the CRD option for the File type. If you wanted to transfer a raw data file you would select the RAW option. Or, to transfer a point list file select PLST.

Step 2: The next three lines of this screen are all of the 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-48GX. If you are using the TFR software in your PC to communicate with your TDS-48GX, these parameters should be set to wire interconnection, 9600 baud and no parity, as displayed in the screen above.

Step 3: 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 4: Once your PC software is waiting for data from your data collector, press **[SEND]** on your TDS-48GX. 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.

NOTE:

> 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-48GX. 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 data collector 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-48GX. 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-48GX 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.

The **[GET]** key is for users who have an RS232 interfaced floppy drive that emulates the kermit server protocol. The **[GET]** key can be used to retrieve a file from this drive. Set the communication parameters to the drives requirements and press **[GET]**. You will be prompted for a file name. Enter the complete file name, then press **[ENTER]** and the file should be loaded into the TDS-48GX. The **[SEND]** key can be used to send files to the drive.

PRINTING & DATA COMM

File Transfer Between Two TDS-48GX's

You may use the wireless communication capabilities of the HP-48GX to copy a coordinate or point list file from one TDS-48GX to another or to a TDS system95. 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-48GX 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-48GX using coordinate data gathered by the TDS-48GX Surveying Card. Effective understanding of this material requires some understanding of the programming language of the HP-48GX.

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

If you plan on writing your own programs to use in conjunction with the TDS-48GX, you will want to set up the HP-48GX to access the TDS-48GX 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 {TDS48} in the command line. To do this you will actually have to press the following keys: ↰ **[{}]** **[α]** **[α]** **[T]** **[D]** **[S]** **[4]** **[8]** **[α]**.

2) Press **[ENTER]**.

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).

Now if you are in the operating system of the HP-48GX and you want to return to the TDS-48GX Surveying Card, press **[CST]** and then the **[TDS48]** softkey.

USING TDS-48GX 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-48GX Surveying Card. However, it is recognized that a user proficient in the programming and use of the HP-48GX itself may choose to develop his or her own routines to solve additional problems. To this end, the TDS-48GX includes two functions which allow you direct access to the coordinate data files from the standard HP-48GX operating system.

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

PRINTING & DATA COMM

RETREIVING 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-48GX.

REFERENCE

This section of the manual presents the reference material about the TDS-48GX. 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-48GX. 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-48GX. 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.)

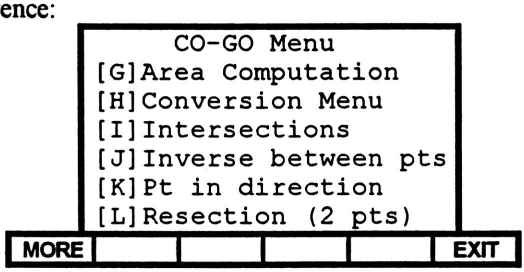
Thus, the Menus are not presented individually. They are discussed in general in the beginning of this section. Then each screen is presented. Screens are grouped by class of application from the Main Menu and by access letter within this grouping. Screens which may be accessed via multiple menu paths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

INTRODUCTORY COMMENTS

All work in the TDS-48GX 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.

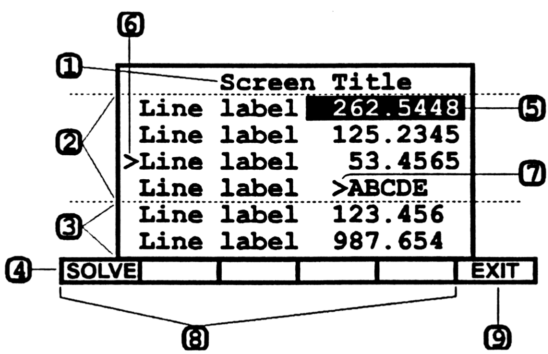
THE GENERIC MENU

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-48GX 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-48GX.

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 <u>not</u> 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-48GX. 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-48GX 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-48GX 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 <u>and</u> 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.

SCREEN TREE MAP

The next three figures provide a pictorial "map" of the TDS-48GX 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-48GX.

MAIN MENU

- G Job Menu
  - G Create New Job
  - H Open Existing Job
  - I Current Job Info.
  - J Edit Coordinates
  - K Raw Data Menu
    - G View R. Data
    - H Create R. Data File
    - I Delete R. Data File
    - J View Descriptors
    - K Create Descriptors
    - L Delete Descriptors
  - L Delete Job
  - M Rename Job
  - N Delete Points
- H Setup Menu
  - G Time / Date
  - H Devices — COLLI — Collimation
  - I Operating Modes
  - J Repetition Modes
  - K Select Contrl File
  - L Deselect Contrl File
- I Stakeout Menu
  - G Point Stake — LOCAT — Define Location
  - H Offset Stake
  - I Slope Stake
  - J Set Stakeout Mode
  - K Where is Next Pt?
- J Traverse/Sideshot
  - REP
    - G Horiz. Dir & Rev
    - H Horiz. Accumulation
    - I Zenith Dir & Rev
    - J Multiple Distances
    - K Radial Sideshots
    - L Set Repetition Mode
    - M Shoot from two Ends
    - N Go to Record Mode
  - OFFCT
    - G Horiz. Ang. Offset
    - H Horiz. Dist. Offset
    - I Vert. Ang. Offset
    - J Right Ang. Offset
    - K Vert. Dist. Offset
    - L Benchmark
- K Show Directory
- L Trig. Leveling
  - G Differ. Leveling
  - H Trig. Leveling

MAIN MENU

- M CO-GO Menu
  - G Area Computation
  - H Conversion Menu
  - I Intersection
  - J Inverse Between Pts./ Coords. / Lines
  - K Pt in Direction
  - L Resection (2 Pts)
  - M Resection (3 Pts)
  - N Corner Angle Computation
  - O Benchmark
  - P Predetermined Area
- N Survey Adjust.
  - G Change Scale
  - H Translate Job
  - I Rotate Job
  - J Angle Adjustment
  - K Compass Rule
- O SunShot Menu
  - G Ephemeris Method
  - H Almanac Method
- P Screen Plot
- Q Curve Menu
  - G Horiz Curve Solution — LAYOUT
  - H Known PI & Tangent — LAYOUT
  - I Through 3 Points — LAYOUT
    - LAYOUT:
      - G PC Deflection
      - H PI Deflection
  - J Compute Radius Pt
  - K Traverse on Curve
  - L Vertical Curve — LAYOUT — Vert. Curve Layout
  - M Straight Grade
- R Print Menu
  - G Print Coordinates
  - H Print Raw Data
  - I Print Setup
- S File Transfer

UTILITY SCREENS

These screens can be accessed from a number of locations throughout the TDS-48GX program by pressing the **[BACK]** or **[PTLST]** softkeys.

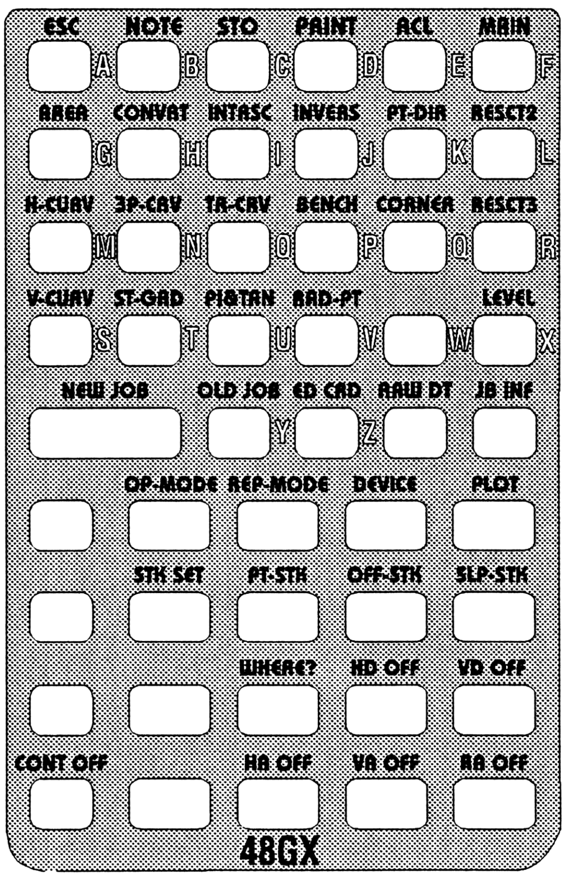
Backsight
- CHECK
  - G Confirm BS Point by Shooting Dist.
  - H Check BS Circle
- CIRCLE
  - G Read BS Circle from Instrument
  - H Send BS Circle to Instrument

Point List Menu
- G Edit Point List — CURVE — Horiz/Vert Curve
- H Clear Point List
- I Store Point List
- J Recall Point List
- K Delete Point List

THE KEYBOARD OVERLAY

Your TDS-48GX 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-48GX. The overlay also displays the shifted function of each key (in purple) for direct access to many of the TDS-48GX's most-used routines. The overlay appears as shown:

Overlay for TDS-48GX



REFERENCE

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-48GX 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-48GX and a simple description of what each does:

Key	Function	Description
A	**ESC**	Escape temporarily from the TDS-48GX program and return to the main operating system of the HP-48GX. S the **ON** or **CONT** key to return to the TDS-48GX
B	**NOTE**	Enter a NOTE in the Raw Data file.
C	**STORE**	Store a value to the Clipboard register.
D	**PRINT**	Print the current screen to an Infrared Printer.
E	**RECALL**	Recall a value from the Clipboard.
F	**MAIN**	Return to the Main Menu from wherever you are in the TDS-48GX.
G	**AREA**	Compute the area of a parcel of land.
H	**CONVRT**	Convert Azimuths to Bearings or Vertical angle and Slope distance to Horiz. distance and change in elevation.
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 pts.

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	ST-GRD	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		
X	LEVEL	Provide access to the Trig-leveling routine.
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	RAW DT	Provide a mechanism for reviewing the raw data file.
←	JB INF	Provide for a way of reviewing many of the important parameters of the currently active job.
9	DEVICE	Establish manual input or communication with an electronic total station.
8	REP-MODE	Establish the technique to be used in acquiring angles and distances in your survey.
7	OP-MODE	Set the operating modes.
6	OFF-STK	Stakeout a right-of-way by specifying the station on the center line and offset distance from the center line.
5	PT-STK	Interact with your gun and your rod man to performing a radial stakeout.
4	STK SET	Establish the setup parameters of the offset stakeout.
3	HD OFF	From Traverse, enter the horizontal distance offset mode.

2	WHERE?	Help the rod man to find the next point relative to his own point of view during a stakeout by point number.
1		
0		
÷	PLOT	View a plot of a block of points in the TDS-48GX screen display.
*	SLP-STK	Slope stake a road.
-	VD OFF	From Traverse, enter the Vertical distance offset mode.
+	RA OFF	From Traverse, enter the Right angle offset mode.
ON	CONT	Return to the TDS-48GX program after ESC to the operating system of the HP-48GX.
•	HA OFF	From Traverse, enter the Horizontal angle offset mode.
SPC	VA OFF	From Traverse, enter the Vertical angle offset mode.

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-48GX 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-48GX to the operating system of the 48GX.

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-48GX, 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 48GX's stack.

NOTE:

> 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]** keys. If **HALT** is not displayed, you must have accidentally **[EXITed]** the program; Rerun the TDS-48GX program.

NOTE COMMAND

Purpose of command - to allow you to key in a note of arbitrary text into your currently active raw data file.

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

This command will present a screen that is blank except for the message "Enter Note". You may then key in arbitrary text information which will be recorded as a note in your active raw data file. The only facility you have to edit this note is with the back space key. When you are finished keying in the note, press **[ENTER]** to place it in the raw data file and return to your previous screen or menu.

At any time during your work, if you would like to record a note, such as the date, names of your crew or any other pertinent information, press ↰ **[B]**. You will then be able to key in random text information which will be stored in the raw data file as a note.

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 ↰ **[C]**.

To save a numeric value, first highlight the field that you want stored and then press ↰ **[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-48GX 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-48GX 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-48GX 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-48GX.

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

This command will immediately return to the MAIN MENU of the TDS-48GX. 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-48GX 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-48GX. TDS-48GX action is initiated by pressing one of the "soft" command keys at the bottom of the screen.

NOTE:

> In certain screens, some of the data input fields may be "filled out" by data transferred automatically from an electronic total station. Such data fields are described in the detailed screen descriptions in this reference manual. In these screens, you may trigger the data collection and transfer to the TDS-48GX by pressing the appropriate "soft" key in the command line.

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.

JOBS MENU SCREENS

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]

```
   New Job
Job name: xxxxxxxx
Raw data: >ON                  <= ON / OFF
Start point:         0
Northing:       0.0000
Easting :       0.0000
Elev    :   0.0000
CREAT |  |  |  |  | EXIT
```

Job name: is the name of the new job file to be created
Raw data: indicates whether or not a raw data file is to be set up and raw data stored for this particular job.
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. If the raw data line is ON, then a raw data file will also be established.

NOTE: If your starting point for the survey is not the lowest numbered point, you should still specify the lowest numbered point in the Start point line. If you do not know the coordinates of this point at the time that you create the job, you may use any coordinates and edit (overwrite) them later. If some other point is the actual starting point with known coordinates, you may key them in the Point Data Screen.

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]

```
ABC.CR5
DEF.CR5
GHI.CR5
```

SELCT	PGUP	PGDN			EXIT

This screen shows the names of the jobs that have been created in the TDS-48GX. 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]
→ From the Main Menu press [G], Jobs Menu - [H] Open Existing Job Screen - [SELCT]

```
  Current Job Info.
Job name: xxxxxxxx
Raw data: >ON                 <= ON / OFF
Start point:       0
Last point:        0
Free memory(pts):    0
Control file: xxxxxxxx
```

					EXIT

Job: is the name of the currently opened and active job.
Raw data: indicates whether or not a raw data file has been established and is open.
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 in the TDS-48GX expressed in number of points.
Control file: is the name of the currently selected control file.

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 Data

Point    :      0
Northing:        0.0000
Easting :        0.0000
Elev     :   0.0000
Desc:xxxxxxxxxxxxxxxx
```

PT +	PT -	STORE	RCL	UNUSE	EXIT

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.
Desc: is the point descriptor 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.

VIEW RAW DATA SCREEN

Purpose of screen: to provide a mechanism for reviewing the raw data file for the current job, if such a file exists.

Path:	From the Main Menu, press **[G]** Jobs Menu - **[K]** Raw Data File Menu - **[G]**

```
JB,NMABC,TM15:23:17.6
SP,PN1,N 5000.000,E...
SP,PN2,N 5120.0000,E..
SP,PN3,N 4521.0000,E..
BK,OP1,BP2,BS69.3110,
LS,HI 5.50,HR 6.00
SS,OP1,FP4,AR24.4915,.
TOP | PGUP | PGDN | VIEW | NOTE | EXIT
```

[TOP] will display the first screen of the raw data file (including the first line).
[PGUP] will display the previous screen of the raw data file.
[PGDN] will display the next screen of the raw data file.
[VIEW] will display the entire contents of the highlighted line of the raw data file.
[NOTE] will temporarily transfer to a Note screen where you may key in an arbitrary note into the next line of the raw data file. Pressing **[EXIT]** from this screen will return to the View Raw Data Screen.

NOTE:

Other than the ability to add notes to the raw data file, it is **not** possible to edit the contents of this file from the View Raw Data Screen. In particular, it is **not possible** to delete any information from the raw data file from the TDS-48GX.

CREATE RAW DATA FILE SCREEN

Purpose of screen - to provide a way of creating a Raw Data file in your TDS-48GX, if one does not already exist.

Path:	From the Main Menu press **[G]**, Jobs Menu - **[K]**, Raw Data File Menu - **[H]**

```
ABC.CR5
DEF.CR5
GHI.CR5
```

SELCT	PGUP	PGDN			EXIT

This screen shows the names of the jobs that have been created in the TDS-48GX. Move the scroll bar to the job for which you want to create a Raw Data file by using the vertical cursor keys **[↑]** and **[↓]**. Then press **[SELCT]**.

[SELCT] will chose the highlighted name as the job to create a Raw Data file for, if one does not already exist in the TDS-48GX. If one already exists, an error message will appear.
[PGUP] will move the display up a page.
[PGDN] will move the display down a page.

DELETE RAW DATA FILE SCREEN

Purpose of screen - provide a way of deleting a Raw Data file from the TDS-48GX.

Path:	From the Main Menu press **[G]**, Jobs Menu - **[K]**, Raw Data File Menu- **[I]**

```
ABC.RW5
DEF.RW5
GHI.RW5
```

SELCT	PGUP	PGDN			EXIT

This screen shows the names of the Raw Data files that have been created in the TDS-48GX. Move the scroll bar to the file you want to delete by using the vertical cursor keys **[↑]** and **[↓]**. Then press **[SELCT]**.

[SELCT] will chose the highlighted name as the Raw Data file to delete. Once a file is selected, you will be prompted: "Are you sure? [Y / N]. Pressing **[Y]** will delete the selected file. Pressing **[N]** will return you to the Raw Data file menu.
[PGUP] will move the display up a page.
[PGDN] will move the display down a page.

DESCRIPTOR CODE TABLE SCREEN

Purpose of screen - to provide for a way of reviewing the Descriptor Code Table and adding new descriptor codes while in the field.

Path: From the Main Menu press **[G]**, Jobs Menu - **[K]**, Raw Data File Menu - **[J]** View Descriptors

```
CODE DESCRIPTOR
1 POB
2 HUB
3 CURB
4 TREE
5 FENCE
```

TOP	PGUP	PGDN	VIEW	DESC	EXIT

The top line is the heading for the file indicating that the code is followed by the descriptor separated by exactly one space.

Each subsequent line is a separate code/descriptor pair.

[TOP] will display the descriptor file from the top.
[PGUP] will move up to the next screen of descriptor codes
[PGDN] will move back to the previous screen of descriptor codes.
[VIEW] will display the entire descriptor at the cursor.
[DESC] will allow you to key in another code/descriptor pair. At the prompt key in CODE {space} DESCRIPTOR.

NOTE: Descriptors may be any length, but only the first 16 characters will be stored in the coordinate file when the code is invoked.

CREATE DESCRIPTOR FILE COMMAND

Purpose of command - to provide for a way of creating a Descriptor Code Table in your TDS-48GX, if one does not already exist.

Path:	From the Main Menu press [G], Jobs Menu - [K], Raw Data File Menu - [K]

This sequence of keystrokes will create an empty descriptor code table, if one does not already exist in the TDS-48GX. If one already exists, an error message will appear.

DELETE DESCRIPTORS COMMAND

Purpose of screen - to provide for a way of deleting the Descriptor Code Table from your TDS-48GX.

Path:	From the Main Menu press [G], Jobs Menu - [K], Raw Data File Menu - [L]

This sequence of keystrokes will delete the descriptor code table from your TDS-48GX. If one does not exist, an error message will appear.

DELETE JOB SCREEN

Purpose of screen - to allow a job to be deleted from the TDS-48GX.

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

```
ABC.CR5
DEF.CR5
GHI.CR5
```

SELCT					EXIT

This screen shows the names of the jobs that have been created in the TDS-48GX. 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.

RENAME FILE SCREEN

Purpose of screen - to allow you to change the name of an existing file.

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

```
   Rename File
File type:> Coord.
Old name: ########
New name: ########
```

<= Coord / PtLst / Text

START					EXIT

File type: is the type of file to be renamed, either coordinate, point list, or text.
Old name: is the file name before renaming.
New name: is the file name after renaming.

[START] renames the file.

DELETE POINTS SCREEN

Purpose of screen - To allow you to delete points from the currently active coordinate file.

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

From point - To point /
Using point list =>

```
    Delete points
>From point:          0
To point   :          0
```

DEL	PTLST				EXIT

From point / To point - Using point list : allow you to specify all points which are to be deleted.

[DEL] deletes the points specified from the currently active job file.

[PTLST] will transfer to the Point List Screen.

SETUP MENU SCREENS

TIME / DATE SCREEN

Purpose of screen - to enable you to set the date, time, and time offset from GMT into your TDS-48GX.

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

```
  Set Date and Time
Date: 01-25-1993
Time: 12:34:56
Hours to GMT:    0
Time + sec:    0.00
```

SET	T+S		CLCK		EXIT

Date: is the current date as this screen is displayed.
Time: is the current time as this screen is displayed.
Hours to GMT: is the number of hours that GMT is in advance of local time.
Time + sec: is the number of seconds to be added to the current time when [T + S] is pressed.

[SET] will prompt for a new date and new time. After each is keyed in, press **[ENTER]**. The current displayed date and time will be adjusted accordingly. If you do not wish to change either the date or the time, press **[ENTER]** at that prompt without keying in new data.
[T + S] will adjust the current time by the number of seconds shown in the Time + sec: line of the display.
[CLOCK] will display the current time continuously.

DEVICE SETUP SCREEN

Purpose of screen - to allow you to establish manual input or communication with an electronic total station; to establish single or multiple distance readings with averaging.

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

```
  Device Setup
Instrmnt: ><<Manual>>       <= (See Below)
  Model : >
Instr dist unit:>Feet       <= Feet / Meter
Dist measur:>Single         <= Single / Averagin

|      | COLLI |      | FAST |      | EXIT |
```

Instrument brand and model list -
<<Manual>>
Topcon: RS232 Port;
Lietz: SETs - SETsB - SDM3F - SDM3FR - SDM3E - SDM3ER - DT20E;
Nikon: TOPGUN;
Wild: T2000 + EDM - T1000 + EDM - T2000 - T1000;
Pentax: PTS-10 - PTS II;
Zeiss: Elta/C - Old Elta;
Geodimeter: RS232 port.
New gun

Instrument: is the line in which you use the horizontal cursor keys to scroll to the instrument brand name that you intend to use with the TDS-48GX. (see list above)
Model: After the instrument brand name is selected, you may scroll to the appropriate model number on this line. (see list above)
Instr dist unit: Allows you to set the TDS-48GX to assume that the instrument is measuring distances in either feet or meters.
Dist meas: Allows you to select whether or not you intend to take single or multiple distance measurements with averaging with your gun.

[INIT] will initialize an instrument.
[COLLI] will transfer to the Collimation Screen.

[FAST] will toggle the *instrument coarse* mode on and off. Coarse mode is only available for certain brands of guns. If coarse mode is not available for your gun model, the computer will display: "Fast (Coarse) Mode not Applicable". The effect of coarse mode is to put the gun in a fast measurement mode. This mode may be used for topographic surveys to speed up the gathering of data or for stakeout. When used from the Stakeout Screen, however, coarse mode will not cause the TDS-48GX to take shots continuously.

NOTE: If you use an electronic theodolite with a top mounted EDM, you should set up your equipment so that the theodolite sights to a point on the rod below the prism at a distance equal to the distance that the EDM is offset from the optical axis of the theodolite.

NOTE: Specific information concerning the operation of each of the brands of electronic total stations with the TDS-48GX may be found in Appendix B.

COLLIMATION SCREEN

Purpose of screen - to allow you to compute and apply collimation corrections to all measured angles, and to apply a prism constant correction to all measured distances.

Path: From the Main Menu, press **[H]** Setup Menu - **[H]** Device Setup Screen - **[COLLI]**

```
     Collimation
Apply collimation:>No

Horiz coll.:    0.0000
Vert coll.:     0.0000

Prism constant:  0.000
```

<=No / Yes

SHOOT		STORE			EXIT

Apply collimation: allows you to select whether or not the corrections shown in this screen will be applied to measurements taken by the TDS-48GX.
Horiz coll.: is the amount of angle correction that will be added to or subtracted from each measured horizontal angle.
Vert coll.: is the amount of angle correction that will be added to or subtracted from each measured zenith angle.
Prism constant: is the amount of distance correction that will be added to each slope distance measurement.

[SHOOT] can be used to shoot a target and let the TDS-48GX compute the collimation errors automatically. You can shoot at multiple points with significant vertical separation to improve the collimation calculation. Every time **[SHOOT]** is pressed, it will prompt for a set of direct and reverse shootings. The results of the multiple sets will be averaged.
[STORE] will store the collimation values shown in this screen to your currently active raw data file.

NOTE:

Collimation is used to correct for "slack" in your gun. When collimation is applied, it will correct your angle readings using the following equations:
Corrected HA = Measured HA + Horiz collimation
Corrected ZE = Measured ZE + Vert collimation

The Prism constant is always added to the distance reading.

OPERATING MODES SCREEN

Purpose of screen - allow you to set the operating modes of the TDS-48GX .

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

```
  Operating Modes
Azimuth: >N. azimuth          <= N. azimuth / S. azimuth
Scale factor:0.0000000
Earth curve adj.:>OFF         <= OFF / ON
Storing pause:    >OFF        <= OFF / ON
Dist unit: >Feet              <= Feet / Meter
Angle unit: >Degree           <= Degree / Grad
MORE | | | | NEXT | EXIT
```

```
   OP Modes (cont.)
Beeper:> ON                   <= ON / OFF
Prompt for rod Ht:>No         <= No / Yes
Prompt for description
 in sideshot:       Yes       <= Yes / No
PREV | | | | | EXIT
```

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:

$$\text{Vertical distance adjustment(ft)} = 0.574 * \text{horizontal distance(in miles)}^2$$

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 Gradians)
Prompt for rod Ht: specifies whether the TDS-48GX should ask for the height of the rod before each shot is taken.

[MORE] will display the next Operating Modes screen.

REPETITION MODE SCREEN

Purpose of screen - to allow you to establish the technique to be used in acquiring angles and distances in your survey.

Path:	→ From the Main Menu, press **[H]** Setup Menu - **[J]** → From the Main Menu, press **[J]** Traverse/Side Shot Screen - **[REP]** Repetition Modes Menu - **[K]**

`Horiz angle mode:`	
`       >Single`	Single / Directional / <= Accumulation
`Vert angle: >Single`	<= Single / Multiple
`Dist mode:  >Single`	<= Single / Multiple
`Number of sets:  0`	
`Angle tol(sec):   0.00`	
`Dist tol(ft)  :   0.00`	

MORE					EXIT

`Shooting sequence`	
`for directional:`	BS.FS flip BS.FS /
`>BS.FS  flip  BS.FS`	<= BS.FS flip FS.BS

					EXIT

Horiz. angle mode: may be set in one of four modes -
Single - a single horizontal angle shot will be taken for each point.
Directional - the sequence of shots to determine the horizontal angle for each point is as follows:

- direct to the backsight; direct to the foresight; reverse (flop) the scope; reverse to the backsight; reverse to the foresight.
- direct to the backsight; direct to the foresight; reverse (flop) the scope; reverse to the foresight; reverse to the backsight.

To select between these to shooting sequences see Shooting sequence below. The above group of shots is one set and each forward and revese angle from all sets are then averaged to determene the horizontal angle.

Accumulation - multiple angles (windings) are taken to determine each horizontal angle. For each set, you will take a horizontal angle between your backsight and foresight then rotate your lower motion back to your backsight and take the next angle from that circle reading. The value of the circle angle from each foresight sighting is used as the circle angle for the next backsight; thus, accumulating the readings. All sets are then averaged.

Vertical angle: may be set as either a single or multiple readings to be averaged to determine the vertical or zenith angle for each point.
Dist. mode: may be set to take either a single or multiple distances to be averaged in the TDS-48GX for each point.
Number of sets: is where you specify the number of readings to be taken for each multiple mode. If you choose a multiple mode, the number of sets must be entered as 1 or more.
Angle err (sec): lets you specify the error among multiple angle readings that will be tolerated before you are alerted by the TDS-48GX that an error has occurred.
Dist. err (Ft): lets you specify the error among multiple distance readings that will be tolerated before you are alerted by the TDS-48GX that an error has occurred. When the units are feet, the distance tolerance is in feet. When the units are meters, the distance tolerance is in centimeters.
Shooting sequence: lets you select between shooting the backsight and then the foresight or the foresight and then the backsight after you flip your scope for the reverse readings.

MORE: brings up the second screen of the Repetition Mode Screen where you may select the shooting sequence for the Directional horizontal angle mode.

NOTE:

To use the accumulation mode for horizontal angles, you must have a gun that has a lower motion screw or some other device that will allow you to move the gun through a horizontal angle without changing the circle angle reading.

SELECT CONTROL FILE SCREEN

Purpose of screen - to provide a way to select a control file in your TDS-48GX.

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

```
ABC.CR5
DEF.CR5
GHI.CR5
```

SELCT	PGUP	PGDN			EXIT

This screen shows the names of the jobs that have been created in the TDS-48GX. Move the scroll bar to the job you wish to select as a Control file by using the vertical cursor keys [↑] and [↓]. Then press [SELCT].

[SELCT] will chose the highlighted name as the Control file for the current job.
[PGUP] will move the display up a page.
[PGDN] will move the display down a page.

DESELECT CONTROL FILE COMMAND

Purpose of command - to provide a way of deselecting a control file in your TDS-48GX.

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

When this command is chosen, the currently selected control file is "turned off". The Current Job Info screen is then displayed to indicate that no control file is now selected.

STAKEOUT MENU SCREENS

POINTS STAKE SCREEN

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

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

BS pt / BS azm / BS brg =>

```
      Point Stake
Occupy pt:         0
>BS pt :           0
FS pt   :          0
Store pt:        0
Circular  :      0.0000
Horiz dist:       0.000
```

SOLVE	STAKE	CIR-0	FS+1	LOCAT	EXIT

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).
Store pt: is the point number that will be used to store the actual coordinates of the point 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.
[STAKE] will transfer you to the Stake Shots Screen (see below).
[CIR-0] will set the circular angle of your gun such that, when you are sighting the foresight, the circle (horizontal) angle reading in the gun will be zero. You must be sighting the backsight and zero your gun when you press this key for the first time; and, you must be sighting the previous foresight when you press it for subsequent points.
[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.
[LOCAT] will transfer to the Define a Location Screen (see below).

STAKE SHOTS SCREEN

Purpose of screen - to allow you to actually performing a stakeout.

Path:	→ From the Main Menu, press **[I]** Stakeout Menu - **[G]** Points Stake Screen - **[STAKE]** → From the Main Menu, press **[I]** Stakeout Menu - **[H]** Offset Stakeout Screen - **[STAKE]**

```
          Stake Shot
         Horiz dist:       0.000
         HI:  0.000 HR:    0.000
         Zenith ang:      0.0000
         Slope dist:       0.000
Come / Go => Come:   0.000
 Cut / Fil => Cut: 0.000Elv:     0.00
GRADE  SHOT  STORE  FAST        EXIT
```

Horiz dist: is the horizontal distance to the foresight as computed in the previous screen (Points Stake).
HI: is the height of the instrument above the occupied point on the ground.
HR: is the height of the target on the rod above the ground.
Zenith ang: is the actual zenith angle to the rod at the proposed stake point. This data may either be entered in manual mode or it may be collected automatically from an electronic total station by pressing **[SHOT]**.
Slope dist: is the actual slope distance to the rod at the proposed stake point. This data may either be entered in manual mode or it may be collected automatically from an electronic total station by pressing **[SHOT]**.
Come - Go: {output only} is the distance that the rod man must move toward or away from the gun to locate the stake point exactly.
Cut - Fill: {output only} is the amount of earth that must be removed from or added to the ground at the stake point to bring the actual point even with the design elevation.
Ele: {output only} is the actual elevation of the stake point.

[GRADE] will prompt you for a different grade for this point; then it will recompute the "Cut/Fill" accordingly.
[SHOT] will compute the Come or Go and Cut or Fill information based on the angle and distance information which has been provided. *If you are connected to an electronic total station, it is not necessary to key in the angle and distance.* Pressing **[SHOT]** will trigger the gun to gather this information for you. After that, the Come or Go and Cut or Fill information will be computed and displayed.
[STORE] will store the actual staked coordinates at the point number specified in the previous screen (Points Stake). If **[STORE]** is pressed before a shot is taken, it will store the computed values of the coordinates. This feature may be used to generate points which may be staked later using the Points Stake Screen. This latter feature is only operative if the Stake Shots Screen is entered from the Offset Stakeout Screen.
[FAST] if your gun supports it, will put your gun in tracking mode. Thereby, you may track the movement of the rod man continuously without having to trigger the gun from the TDS-48GX keyboard.

DEFINE A LOCATION SCREEN

Purpose of screen - allow you to stake a point that is not in the coordinate file, but whose position is known relative to a point that is in the file.

Path: From the Main Menu, press **[I]** Stakeout Menu - **[G]** Points Stake Screen - **[LOCAT]**

Azimuth / Bearing =>

```
  Define Location
Reference pt:       0
>Azimuth   :        0
Horiz dist:     0.000
+/- ang :    0.0000
```

SOLVE	DFDIR				EXIT

Reference pt: is the point number of the point from which the point to be staked is referenced.

Azimuth: - Bearing: is the angle from the reference point to the point to be staked (as modified by the +/- ang parameter below).
Horiz dist: is the horizontal distance from the reference point to the point to be staked.
+/- ang: is the angular deviation from the azimuth or bearing listed above from the reference point to the point to be staked. A + angle represents a clockwise deviation; a - angle represents a counter-clockwise deviation.

[SOLVE] will compute the angle right and the horizontal distance from the occupied point to the point to be staked. The TDS-48GX will return to the Points Stake Screen automatically with the foresight point reported as "0".
[DFDIR] will transfer you to the Define a Direction Screen.

OFFSET STAKEOUT SCREEN

Purpose of screen - to allow you to stakeout a right-of-way by specifying the station on the center line and the offset distance from the center line.

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

```
   Offset Stakeout
Station:    0 +  0.000
Offset : >Center
Store pt:        0
Segment: Straight
Circular  :    0.0000
Horiz dist:     0.000
SOLVE | STAKE | CIR-0 | ADV | SETUP | EXIT
```

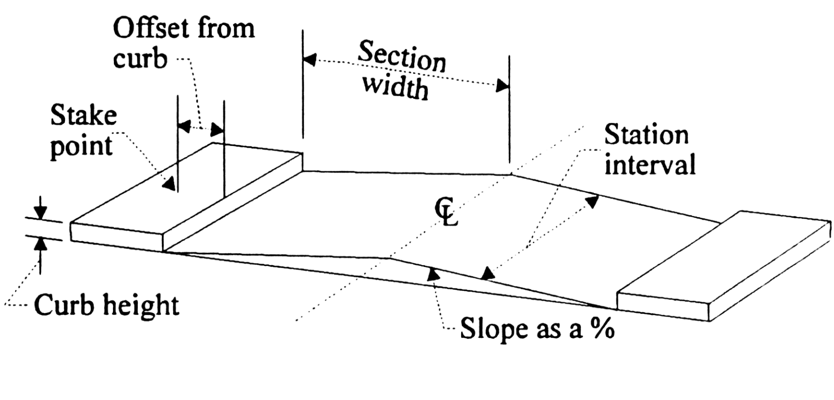
<= Center / Right / Left

** Straight / H curve / V curve / H+V curve **

Station: is the station number currently being staked.
Offset: is the direction of the offset from the center line; either right, left, or directly on the center line.
Store pt: is the point number that will be used to store the actual coordinates of the point staked.
Segment: {output only} describes the nature of the road segment at the current station, either straight or curved.

Circular: {output only} is the horizontal angle reading from the backsight to 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. You must execute **[SETUP]** at least once before you may press **[SOLVE]**.
[STAK] will transfer you to the Stake Shots Screen. (see Points Stake Screen).
[CIR-0] will set the circular angle of your gun so that, when you are sighting the foresight, the circle (horizontal) angle reading in the gun will be zero. You must be sighting the backsight and zero your gun when you press this key for the first time; and, you must be sighting the previous foresight when you press it for subsequent points.
[ADV] will increment the station in the screen by the distance established in the Offset Stakeout Setup Screen (see below). This is useful when you have completed staking a point and you want to move on to the next one. **[ADV]** will also execute the **[SOLVE]** command on the next station.
[SETUP] will transfer to the Offset Stakeout Setup Screen (see below).



OFFSET STAKEOUT SETUP SCREEN

Purpose of screen - to establish the setup parameters of the offset stakeout.

Path:	→ From the Main Menu, press [I] Stakeout Menu - [H] Offset Stakeout Screen - [SETUP] → From the Main Menu, press [I] Stakeout Menu - [I] Slope Stake Screen - [SETUP]

```
Occupy pt:          0
Begin sta:     0+  0.000
Sta. intrvl(ft):   0.0
Section width   :  0.0
Cross slope(%)  :  0.00
Curb height(in):   0.00
Ofst from curb  :  0.00
SOLVE | PTLST | BACKS |  |  | EXIT
```

Occupy pt: is the point number of the currently occupied gun position from which the stakeout will be done.
Begin sta: is the station number of the first point in the point list.
Sta. intvl(ft): is the interval between stations in feet. (see figure). When the distance units are set to meters, the station interval is in meters.
Section width: is the width of the road in feet from the center line to the edge of the right-of-way or to the *inside* edge of the curb (if any). (see figure)
Cross slope (%): is the slope of the cross section of the road expressed as a per cent. (see figure)
Curb height (in): is the height of the curb (if any) in inches. (see figure) When the distance units are set to meters, the curb height is in cm.
Ofst from curb: is the distance of the stake point from the true location of the *inside* edge of the curb. (see figure)

[SOLVE] will compute and store the parameters of the stakeout once all of the information has been entered in the screen. You must set the backsight and setup the Point List before using this key for the first time.
[PTLST] will transfer to the Point List Screen (see Utility Screens section).
[BACK] will establish the backsight for the stakeout (see Backsight Screen in Utility Screens section).

SLOPE STAKE SCREEN

Purpose of screen - to allow you to slope stake a road.

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

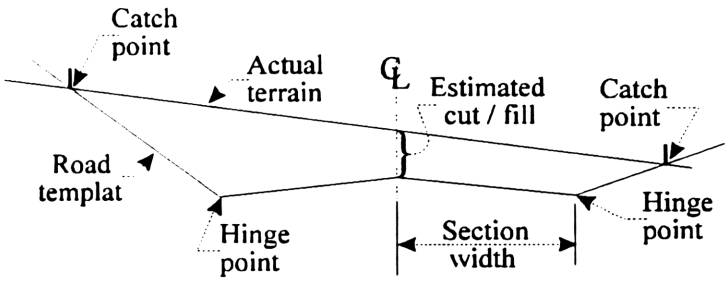
```
   Slope Staking
Station:    0 +  0.000
Segment: Straight
Section width  :  0.0
Slope ratio:     0.00
Estimated C/F:    0.00
Store pt:        0
```

<= Straight / H curve / V curve / H+V curve

	STAKE		ADV	SETUP	EXIT

Station: is the current station being staked.
Segment: {output only} describes the nature of the road (straight or curved) at the current station.
Section width: is the width of the road in feet from the center line to the edge of the right-of-way. (see figure)
Slope ratio: the slope ratio of the section being staked. This is expressed as the horizontal component of the slope / vertical component of slope.
Estimated C/F: The estimated cut/fill at the catch point: - for fill; + for cut.
Store pt: the point number used to store the actual coordinates of the staked point.

[STAKE] will transfer you to the Slope Stake Shots Screen. (see below).
[ADV] will increment the station in the screen by the distance established in the Offset Stakeout Setup Screen (see above). This is useful when you have completed staking a point and you want to move on to the next one.
[SETUP] will transfer to the Offset Stakeout Setup Screen (see above). You must complete a setup before you can execute **[STAKE]**.



NOTE:

> Since the TDS-48GX does not know the actual terrain features during slope staking, the process of locating catch points is iterative. Therefore, it is necessary for you to provide an estimate of the amount of cut or fill that will be required at the center line of the road.

SLOPE STAKE SHOTS SCREEN

Purpose of screen - to allow you actually to take slope stake shots.

Path:	From the Main Menu, press **[I]** Stakeout Menu - **[I]** Slope Stake Screen - **[STAKE]**

```
                                     Slope Stake Shot
                                 Station:    0 +  0.000
                                 HI:   0.000 HR:  0.000
                                 Circular:      0.0000
Zenith ang / Vert dist =>        >Zenith ang:    0.0000
Slope dist / Horiz dist =>        Slope dist:     0.000
Come to C.L. / Go from C.L.=>    Come to C.L.:   0.000
                               SIGHT | SHOT | STORE | FAST |  | EXIT
```

Station: {output only} is the current station being staked.
HI: is the height of the instrument above the occupied point on the ground.
HR: is the height of the target on the rod above the ground.
Circular: is the angle right from the backsight to the "trial" catch point.
Zenith ang: is the actual zenith angle to the rod at the proposed stake point. This data may either be entered in manual mode or it may be collected automatically from an electronic total station by pressing **[SHOT]**.

Slope dist: is the actual slope distance to the rod at the proposed stake point. This data may either be entered in manual mode or it may be collected automatically from an electronic total station by pressing **[SHOT]**.
GO (or COME) from C.L.:{output only} the distance the rod must move toward or away from the center line to establish the next "trial" catch point.

[SIGHT] will display distance and angle information related to the location of the next "trial" shot from the vantage point of the gun. It is displayed as:

Stake elev: the current elevation at the rod.
Stake to hinge: the distance from the current location of the rod to the hinge point (see figure).
Sight C.P. from gun:
Circular:
Horiz dist:
Cut:

This information is the horizontal angle and horizontal distance from the gun to the next trial point as well as the current Cut (or Fill). Press any key to return to the Slope Stake Shots Screen.
[SHOT] will compute the Come or Go and Cut or Fill information based on the angle and distance information which has been provided. *If you are connected to an electronic total station, it is not necessary to key in the angle and distance.* Pressing **[SHOT]** will trigger the gun to gather this information for you. After that, the Come or Go and Cut or Fill information will be computed and displayed.
[STORE] is the key that you may use if you want to store the coordinates of the stake locations in the job file. It will first prompt for an offset distance from the catch point to a reference point where the stake is to be set. If you want to store the coordinates of the catch point itself, you should enter zero in response to this prompt. Press **[ENTER]**. The coordinates of the reference point will be stored at the point number that has been specified in the Slope Stake Screen. The offset is on a line from the catch point to the center line of the road. The unit will then prompt you with the message "Wish to store line stake? [Y/N]". If you would like to store the coordinates of another point on the line from the catch point to the center line, press **[Y]** in response to this prompt. Then you will see the prompt "Offset from ref:". Key in the offset from the previously specified reference point in response to this prompt. Then press **[ENTER]**. These coordinates will be stored at the next point number from the previous reference point.
[FAST] if your gun supports it, will put your gun in coarse mode.

STORE / STAKE REFERENCE POINT SCREEN

Purpose of screen - to allow you to store and / or stake the coordinates of the catch point while doing slope staking, and to store / stake reference points to that catch point.

Path:	From the Main Menu, press [I] Stakeout Menu - [I] Slope Stake Screen - [STAKE] Slope Stake Shots Screen - [STORE]

```
  Store/Stake Ref. Pt
Ref. pt offset:  0.00
Desc:
Store pt:        0
Circular  :      0.0000
Horiz dist:       0.000
Elevation:          0.00
```

SOLVE	STAKE	STORE			EXIT

Ref. pt offset: is the offset distance from the catch point to the reference point. You enter this distance before the reference point coordinates are calculated. The reference point is calculated with the same elevation as the catch point. An offset of 0.00 indicates the catch point itself.
Desc: is the descriptor for the point (limited to 16 alpha, numeric, or special characters).
Store pt: is the point number that will be used to store the coordinates of the reference point.
Circular: {output only}is the horizontal angle right from the backsight to the catch point.
Horiz dist: {output only} is the horizontal distance to the catch point.
Elevation: {output only}is the elevation of the catch point.

[SOLVE] will compute the location of the reference point.
[STAKE] can be used to stake the reference point.
[STORE] will store the reference point.

SET STAKEOUT MODE SCREEN

Purpose of screen - allow you to set the horizontal angle error limit, the slope stake error limit, and specify whether or not you want to store a cut sheet.

Path: From the Main Menu, press [I] Stakeout Menu - [J]

```
  Set Stakeout Mode

Store cut sheet: >OFF     <=OFF / ON
HA tolerance(sec):0.00
Slope stk tol(ft):0.00
[     ][     ][     ][     ][     ][EXIT]
```

Store cut sheet: may be set either ON or OFF depending on whether or not you want to store a cut sheet of the stakeout.
HA tolerance (sec): is the *maximum* deviation allowed between the observed horizontal angle and the true computed horizontal angle before the TDS-48GX will alert you of an error.
Slope stake tol (ft): is the maximum allowed deviation of the rod from the true station location before the TDS-48GX will alert you of an error.

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.

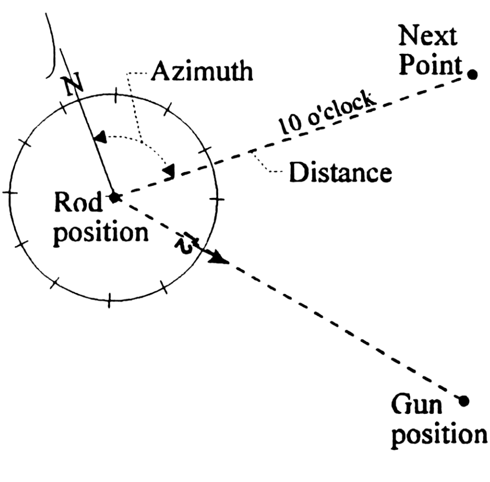
Path:
→ From the Main Menu, press [M] CO-GO Menu - [P]
→ From the Main Menu, press [I] Stake Out Menu - [K]

```
  Where is Next Point
Rod pt:         0
Next pt:        0
Reference pt:        0
Direction:  0 O'clock
Horiz dist:     0.000
Azimuth:       0.0000
[SOLVE][     ][     ][ADV][     ][EXIT]
```

REFERENCE

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.



TRAVERSE/SIDESHOT SCREENS

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:         0 FS:        0
                                                  BS pt:        0
         Ang right  / Azimuth / Bearing /
          Ang left /  Def right /Def left=>       >Ang right :     0.0000
   Zenith ang / Vert ang / Chng elev=>            >Zenith ang:     0.0000
Slope dist / Slope dist / Horiz dist=>             Slope dist:      0.000
                                                  Desc:xxxxxxxxxxxxxxxx
                                                  HI:   0.000 HR:   0.000
                                          SIDES | REP | BACKS | TRAV | OFFCT | EXIT
```

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-48GX.

Desc: is the descriptor for the point (limited to 16 alpha, numeric, or special characters).

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.)

[REP] will transfer to the TR/SS Repetition Menu (see below).

[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. (See note below for more information.)

[OFFCT] will transfer to the Off Center Shot Menu (see below).

NOTE:

If you are gathering data automatically from an *electronic total station,* it is not necessary to fill in the horizontal angle, vertical angle or distance lines in the screen before pressing either **[SIDES]** or **[TRAV]**. When **[SIDES]** or **[TRAV]** are pressed, the TDS-48GX will trigger the gun to make the appropriate measurements and transfer them to the data collector. Also, after the total station is taking the measurements and transferring them to the TDS-48GX, the unit will display a descriptor screen for you to key in the descriptor.

TR/SS REPETITION MENU

Purpose of menu - to establish a variety of repetition (repeated readings) modes for doing field work.

Path: From the Main Menu, press **[J]** Traverse/Sideshot then, **[REP]**

```
  TR/SS Repetition
[G] Horiz dir & rev
[H] Horiz accumulation
[I] Zenith dir & rev
[J] Multiple distances
[K] Radial sideshots
[L] Set Rep. mode
```

MORE					EXIT

```
  TR/SS Repetition
[M] Shoot from 2 ends
[N] Go to record mode
```

					EXIT

NOTE:

If you have preset the Repetition Mode Screen to a non-zero number of "sets", pressing **[SIDES]** or **[TRAV]** from the Traverse/Sideshot Screen will cause the TDS-48GX to prompt you for input (either manual or electronic) in the proper sequence to take the repeated readings. Pressing **[REP]** from the Traverse/Sideshot Screen will display the menu choices shown above. Selecting any of these will prompt you for input (either manual or electronic) in the proper sequence to take repeated readings and compute <u>either</u> the average angles <u>or</u> average distances (depending on which menu choice you make). Pressing **[EXIT]** from this menu will return you to the Traverse/Sideshot Screen. Pressing **[SIDES]** or **[TRAV]** now will cause the TDS-48GX to complete collecting the data for this point (either angles or distance - whichever is missing - in the normal way) and compute the coordinates of the new point from a combination of average data and single readings as required by the TR/SS Repetition Menu choice.

RADIAL SIDESHOTS SCREEN

Purpose of screen - to allow you to take multiple readings to a series of foresight points, using the same backsight reading for each point.

Path:	From the Main Menu, press **[J]** Traverse / Side Shot screen - **[REP]** - TR / SS Repetition Menu - **[K]**

```
   Radial Sideshots
HI:  0.000 HR:  0.000
Ang right:     0.0000
Zenith ang:    0.0000
Slope dist:     0.000
Horiz error:   0.0000
Vert error:    0.0000
```

SIDES					EXIT

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.

Ang right: is the angle right to the rod position.

Zenith ang: is the zenith angle to the rod position.

Slp dist: is the slope distance to the rod position.

Horiz error: is the difference between the largest and the smallest horizontal angle readings.

Vert error: is the difference between the largest and the smallest vertical angle readings.

[SIDES] will begin taking a series of shots to a foresight point. After this series, **[SIDES]** can pressed again to shoot another foresight point.

SET REPETITION MODE SCREEN

NOTE: For details of this screen, see the Repetition Mode Screen under the Setup Menu Section of this Reference manual.

SHOOT FROM TWO ENDS SCREEN

Purpose of screen - to allow you to average two sets of distance and zenith angle measurements. The first set is taken from the occupied point to the foresight point, and the second set is taken in the opposite direction.

Path:	From the Main Menu, press **[J]** Traverse / Side Shot screen - **[REP]** - TR / SS Repetition Menu - **[M]**

```
  Shoot from 2 Ends
Option: >Direct & Rev
-Use [FRWRD] & [BKWRD]
 to shoot from 2 ends.
-Then press [SOLVE]
 to average.
 HA is not affected.
```

SOLVE	FRWRD		BKWRD		EXIT

<=Direct & Rev / Direct only

Option: allows you to choose whether to take one shot only, or two shots, flopping the scope between shots.

[SOLVE] will average the readings taken from the forward and backward shots, and place the results in the Traverse / Sideshot screen.

[FRWRD] will transfer to the Forward Shooting Screen.

[BKWRD] will transfer to the Backward Shooting Screen.

FORWARD SHOOTING SCREEN

Purpose of screen - to allow you to take the distance and zenith angle measurement from the occupied point to the foresight point.

Path:	From the Main Menu, press **[J]** Traverse / Side Shot screen - **[REP]** - TR / SS Repetition Menu - **[M]** Shoot from Two Ends screen - **[FRWRD]**

```
  Forward Shooting
HI:  0.000 HR:  0.000
Zenith ang:   0.0000
Slp dist:      0.000
```

SHOOT					EXIT

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.

Zenith ang: is the zenith angle to the rod position.

Slp dist: is the slope distance to the rod position.

[SHOOT] will collect the distance and zenith angle measurements from an electronic total station.

BACKWARD SHOOTING SCREEN

Purpose of screen - to allow you to take the distance and zenith angle measurement from the foresight point to the occupied point.

Path:	From the Main Menu, press **[J]** Traverse / Side Shot screen - **[REP]** - TR / SS Repetition Menu - **[M]** Shoot from Two Ends screen - **[BKWRD]**

```
  Backward Shooting
HI:  0.000 HR:  0.000
Zenith ang:   0.0000
Slp dist:      0.000
```

SHOOT					EXIT

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.

Zenith ang: is the zenith angle to the rod position.

Slp dist: is the slope distance to the rod position.

[SHOOT] will collect the distance and zenith angle measurements from an electronic total station.

GO TO RECORD MODE SCREEN

Purpose of screen - to allow you to put the TDS-48GX into a mode where you control the total station from its own keypad. The data collector will then simply log points as they are received.

Path:	From the Main Menu, press **[J]** - Traverse/Sideshot Screen - **[REP]** - TR/SS Repetition Menu - **[N]**

```
The data collector is
now in recording mode.
Press appropriate key
on gun to take shots.


<Any key to continue>
|    |    |    |    |    |EXIT|
```

Press a key on the TDS-48GX and you will be prompted to Enter a descriptor for all of the shots to follow. Enter a descriptor that will be stored with all shots recorded in this mode. After pressing **[ENTER]**, you will see one or two more prompts telling you how to control your particular gun. Follow the prompts, collecting shots until you are finished.

NOTE: The Record mode routine only supports certain instruments. If you receive the prompt: **"Record mode not supported."** after pressing the **[N] Go to Record mode** key, you are either in the Manual mode or your instrument is not supported.

OFF CENTER SHOT MENU

Purpose of menu - to allow you to shoot points for which you cannot place the rod target exactly on the point.

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

```
  Off center shot
[G] Horiz ang offset
[H] Horiz dist offset
[I] Vert ang offset
[J] Right ang offset
[K] Vert dist offset
[L] Bench Mark
|     |     |     |     |     | EXIT |
```

The Off Center Shot Menu covers six common situations that are encountered in the field when it is not possible for the rod to occupy the point that is to be shot. Those six situations are specified in the menu and illustrated in the screens shown below. If you are taking the data *manually*, you should fill out the Traverse/Sideshot Screen with the data as obtained from the shot to the prism in each of the four cases. Then press **[OFFCT]**. You will be prompted to key in the missing data for each situation as required. After following the prompts, you will be returned to the Traverse/Sideshot Screen where the input data will have been modified to reflect the actual point to be shot. Then you should press **[SIDES]** to complete the shot.

If you are collecting your data *electronically*, pressing **[OFFCT]** will take the appropriate shots and prompt you to move the rod or key in the data to the actual point as required. After the final prompt, the sideshot to the unknown point will be completed and you will be returned to the Traverse/Sideshot Screen for the next shot.

HORIZONTAL ANGLE OFFSET SCREEN

Purpose of screen - To allow you to shoot the center of a large object, such as a big tree.

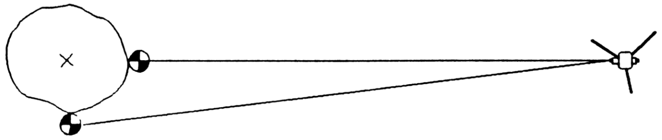
Path:	From the Main Menu, press **[J]** Traverse / side shot screen - **[OFFCT]** Off Center Shot Menu - **[G]**

```
  Horiz Ang Offset
HI:  0.000 HR:  0.000
Desc:xxxxxxxxxxxxxxxx
Side HA:      0.0000
Zenith:       0.0000
Slp dist:      0.000
Center HA:    0.0000
```

CNTR	SIDE	STORE		HELP	EXIT

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.
Desc: is the descriptor for the point (limited to 16 alpha, numeric, or special characters).
Side HA: is the horizontal angle to the side of the object.
Zenith: is the zenith angle to the side of the object.
Slp dist: is the slope distance to the side of the object.
Center HA: is the horizontal angle to the center of the object.

[CNTR] takes a shot to the center of the object.
[SIDE] takes a shot to the side of the object.
[STORE] calculates and stores the coordinates of the actual point.



HORIZONTAL DISTANCE OFFSET SCREEN

Purpose of screen - To allow you to shoot a point beyond the rod point, such as the middle of a river.

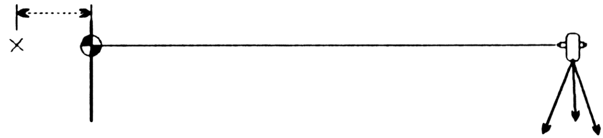
Path:	From the Main Menu, press **[J]** Traverse / side shot screen - **[OFFCT]** Off Center Shot Menu - **[H]**

```
  Horiz Dist Offset
HI:  0.000 HR:  0.000
Desc:xxxxxxxxxxxxxxxx
Ang Rt:        0.0000
Zenith:        0.0000
Slp dist:       0.000
HD +/-:         0.000
```

CNTR		STORE		HELP	EXIT

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.
Desc: is the descriptor for the point (limited to 16 alpha, numeric, or special characters).
Ang Rt: is the angle right to the rod position.
Zenith: is the zenith angle to the rod position.
Slp dist: is the slope distance to the rod position.
HD +/-: is the amount to be added or subtracted from the distance measured to the rod.

[CNTR] takes a shot to the rod position.
[STORE] calculates and stores the coordinates of the actual point.



VERTICAL ANGLE OFFSET SCREEN

Purpose of screen - To allow you to shoot a point that is too high to reach, such as the top of a power pole.

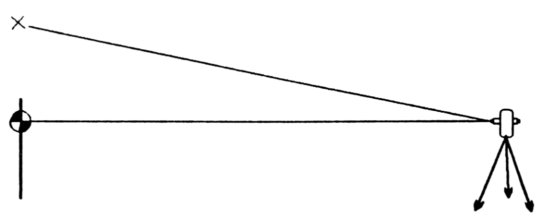
Path:	From the Main Menu, press [J] Traverse / side shot screen - [OFFCT] Off Center Shot Menu - [I]

```
     Vert Ang Offset
HI:  0.000 HR:  0.000
Desc:xxxxxxxxxxxxxxxx
Ang Rt:         0.0000
Zenith:         0.0000
Slp dist:        0.000
True zen:       0.0000
```

CNTR	ZEN	STORE		HELP	EXIT

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.
Desc: is the descriptor for the point (limited to 16 alpha, numeric, or special characters).
Ang Rt: is the angle right to the rod position.
Zenith: is the zenith angle to the rod position.
Slp dist: is the slope distance to the rod position.
True zen: is the zenith angle to the actual point.

[CNTR] takes a shot to the rod position.
[ZEN] shoots the zenith angle to the actual point.
[STORE] calculates and stores the coordinates of the actual point.



RIGHT ANGLE OFFSET SCREEN

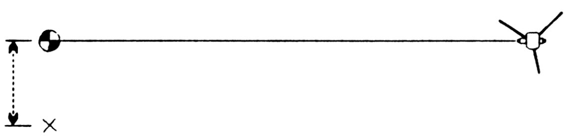
Purpose of screen - To allow you to shoot a point that is at a right angle to your rod position, such as around the corner of a building.

Path:	From the Main Menu, press **[J]** Traverse / side shot screen - **[OFFCT]** Off Center Shot Menu - **[J]**

```
  Right Ang Offset
HI:  0.000 HR:  0.000
Desc:xxxxxxxxxxxxxxxx
Ang Rt:       0.0000
Zenith:       0.0000
Slp dist:      0.000
Offset dist:   0.000
SHOOT |   | STORE |   | HELP | EXIT
```

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.
Desc: is the descriptor for the point (limited to 16 alpha, numeric, or special characters).
Ang Rt: is the angle right to the rod position.
Zenith: is the zenith angle to the rod position.
Slp dist: is the slope distance to the rod position.
Offset dist: is the right angle distance from the rod position to the actual point.

[SHOOT] takes a shot to the rod position.
[STORE] calculates and stores the coordinates of the actual point.



VERTICAL DISTANCE OFFSET SCREEN

Purpose of screen - To allow you to shoot a point which you cannot occupy, but can find the vertical distance to, such as down a manhole.

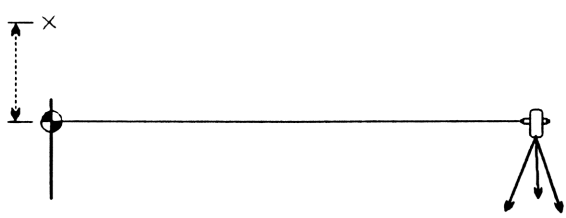
Path:	From the Main Menu, press **[J]** Traverse / side shot screen - **[OFFCT]** Off Center Shot Menu - **[K]**

```
   Vert Dist Offset
HI:  0.000 HR:  0.000
Desc:xxxxxxxxxxxxxxxx
Ang Rt:        0.0000
Zenith:        0.0000
Slp dist:       0.000
VD +/-:         0.000
```

SHOOT		STORE		HELP	EXIT

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.
Desc: is the descriptor for the point (limited to 16 alpha, numeric, or special characters).
Ang Rt: is the angle right to the rod position.
Zenith: is the zenith angle to the rod position.
Slp dist: is the slope distance to the rod position.
VD +/-: is the vertical distance from the rod point to the actual point.

[SHOOT] takes a shot to the rod position.
[STORE] calculates and stores the coordinates of the actual point.



SHOOT BENCH MARK SCREEN

NOTE: This screen is detailed under the CO-GO Menu Section of this Reference manual.

DIRECTORY SCREEN

DIRECTORY SCREEN

Purpose of screen - to allow you to review the directory of files in the TDS-48GX.

Path: From the Main Menu, press [K]

```
ABC.CR5      ##
ABC.RW5      ##
DEF.CR5      ##
DEF.RW5      ##
GHI.CR5      ##
GHI.RW5      ##
```

MORE					EXIT

This screen will prompt you to enter a file specification. The file extensions which are stored in the TDS-48GX are:

Coordinate files - .CR5
Raw data files - .RW5
Point list files - .PL5

TRIG. LEVELING MENU SCREENS

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 [L] Trig. Leveling Menu - [G]

elv / pt=>

```
Differential Leveling
>BS elv:                0
BS rod reading:     0.000
FS rod reading:     0.000

Instr. elev:        0.000
FS elev:           0.0000
```

SOLVE		FS2BS			EXIT

BS elv - 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.

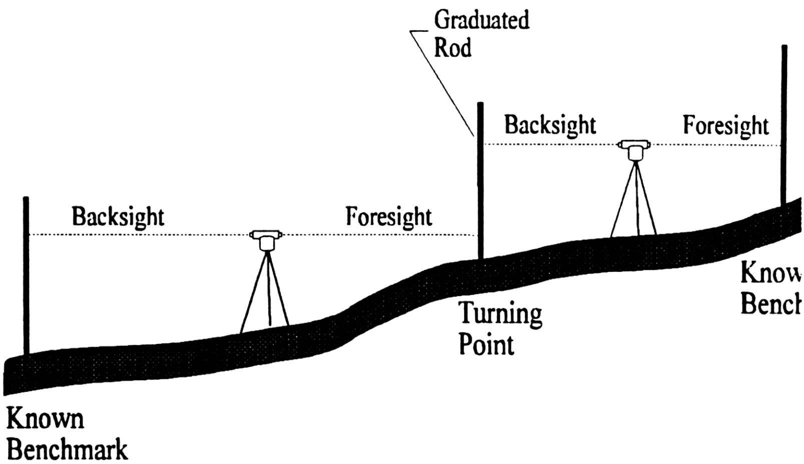
FS rod reading : is the height of the target on the rod at the foresight point.

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.

[FS->B] 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 [L] Trig. Leveling Menu - [H]

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

SOLVE		HD			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.

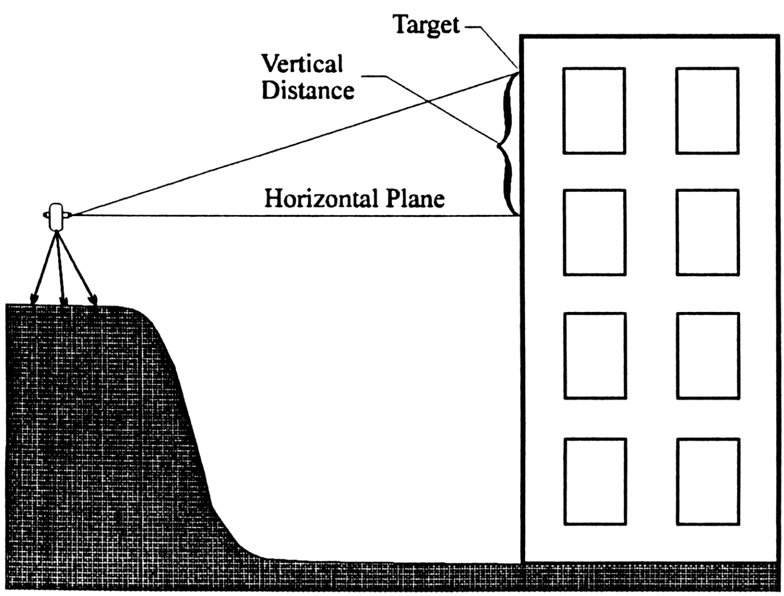
Vert ang - Zenith : allows you to specify the angle between the horizontal plane and the target point.

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.

[HD] : will trigger an electronic total station to read the horizontal distance from the instrument to a prism in the vertical plane.



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-48GX.

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

From point - To point /Using point list =>

```
   Acreage
>From point:        0
To point   :        0
Acreage :       0.000
Perimeter:      0.000
Square ft:      0.000
```

SOLVE	PTLST				EXIT

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.

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<->Bearing

Azimuth:     0.0000

Bearing: N00.0000E


 A2B | B2A |     |     |     | EXIT
```

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=>

```
     Zenith & Slope Dst

>Zenith    :     0.0000
Slope dist:      0.000

Horiz dist:      0.000
Vert. dist:      0.000
```

SOLVE					EXIT

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]

Azimuth / Bearing / Distance=>

Azimuth / Bearing => / Distance

```
     Intersection
  Point 1 :          0
 >Azimuth :     0.0000
  Point 2 :          0
 >Azimuth :     0.0000
  Store pt:          0
```

SOLVE	DFDIR				EXIT

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

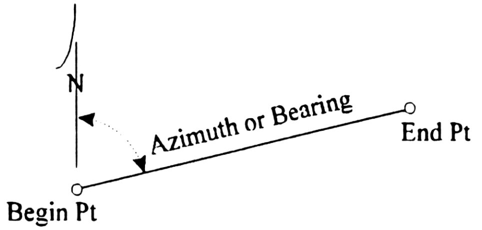
Path:	→ From the Main Menu, press **[M]** CO-GO Menu: • **[I]** Intersection Screen - **[DFDIR]** • **[P]** Pre-Determined Area Screen **[DFDIR]** → From the Main Menu, press **[N]** Survey Adjustment Menu - **[G]** Translate Job **[DFDIR]**

```
   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]

```
     Inverse by Points
Begin point:          0
End point  :          0
Bearing    : N00.0000E
Azimuth    :    0.0000
Horiz dist:      0.000
Vert dist :      0.000
```

SOLVE		BYCRD	BYLIN		EXIT

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:          0.0000
Begin E:          0.0000
End N  :          0.0000
End E  :          0.0000
Bearing   : N00.0000E
Azimuth   :     0.0000
Horiz dist:      0.000
```

SOLVE	BYPTS		BYLIN		EXIT

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]**

Pt2 of line / Bearing=>

```
Point to Line Inverse
Point        :       0
Pt1 of line  :       0
>Pt2 of line:          0
Bearing     :N00.0000E
Offset      :   0.0000
Long side   :    0.000
```

SOLVE	BYPTS	BYCRD			EXIT

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.

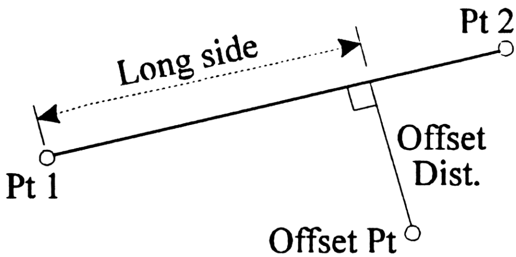
Pt 2 of line - Bearing: is the method that you use to define the line to which the inverse is to be computed.

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.

[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.

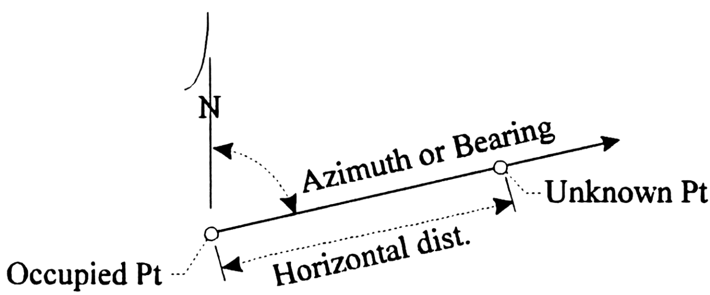
Horizontal dist: is the distance from the known point to the unknown point.

+ / - 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.

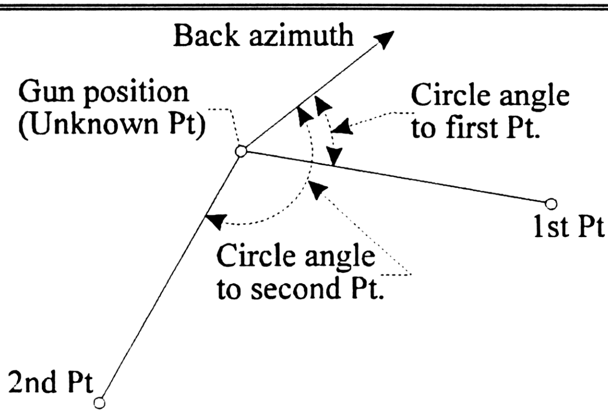
Path: From the Main Menu, press [M] CO-GO Menu - [L]

```
   Resection from 2 Pts
 Option: >Direct & Rev
 First pt:          0
 HI:  0.000 HR:  0.000
 Circular:      0.0000
 Zenith ang:    0.0000
 Slope dist:     0.000
SOLVE |    |    |    |    | EXIT
```

<=Direct & Rev / Direct only

Option: lets you select between a direct foresight shot only and shooting one direct and one reversed shot at each foresight.
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]

```
  Resection 2nd Pt
Second pt:          0
           HR:  0.000
Store pt:           0
Circular :     0.0000
Zenith ang:    0.0000
Slope dist:     0.000
```

SOLVE					EXIT

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]

```
 Three Pt Resection
P1:        0 P2:        0
P3:        0
P1 ang   :     0.0000
P2 ang   :     0.0000
P3 ang   :     0.0000
Store pt:         0
```

SOLVE	SHOT1	SHOT2	SHOT3		EXIT

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.

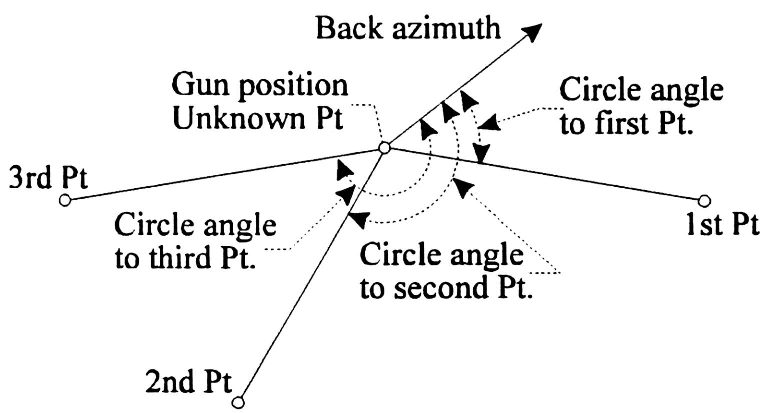
[SOLVE] will compute the coordinates (northing and easting) of the unknown occupied point and store them in the job file at the specified point number.

[SHOT1] will trigger an electronic total station to read the horizontal angle from the first point automatically.

[SHOT2] will trigger an electronic total station to read the horizontal angle from the second point automatically.

[SHOT3] will trigger an electronic total station to read the horizontal angle from the third point automatically.

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.

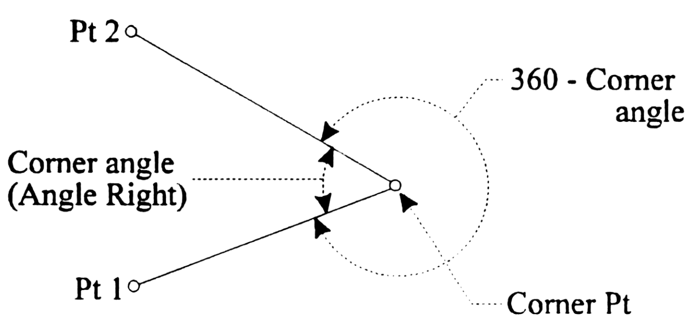
Path: From the Main Menu, press [M] CO-GO Menu - [N]

```
  Compute Corner Angle
Point 1:          0
Corner pt:        0
Point 3:          0

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.
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 **[J]** Traverse / Sideshot Screen - **[OFFCT]** Off Center Shot Menu - **[L]** → From the Main Menu, press **[M]** CO-GO Menu - **[O]**

	Shoot Bench Mark	Direct & Rev /
	Option: >Direct & Rev	<= Direct only
FS elev / FS pt =>	>FS elev: 0	
Zen ang/Vert ang/Chng elev=>	>Zenith ang: 0.0000	
Slope dist / Horiz dist	Slope dist: 0.000	
	HI: 0.000 HR: 0.000	
OC elev / OC pt =>	>OC elev: 0	

SOLVE		FSELV			EXIT

Option: lets you select between a direct foresight shot only and shooting one direct and one reversed shot at the foresight.
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.

[FSELV] This key will calculate the foresight elevation from the occupied elevation and the data entered into the screen.
[SOLVE] if the TDS-48GX is connected to an electronic station, this key will trigger the gun to take a shot. If the TDS-48GX 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.

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.

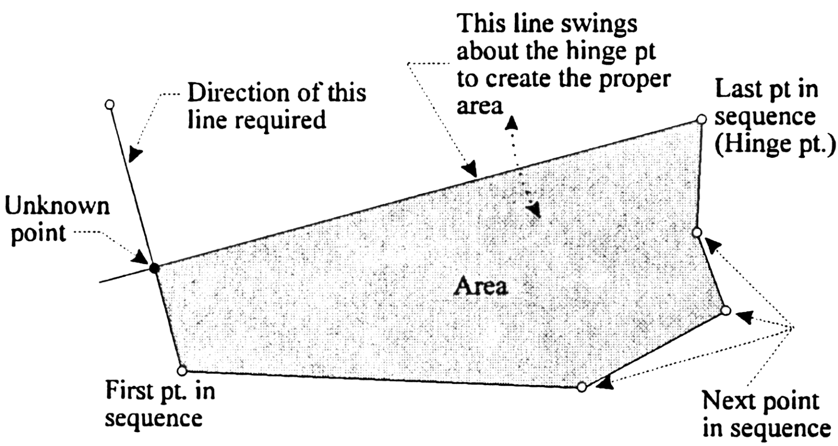
Path: From the Main Menu, press [M] CO-GO Menu - [P]

Acre / Square ft=>	>Acre : 0.00
From point-To point =>	>From point: 0
/ Using point list	To point : 0
Pt on line / Bearing=>	>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.
Bearing: - Pt on line: 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=>   >Acre        :        0.00
                     Side 1: pt 1:         0
pt 2 / Bearing=>     >       pt 2:           0
                     Side 2: pt 1:         0
pt 2 / Bearing=>     >       pt 2:           0
                     Store 1st pt:         0
                           2nd pt:         0
                 SOLVE |      | DFDIR |      |      | EXIT
```

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.

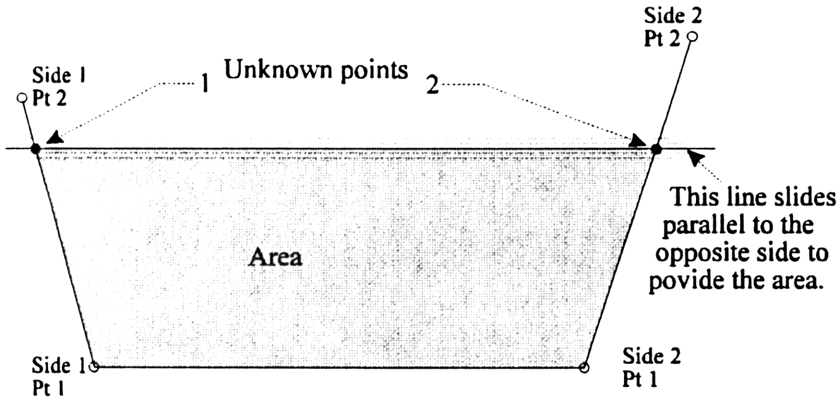
[Note: The line that defines the bearing of the unknown line is the line that connects the two Pt 1's above.]

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.

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 point - To point / Using point list =>

Azimuth / Bearing=>

```
   Translate Job
>From point:        0
To point   :        0
>Azimuth  :          0
Horiz dist:      0.000
Elevation+-:     0.000
```

SOLVE	PTLST	INVRS			EXIT

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 pt: - <Using point list>
To: 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 point - To point / Using point list =>

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

Angular err:    0.0000
```

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.

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] transfers to the Compute Angular Error Screen to compute the angular error and return it to the Angular Error field.

COMPUTE ANGULAR ERROR SCREEN

Purpose of screen - To compute the angular error and return it to the Angular Error field in the Angle Adjustment Screen.

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

```
  Compute Angular Err
Option:>Polygon rule
Computed azm:    0.0000
Correct azm:     0.0000

Angular err:     0.0000
```

<=Polygon rule / Closing azm

SOLVE					EXIT

Option:
Polygon Rule: 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. When the polygon rule is selected, the Computed azm and Correct azm fields are not used in the calculation.
Closing Azm: Angular error will be calculated by subtracting the computed azimuth from the correct azimuth.

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.

Angular err: is the angular error which is passed back to the Angle Adjustment Screen.

[SOLVE] computes the angular error and returns it to the Angular Error field.

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.

SUNSHOT MENU SCREENS

NOTE:

Direct viewing of the sun without a solar filter can cause serious and permanent eye damage. Also, sighting your electronic total station toward the sun without an objective lens filter can cause damage to your EDM.

EPHEMERIS DATA SCREEN

Purpose of screen - to allow you to key in data from an ephemeris in preparation for performing sunshots in the field.

Path:	From the Main Menu, press **[O]** Sunshot Menu - **[G]** Ephemeris method

```
  Ephemeris Data
GHA 0 :       0.00000
GHA 24:       0.00000
Decl 0 :      0.00000
Decl 24:      0.00000
Semi DIA:     0.00000
```

SOLVE					EXIT

GHA 0: is the Greenwich Hour Angle of the sun at zero hour Universal Time, Greenwich on the current date.
GHA 24: is the Greenwich Hour Angle of the sun at zero hour Universal Time, Greenwich on the next date (24 hours later).
Decl 0: is the declination of the sun on the current date.
Decl 24: is the declination of the sun on the next date (24 hours later).
Semi Dia: is the semidiameter of the sun expressed in minutes and seconds.

[SOLVE] will transfer to the Sun Shot Setup Screen in preparation for taking the sunshots.

SUNSHOT SETUP SCREEN

Purpose of screen - to set the proper local constants into the TDS-48GX in preparation for taking sunshots.

Path:	→ From the Main Menu, press **[O]** Sunshot Menu - **[G]** Ephemeris Data Screen - **[SOLVE]** → From the Main Menu, press **[O]** Sunshot Menu - **[H]** Almanac method

```
  Sunshot Setup
Lat :    0.0000>N          <=N / S
Long:    0.0000>W          <=W / E
Sun: >Left trail           <=Left trail / Right trail / Center
Number of sets:  0
C long :    0.0000
Z const: 0.000000
```

SOLVE					EXIT

Lat: is the latitude of the *observer.*
Long: is the longitude of the *observer.*
Sun: indicates the location of the cross hair of the gun with respect to the sun at the time of the sunshot: left trailing edge, right trailing edge, or center.
Number of sets: is the number of sets of sunshots (direct and reverse) that are to be taken.
C long: is the central meridian longitude.
Z const: is the zone latitudinal constant for your region.

[SOLVE] will prompt you for the proper positioning of the gun and the sequence of readings to be taken. The procedure is to take a direct sighting on the backsight; then the direct sightings on the sun. Then, reverse (flop) your scope and take the reverse readings on the sun. The number of direct and reversed sightings on the sun are the sets specified in the Setup Screen. For each sighting of the sun, you must record the time of the reading. If you are connected to an electronic total station, the TDS-48 will take all readings automatically, including the time, as you trigger the machine. After the last shot has been collected, the TDS-48GX will compute and display the individual back azimuths from each reading.

Pressing a key one more time will display the following message:

```
The next screen will
let you delete bad
azimuth from the set.
Enter 0 to accept all
or a number to DEL

<Any key to continue>
SOLVE |  |  |  |  | EXIT
```

Again hit a key and you can delete any shot from the set. To delete one reading from the average type its number and press **[ENTER]**.

```
1-241.1230 2-241.1260
3-241.1248 4-240.5237
5-241.1241 6-241.1237



Enter 0 or n to DEL █
SOLVE |  |  |  |  | EXIT
```

The average will then be displayed. Depending upon whether or not you used state grid constants in the Sun Shot Setup Screen, these azimuths will be relative either to the state grid coordinate system or to true north.

NOTE:

If you are connected to an electronic total station, pressing the [SOLVE] key from this screen will prompt you with the proper positioning of the gun. You will then trigger each shot at the proper time by pressing **[ENTER]**. The TDS-48GX will collect the proper data automatically prior to computing the correct value for your back azimuth.

SCREEN PLOT SCREEN

Purpose of screen - to allow you to view a plot of a block of points in the TDS-48GX screen display.

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

From point - To point / Using point list =>

```
      Screen Plot
>From point:         0
To point    :        0

Plot pt number: >Yes
```

<= Yes / No

POINT	PTLST	LINES	SCALE	PRINT	EXIT

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.

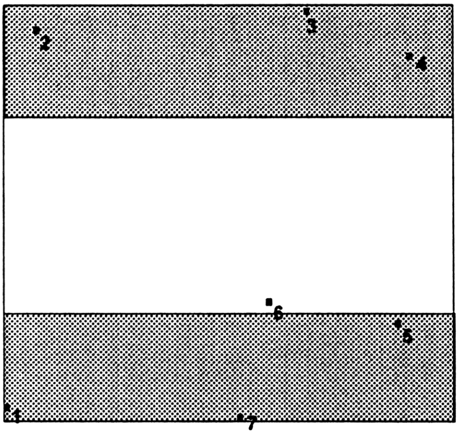
[POINT] will cause the points indicated at the top of the screen to be plotted in the TDS-48GX's display (see below).
[PTLST] will transfer to the Point List Screen.
[LINES] will cause the points indicated at the top of the screen to be plotted in the TDS-48GX's display and to be connected by straight 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.

NOTE:

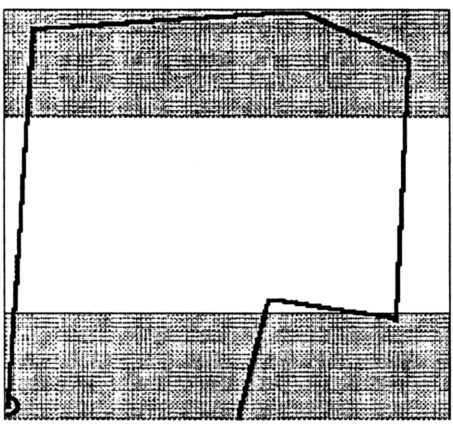
If you are using the Point List option to specify the point sequence and you want to show a figure that has more than one separate connected line sequence, you may "lift the pen" in this screen plot by inserting a PENUP command in the point list. Use the **[PENU]** softkey in the Point List Screen.

REFERENCE

POINTS SCREEN



LINES SCREEN



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**.

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]

```
                                        Solving Horiz Curve
        Radius / Degree / Delta=>      >Radius  :      0.000
Delta / Length / Chord / Tangent =>    >Delta   :      0.000
              / Mid ord
                                       Definition:> Arc          <=Arc / Cho
                                  SOLVE |      | LAYOU |      |      | EXIT
```

Radius: - Degree (of curvature): - Delta: is a measure of the curvature of the curve.
Delta: -Length: - Chord: - Tangent: - Mid ord: is a measure of the size of the curve segment:

[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.

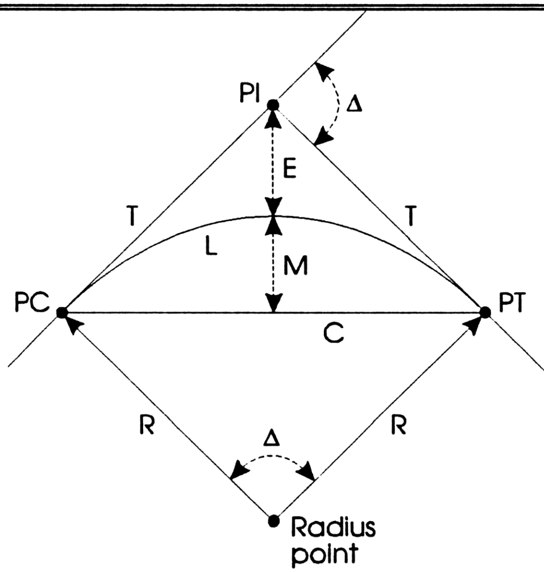
Path:	From the Main Menu, press [Q] Curve Menu - [G] Horizontal Curve Screen - [SOLVE]

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

MORE					EXIT

All terms are defined as in the figure shown below.

Radius: - R
Length: - L
Chord: - C
Degree: - (18000/(P R)) expressed in degrees. minutes seconds
Delta: - D
Tangent: -T
External: - E
Mid ordinate: - M



[MORE] will show the value of the mid ordinate. Then pressing the **[EXIT]** key will return to the previous screen or menu.

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 Deflection
PC sta. :    0+  0.000
Curr sta:    0+  0.000
Sta.intvl:    0.000
Def angle  :   0.0000
Long chord :    0.000
Short chord:    0.000
```

SOLVE		STA+			EXIT

PC sta: is the station number of the PC. Your gun should be occupying the PC and backsighting the PI.
Sta interval: is the interval from the current station to the next station.
Curr sta: is the station number of the current 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 Deflection
PI sta. :    0+ 0.000
Curr sta:    0+ 0.000
Sta.intvl:     0.00

Def angle:    0.0000
Distance :     0.000
```

SOLVE		STA+			EXIT

PI sta : is the station number of the PI. Your gun should be occupying the PI and backsighting the PC.

Sta interval is the interval from the current station to the next station.

Curr sta: is the station number of the current 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.

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 & Tangents known
 PI point:        0
>Azm PI->PC:          0
>Azm PI->PT:          0
Radius:          0.000
PC sto pt:             0
Radius pt:             0
```

SOLVE		LAYOU	CURV		EXIT

PI pt: is the point number of the PI.
Brg PI to PC:- Azm PI to PC : are two ways of specifying the direction of the line from the PI to PC.
Brg PI to PT:- Azm PI to PC : 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]

```
                  Through 3 Points
Radius / 1st=>  >Radius point:        0
                 2nd point:           0
                 3rd point:           0
                 Sto radius pt:       0
                 Radius:         0.000
                 Length:         0.000
            SOLVE | DATA | LAYOU | TRAV |  | EXIT
```

1st Point: - Radius 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: is the radius of the curve.
Length: 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]

```
 Compute Radius Pt
PC point:               0
PT point:               0
Curve >Right                 <=Right / Left
Radius:         0.000
Sto radius pt:          0

SOLVE |  |  | CURV |  | EXIT
```

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 : - Delta : - Tangent : are the three parameters which may be used as the "known-curve-parameter".

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]**

```
   Traverse on Curve
Radius:      0.000
Length:      0.000
PC point:        0
F tangent:     0.0000
Turn: >Right
PT point:        0
```

<=Right / Left

SOLVE		BACKS			EXIT

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. =>

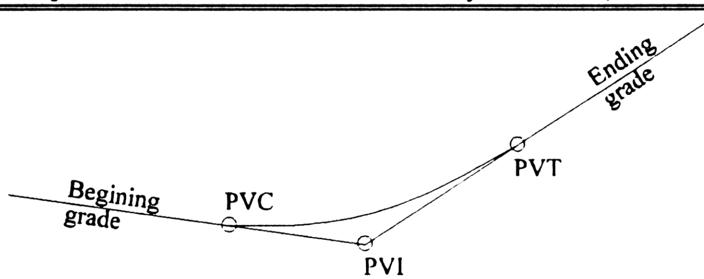
Length / Sta. Elevation / => H/L El

```
     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.
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).
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.

[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.:      0+   0.000
Elev:       0.000
PVI Sta.:      0+   0.000
Elev:       0.000
PVT Sta.:      0+   0.000
Elev:       0.000
```

MORE					EXIT

```
High/Low point
Station:   0+   0.000
elev:       0.000
```

PREV					EXIT

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

Sation: {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]**

```
  Vert. Curve Layout
Sta.intvl:     0.000
Station:   0 +    0.000
Elevation:     0.000
```

S->E	E->S	STA+			EXIT

Sta. intvl: is the interval between stations to be laid out.

Station: is the current station.

Elevation: is the elevation at the current station.

Grade: {output only} is the grade of the vertical curve at the specified station expressed as a %. (This line only appears after [S->E] is pressed.)

[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

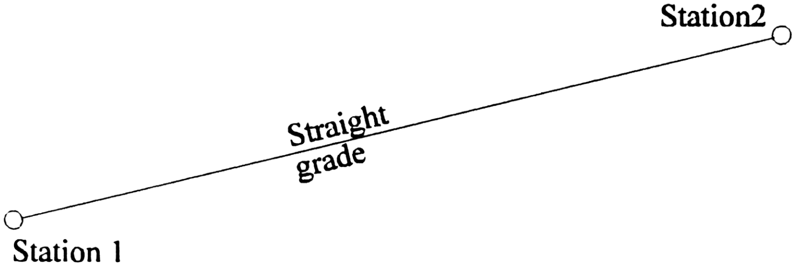
Purpose of screen - to solve for the elevation at various stations along a straight grade.

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 =>

```
    Print Points
>From point:          0
To point    :         0
```

PRINT	PTLST				EXIT

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 RAW DATA COMMAND

Purpose of command - to obtain a printout of the raw data of a job.

Path: From the Main Menu, press **[R]** Print Menu - **[H]**

Pressing **[H]** from the Print Menu will cause the TDS-48GX to print out the contents of the raw data file of the *currently active* job.

PRINT SETUP SCREEN

Purpose of screen - to setup your TDS-48GX for printing.

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

```
   Print Setup
IR/wire:     >Wire       <=Wire / IR
Baud rate:   >9600       <=9600 / 1200 / 2400 / 4800
Parity:      >None       <=None / Odd / Even

|     |     |     |     |     | EXIT |
```

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

Purpose of screen - to transfer data to or from the TDS-48GX from into a PC.

Path: From the Main Menu, press [S]

```
File type:     >CRD      <=CRD / RAW / PLST
IR/wire:       >Wire     <=Wire / IR
Baud rate:     >9600     <=9600 / 1200 / 2400 / 4800
Parity:        >None     <=None / Odd /Even

Start pt:          0
End pt:            0
SENDF | RECV | SBLK | GET |  | EXIT
```

File type: is the type of file to be transferred, either coordinate, raw data, or point list.
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-48GX to another device according to the established screen parameters.
[RECV] will set up the TDS-48GX 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.
[GET] allows you to get a file from a remote storage device to which you are connected. You will be prompted for a file name for the data collector to retrieve from the remote system.

NOTE: If you are using the companion TDS-48GX TFR PC software, the proper communication parameter settings are: Baud rate - 9600, Parity - None, IR/Wire - Wire.

UTILITY SCREENS

NOTE: These screens can be accessed from a number of locations throughout the TDS-48GX program by pressing the **[BACK]** or **[PTLST]** softkeys.

BACKSIGHT SCREEN

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

Path:	→ From the Main Menu, press **[I]** Stakeout Menu - **[H]** Offset Stakeout Screen - **[SETUP]** Offset Stakeout Setup Screen - **[BACK]** → From the Main Menu, press **[I]** Stakeout Menu - **[H]** Slope Stake Screen - **[SETUP]** Offset Stakeout Setup Screen - **[BACK]** → From the Main Menu, press **[J]** Traverse/Sideshot Menu - **[BACK]**

BS point / BS azm / BS brg =>

```
    Backsight
>BS point:    0.0000
 Circle:      0.0000

BS Azm:       0.0000
BS Brg:    N00.0000E
```

SOLVE	CHECK		FAST	CIRCLE	EXIT

BS azm - BS brg - BS pt: specifies the azimuth or bearing to be used as a back azimuth or back bearing or the point number that is to be used for a back sight.

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.

[CHEC] will transfer to the Check Backsight Menu (see below).

[INIT] will send out an initial command to your gun to inform it that there is a data collector attached to its communication port. Some guns require this *initializing* step each time that they are turned on before they can be triggered from the TDS-48GX. To see if your gun requires this, press this key. The TDS-48GX will report in its display if this step is required.

[FAST] will toggle the *instrument coarse* mode on and off. Coarse mode is only available for certain brands of guns. If coarse mode is not available for your gun model, the computer will display: "Fast (Coarse) Mode not Applicable". The effect of coarse mode is to put the gun in a fast measurement mode. This mode may be used for topographic surveys to speed up the gathering of data or for stakeout. However, when used from the Stakeout Screen, coarse mode will not cause the TDS-48GX to take shots continuously.

[CIRCL] will transfer to the Backsight Circle Menu (see below).

CONFIRM BACKSIGHT POINT BY SHOOTING DISTANCE COMMAND

Purpose of screen - to allow you to double check your backsight point by taking a distance measurement.

Path:	From the Backsight Screen (see above), press **[CHEC]** Check Backsight Menu - **[G]**.

Selecting this command will prompt you to take a shot to a prism located on your Backsight point. The TDS-48GX will then compare the measured distance to the calculated distance and display the difference. If your prism is located on the correct Backsight point, this difference should be very small.

CHECK BACKSIGHT CIRCLE COMMAND

Purpose of screen - to allow you to double check your instrument circle reading by taking an angle measurement.

Path:	From the Backsight Screen (see above), press **[CHEC]** Check Backsight Menu - **[H]**.

Selecting this command will take a horizontal circle reading to your Backsight point. The TDS-48GX will then compare the measured horizontal circle to the circle value shown in the Backsight screen and display the difference. If you are pointing at the correct Backsight point, and your instrument horizontal circle is still correct, this difference should be very small.

READ BACKSIGHT CIRCLE FROM INSTRUMENT COMMAND

Purpose of screen - to allow you to set the Backsight circle field in the TDS-48GX by reading the horizontal circle value from your instrument.

Path:	From the Backsight Screen (see above), press **[CIRCL]** Backsight Circle Menu - **[G]**.

Selecting this command (if connected to an electronic total station) will trigger the gun to read the horizontal angle and record it in the Backsight screen as the circle angle to the backsight.

SEND BACKSIGHT CIRCLE TO INSTRUMENT COMMAND

Purpose of screen - to allow you to set the horizontal circle value in your instrument to the same value as the Backsight circle field in the TDS-48GX.

Path:	From the Backsight Screen (see above), press **[CIRCL]** Backsight Circle Menu - **[H]**.

Selecting this command (if connected to an electronic total station) will send the value currently set in the Backsight circle field to your instrument.

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-48GX. 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]**

```
NXT PT?
```

CURVE	END	DEL	EDIT	PENU	EXIT

The Point List is a mechanism with which you can specify a block of points for some operations in the TDS-48GX. 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.

[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.

[EDIT] will replace the entry above the data entry bar with the contents of the bar.

[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]**

Radius / Straight vert curve=>

```
     Horiz/Vert Curve
P1:         0 P2:        0
>Radius :        0.000
Turn: >Right
Arc:  >Small
Beg grade(%):   0.000
End grade(%):   0.000
```

<=Right / Left

<=Small / Large

ENTR					EXIT

P1: is the first point on the curve.

P2: is the second point on the curve.

Spur azm: is the azimuth angle for a spur to use to place a call on the curve by the plotter.

Radius: is the radius of a horizontal curve.
Straight line V. crv: indicates that there is a straight grade with a change in elevation.

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° central angle) or large (greater than 180° 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.

STORE POINT LIST TO FILE COMMAND

Purpose of screen - to allow you to save a point list for later use.

Path:	from any screen which has a **[PTLST]** "soft" key, press **[PTLST]** Point List Menu - **[I]**

Selecting this command will prompt you to enter a file name. Your currently active point list will be saved in this file.

RECALL POINT LIST FROM FILE COMMAND

Purpose of screen - to allow you to use a previously stored point list.

Path:	from any screen which has a **[PTLST]** "soft" key, press **[PTLST]** Point List Menu - **[J]**

Selecting this command will display a list of any point list files you have stored. You may then select a file to become the active point list.

DELETE POINT LIST IN FILE COMMAND

Purpose of screen - to allow you to delete a previously stored point list file.

Path:	from any screen which has a **[PTLST]** "soft" key, press **[PTLST]** Point List Menu - **[K]**

Selecting this command will display a list of any point list files you have stored. You may then select a file to be deleted from storage.

REFERENCE

ALPHABETICAL LIST OF SCREENS

APPENDIX A

Technical Specifications*

Data Collection Software

Main Operating Functions

job creation	initialization
setup	

Traverse/Sideshot

single readings	descriptor code tables
multiple readings and averaging	control files
off center shots	trig. leveling
differential leveling	

Stakeout

by points	slope staking
by station and offset	rod man next point

CO-GO

areas	point-in -direction
elevation	2 and 3 point resections
conversions	corner angle computation
intersections	benchmark
inverses	pre-determined area

Curves

horizontals	verticals

Adjustments

Scale changes	Job rotations
Translations	Angle Adjustment
Compass Rule	

Sunshots

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-48GX)
- Application: TDS-field computer routines

Memory One required:
- 128k-byte,256k-byte or 512k-byte TDS GX RAM card.
- 128k-byte HP RAM card.
- (up to 12000 points depending on card and amount of raw data stored at each point)

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

How to connect the TDS-48 to your electronic total station.

1. Use the TDS-48's Setup Screen to select the proper instrument and model.

2. Setup and level your gun.

3. Connect the TDS-48 to the gun with the proper cable.

4. Turn the gun ON.

5. To confirm that the gun is working properly, take a practice shot at a target.

6. Use the proper TDS-48 functions to trigger your gun and take the data.

Information specific to the use of the TDS-48 with various electronic total stations

APPENDIX B

TOPCON

Models supported - RS232 models

Model:	TDS-48GX setting
GTS 3b-d or GTS 4	GTSB-D & 4
GTS 300 series	GTSB-D & 4
GTS 3	CTS1, GTS3
CTS1	CTS1, GTS3
ET1 or ET2 with RS232	ET1/ET2

When fast mode is set, all shots will be taken in Coarse Mode.

There is no distance averaging mode available for Topcon instruments.

NIKON

Models supported - TOP GUN

Fast mode is available for the TOP GUN.

When the gun is set up to average distance readings, set the "Measurement Mode" in the Device Setup Screen to "Multiple".

The TOP GUN instrument will transfer data faster when emulating the Lietz SET communications. Set both you instrument and the TDS-48GX to the SET mode as follows:

1. Press 2nd function and ON to run the setup program.
2. Toggle COMM MODE to SET, then press ENT
3. Ensure the rate is set at 1200 then press ENT
4. Press 2nd function key and 7 to set the EDM MODE. (This is tricky and may take several attempts to get the screen to come up).
5. Set the EDM MODE to 1 or 2 and press ENT (EDM MODE 2 is the quickest mode.
6. With in the TDS-48GX set the instrument to LIETS and the model to SETS.

Once measuring the D-50 will continue to measure until it is turned away from the prism. The TDS-48GX will record the shot.

SOKKIA (LIETZ)

Models supported	Slope distance?	Zenith angle?	Horizontal angle?
SET 2 / 3 / 4	Yes	Yes	Yes
SDM3FR	Yes	Yes	No
SDM3F	Yes	No	No
SDM3ER	Yes	Yes	No
SDM3E	Yes	No	No
DT20E	Yes / No	Yes	Yes

The DT20E is an electronic theodolite. It can only provide angles. By using it with a top mounted EDM, you can get both angles and distances. For this configuration, choose the "SETs" as the Instrument Setup option in the TDS-48.

You do not have to push any keys on the gun to obtain readings from Lietz instruments. Requesting information and triggering are done automatically from the TDS-48. The data collector will prompt for the proper readings as required by the particular application being done.

Fast mode may be set by placing the gun in tracking mode directly. It will then be in effect whether or not the TDS-48 has been set for fast mode.

There is no distance averaging mode available for Lietz instruments.

Newer Lietz guns have both a theodolite and an CA (distance) mode. The user must select the CA mode on the gun manually for shooting both angles and distances. To shoot angles only, the gun may be in either mode but the gun will return angles much faster if it is in theodolite mode rather than CA mode.

With all SET instruments, select the following communication parameters:

Baud Rate	1200
Checksum	NO
Parity	NO

APPENDIX B

LEICA (WILD)

Models supported -	T1000	TC1000
	T / TC1600	T / TC2000
	TC1610 / 500	

When using a T1600, you should place the T1600 in a mode that will communicate like a T2000. This can be done from the gun with the following key sequences:

SET MODE 74 RUN 1 RUN

Then choose the T2000 from the Instrument Setup Screen in the TDS-500.

The TDS-500 assumes that the Wild instruments are set to communicate at:

Baud rate - 2400
Parity - even
Data bits - 7
Stop bits - 1

The gun may be set to the communication settings given above with the following key sequences:

SET MODE 70 RUN 4 RUN (to set 2400 baud)
SET MODE 71 RUN 2 RUN (to set even parity)

These sequences only have to be keyed into the gun once. The instrument will remember these settings even if the battery is briefly removed.

Fast mode is available for all models. When using a T2000 or T1600, you need to set the gun tracking mode manually. This can be done by pressing the **[REP]** and **[DIST]** keys on the gun.

There is no distance averaging mode available for Wild instruments.

Troubleshooting tip:

> If the TDS-48 does not seem to be triggering the gun or if the TDS-48 does not get the distance reading from the gun, the problem is most likely in the software in you gun. contact your Wild dealer and request an upgrade in the data communication software in you gun.

GEODIMETER

Models supported - 400s RS232

When used with the 400 series, you should set the gun for the RS232 interface (see below). When set this way, you must press the **[AIM]** key on the gun to take a shot.

Setting up the Geodimeter 400 Series total stations to communicate with the TDS-48.
[Note: This procedure needs to be done only once. The gun will remember the proper setting when turned "OFF".]

On the gun:
1. Press **[MNU]**.
2. Press **[4]**. The display will now show:
   Data com
   1 Select device
   2 Create table
3. Press **[1]**. The display will now show:
   1 Geodat
   2 Serial
   3 Xmem
4. Press **[2]**. The display will now show:
   Serial ON?
5. Press **[REG]** (for Yes). The display will now show:
   Serial

   COM=1.7.2.1200

These are the current settings of the communication parameters. If the current readings do not match those shown above, key in the numbers as shown from the digit keypad. The decimal point is the key next to the **[0]** key on the bottom row of the keypad.

6. Press **[ENT]**. The display will now show:
   U.D.S ?
7. Press **[AIM]** (for No). The display will now show:
   Table no=
8. Press **[ENT]** to select the default table number. The display will now show:
   Request?

9. Press **[REG]** (for Yes). The display will now show:

HA:
VA:
SD:

The gun setting is now complete.

On the TDS-48:
1. From the Main Menu press **[H]**.
2. From the Setup Menu press **[H]**.
3. Move the scroll bar to the Instrument line and select >Geodimeter
4. Move the scroll bar to the Model line and select >Auto trigger or Manual Trigger.

Fast Mode is available with the 400 series total stations.
Fast mode must be set in the gun manually.

ZEISS

Models supported - Elta /C, Old Elta

Zeiss has changed their communication commands during 1986 and 1987. If you have an Elta gun you should first try the "Elta /C" option. If this doesn't work, then try the "Old Elta" option.

There is no fast mode nor distance averaging mode available for Zeiss guns.

APPENDIX C

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.

APPENDIX D

Codes and symbols used in TDS-48 Raw Data Files

The Raw Data File is made up of a sequence of ASCII text records. Each record contains data for a complete field operation, such as a traverse or a side shot. A record may consist of multiple fields of data that describe the operation. Each record occupies a line in the screen when you select the Raw Data Screen from the Jobs Menu. The entire line may be viewed by moving the cursor to the appropriate line and pressing **[VIEW]**. These different fields are separated by commas in a record.

Each record is started with a two letter code and a comma to identify the type of the record. Each field is also preceded by a two letter code as the field header. The value or data in a field follows directly after the field header.

A typical traverse record will look as follows:
TR,OP3,FP37,AZ125.3406,ZE87.2617,SD249.87,--FIRE HYDRANT

Meaning:

Type (TR):	Traverse
Occupy point (OP):	3
Foresight point (FP):	37
Azimuth (AZ):	125.3406
Zenith (ZE):	87.2617
Slope Distance (SD):	249.87
Note (--):	FIRE HYDRANT

APPENDIX D

Records are described in detail below:

Occupy Record

Record type : OC

Field headers:

PN:	Point number
N :	Northing (the header is N space)
E :	Easting (the header is E space)
EL:	Elevation
-- :	Note

Traverse / Sideshot Record

Record type: TR / SS

Field headers:

OP:	Occupy Point
FP:	Foresight Point
(one of the following)	
AZ:	Azimuth
BR:	Bearing
AR:	Angle-Right
AL:	Angle-Left
DR:	Deflection-Right
DL:	Deflection-Left
(one of the following)	
ZE:	Zenith
VA:	Vertical angle
CE:	Change Elevation
(one of the following)	
SD:	Slope Distance
HD:	Horizontal Distance
-- :	Note

Backsight Record

Record type: BK

Field headers:

OP:	Occupy point
BP:	Back Point
BS:	Backsight
BC:	Back Circle

APPENDIX D

Line of Sight Record

Record type: LS

Field headers:

- HI: Height of Instrument
- HR: Height of Rod

Off Center Shot Record

Record type: OF

Field headers:

- AR: Angle right
- SL: Side slope distance
- DD: Delta Distance
- ZE: Zenith (actual)
- OL: Offset Length

TR/SS Repetition Record

Record type: AA (Accumulating Angle-right)

Field headers:

- BC: Back Circle
- AR: Angle-Right
- ZE: Zenith
- SD: Slope Distance

Record type: RD (Repeat Directional)

Field headers:

- BD: Backsight Direct
- FD: Foresight Direct
- ZD: Zenith Direct
- FV: Foresight Reverse
- ZV: Zenith Reverse
- BV: Backsight Reverse

Record type: MD (Multiple distances)

Field headers:

- SD: Slope distance

APPENDIX D

Store Point Record
Record type: SP
Field headers:

PN:	Point Number
N :	Northing
E :	Easting
EL:	Elevation
-- :	Note

Resection Record
Record type: RS
Field Headers:

PN:	Point number
CR:	Circular Reading
ZE:	Zenith (or VA, CE)
SD:	Slope Distance (or HD)

Note: A two point resection will be recorded as:
RS,PN,CR,ZE,SD
RS,PN,CR,ZE,SD (one reading for each point)

Note: A three point resection will be recorded as:
RS,PN,CR
RS,PN,CR
RS,PN,CR (one reading for each point)

Mode Setup Record
The mode setup will be recorded at the beginning of the raw data file and whenever it is changed.
Record type: MO
Field headers:

AD:	Azimuth direction (0 for North, 1 for South)
UN:_	Distance unit (0 for feet, 1 for meter)
SF:	Scale factor
EC:	Earth Curvature (0 for off, 1 for on)
EO:	EDM offset(inch)

Stake Out Record

Record type: SK

Field headers:

OP: Occupy Point
FP: Foresight point
AR: Angle right
ZE: Zenith
SD: Slope distance

Slope Stake Record

Record type: CP (catch point)

Field headers:

ST: Station (nn+nn.nn)
OD: Offset direction (0 for center, 1 for right, 2 for left)
OL: Offset length
EL: Elevation
GD: Grade (design)
-- : Note

Cut Sheet Record

Record type: CF (cut or fill)

Field headers:

For an offset stakeout cut sheet
ST: Station
OD: Offset direction (0 for center, 1 for right, 2 for left)
OL: Offset length
EL: Elevation
GD: Grade (design)
-- : note

For a point stakeout cut sheet
PN: Point number
EL: Elevation
GD: Grade
-- : note

The above record will be recorded only if the stake point is stored. A Side shot (or store point) record will also be recorded.

APPENDIX D

Sun Shot Record
Record type: SU
Field headers:

For a sunshot setup

GH:	Greenwich hour angle (GHA 0 & GHA 24)
DE:	Declination (DECL 0 & DECL 24)
SM:	Semidiameter of Sun (in angle)
DT:	Local date
TM:	Local time

For the actual sunshot

BD:	Backsight Direct
FD:	Foresight Direct
FV:	Foresight Reverse
BR:	Backsight reverse
LA:	Latitude
LO:	Longitude
EG0:	Left trailing edge sun position
EG1:	Right trailing edge sun position
EG2:	Center sun position

Job Record
Record type: JB
Field headers:

NM:	Job name
DT:	Date
TM:	Time

Shoot Benchmark (Remote Elevation) Record
Record type: RE
Field headers:

OP:	Occupied point
FE:	Foresight elevation
AR:	(always 0)
ZE:	Zenith angle
SD:	Slope distance
-- :	(always "Remote elev")

APPENDIX D

Summary

Alphabetical listing of Record Types

AA:	Accumulating Angle-right
BK:	Backsight
CF:	Cut Sheet
CP:	Slope stake
JB:	Open a job
LS:	Line of sight
MD:	Multiple distances
MO:	Mode setup
OC:	Occupy
OF:	Off center shot
RD:	Repeat Directional
RE:	Remote Elevation
RS:	Resection
SK:	Stakeout a point
SP:	Store Point
SS:	Side shot
SU:	Sun Shot
TR:	Traverse
-- :	Note record

Alphabetical listing of Field Headers

AD:	Azimuth direction (0 for North, 1 for South)
AL:	Angle-Left
AR:	Angle-Right
AZ:	Azimuth
BC:	Back Circle
BD:	Backsight Direct
BP:	Back Point
BR:	Bearing (this field will be recorded as N123.4500W)
BS:	Backsight (when back point is not defined)
BV:	Backsight Reverse
CA:	Center horizontal angle
CE:	Change Elevation
CR:	Circular Reading
DD:	Delta Distance
DE:	Declination

APPENDIX D

DL:	Deflection-Left
DR:	Deflection-Right
DT:	Local date (MM-DD-YYYY)
E :	Easting (the header is E space)
EC:	Earth Curvature (0 for off, 1 for on)
EG0:	Left trailing edge sun position
EG1:	Right trailing edge sun position
EG2:	Center sun position
EL:	Elevation
EO:	EDM offset
FD:	Foresight Direct
FE:	Foresight Elevation
FP:	Foresight Point
FV:	Foresight Reverse
GD:	Grade (design)
GH:	Greenwich hour angle
HD:	Horizontal Distance
HI:	Height of Instrument
HR:	Height of Rod
LA:	Latitude
LO:	Longitude
N :	Northing (the header is N space)
OC:	Occupy Point
OD:	Offset direction (0 for center, 1 for right, 2 for
OL:	Offset length
OP:	Occupy Point
OS:	EDM offset
PN:	Point number
SD:	Slope Distance
SF:	Scale factor
SL:	Side slope distance
SM:	Semi-diameter of Sun (in angle)
ST:	Station
TM:	Local time (HH:MM:SS)
UN:	Distance unit (0 for feet, 1 for meter)
VA:	Vertical angle
ZD:	Zenith Direct
ZE:	Zenith
ZV:	Zenith Reverse
-- :	Note

APPENDIX E

Transverse Mercator Zones

Central Meridians of State Plane Coordinates

E = East
W = West
C = Central

STATE	ZONE	C.M.	STATE	ZONE	C.M.
Alabama	E	85 50	Hawaii	1	155 30
	W	87 30		2	156 40
				3	158 00
Alaska	2	142 00		4	159 30
	3	146 00		5	160 10
	4	150 00			
	5	154 00	Idaho	E	112 10
	6	158 00		C	14 00
	7	162 00		W	115 45
	8	166 00			
	9	170 00	Illinois	E	88 20
Arizona	E	110 10		W	90 10
	C	111 55			
	W	113 45	Indiana	E	85 40
				W	87 05
Delaware		75 25			
Florida	E	81 00	Maine	E	68 30
	W	82 00		W	70 10
Georgia	E	82 10	Michigan	E	83 40
	W	84 10	(1934)	C	85 45
				W	88 45

APPENDIX E

STATE	ZONE	C.M.	STATE	ZONE	C.M.
Mississippi	E	88 50	New Mexico	E	104 20
	W	90 20		C	106 15
				W	107 50
Missouri	E	90 30			
	C	92 30	New York	E	74 20
	W	94 30		C	76 35
				W	107 50
Nevada	E	115 35			
	C	116 40	Vermont		72 30
	W	118 35			
			Wyoming	1	105 10
New Hampshire		71 40		2	107 20
				3	108 45
New Jersey		74 40		4	110 05

APPENDIX F

Lambert Zones

Central Meridians and Zone Constants for State Plane Coordinates

N = North
S = South
C = Central
NC = North Central
SC = South Central
M = Mainland
I = Island
O = Offshore

STATE	ZONE	CENTRAL LONGITUDE	LATITUDINAL CONSTANT
Arkansas	N	92 00	0.581899
	S	92 00	0.559691
California	1	122 00	0.653884
	2	122 00	0.630468
	3	120 30	0.612232
	4	119 00	0.596587
	5	118 00	0.570012
	6	116 15	0.549518
	7	118 20	0.561243
Colorado	N	105 30	0.646133
	C	105 30	0.630690
	S	105 30	0.613378
Connecticut		72 45	0.663059
Florida	N	84 30	0.502526
Iowa	N	93 30	0.677745
	S	93 30	0.658701
Kansas	N	98 00	0.632715
	S	98 30	0.614528
Kentucky	N	84 15	0.622067
	S	85 45	0.606462
Louisiana	N	92 30	0.528701
	S	91 20	0.500013
	O	91 20	0.454007
Maryland		77 00	0.627634
Massachusetts	M	71 30	0.671729
	I	70 30	0.661095
Michigan	N	87 00	0.722790
	C	84 20	0.706407
	S	84 20	0.680529
Minnesota	N	93 06	0.741220
	C	94 15	0.723388
	S	84 20	0.700928

APPENDIX F

STATE	ZONE	CENTRAL LONGITUDE	LATITUDINAL CONSTANT
Montana	N	109 30	0.746452
	C	109 30	0.733354
	S	109 30	0.714901
Nebraska	N	100 00	0.673451
	S	99 30	0.656076
New York (Long Island)		74 00	0.654082
North Carolina		79 00	0.577171
North Dakota	N	100 30	0.744133
	S	100 30	0.729383
Ohio	N	82 30	0.656950
	S	82 30	0.634520
Oklahoma	N	98 00	0.590147
	S	98 00	0.567617
Oregon	N	120 30	0.709186
	S	120 30	0.684147
Pennsylvania	N	77 45	0.661540
	S	77 45	0.648793
South Carolina	N	81 00	0.564497
	S	81 00	0.544652
South Dakota	N	100 00	0.707738
	S	100 20	0.689852
Tennessee		86 00	0.585440
Texas	N	101 30	0.579536
	NC	97 30	0.545394
	C	100 20	0.515059
	SC	99 00	0.489913
	S	98 30	0.454007
Utah	N	111 30	0.659355
	C	111 30	0.640579
	S	111 30	0.612687
Virginia	N	78 30	0.624118
	S	78 30	0.606925
Washington	N	120 50	0.744520
	S	120 30	0.726396
West Virginia	N	79 30	0.637773
	S	81 00	0.618195
Wisconsin	N	90 00	0.721371
	C	90 00	0.705577
	S	90 00	0.687103

G. TROUBLE SHOOTING

This appendix should be the first place you check for problems that you may have when operating your TDS-48GX. 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 choice 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 using a Total Station be sure that the gun is set to transmit Zenith angle and that the Zenith angle is not 0. 3. 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-48GX, 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 if you are using both a TDS-48GX and a TDS-COGO card and want to exchange files, the 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-48GX, 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-48GX's battery warning is set to alert you to the fact that the batteries are almost too low to run the calculator. The HP-48GX 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-48GX, nor its cable to sit over a digitizer. A digitizer emits a powerful electromagnetic field that will interrupt communications and can course memory loss or other serious problems in the 48. If your TDS-48GX 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 proble 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-48GX has a problem with its port. You 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. Thi is not proof positive that the 48s port is working properly bu 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-48GX. 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

You are able to communicate with your with PC but not with your instrument.	This would indicate that your TDS-48GX is working fine and that the problem must be with your instrument cable or the interface of your total station. See solution 6 above.
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-48GX transfer screen, to the same values, in both the HP-48 and Kermit. • Use the transfer screen within the TDS-48GX program. Do not try to use Kermit that is built into the HP-48GX 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 woul if it was down loaded from the TDS-48GX. • 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-48GX HARDWARE (Reset / Batteries / Memory cards)

Your Problem	Solutions to Try
The HP-48GX 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.
	HARDWARE RESET: On the back of the HP-48GX 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 clip 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-48Gx program is not functioning as it once did or one routine is acting incorrectly. Try the Solutions to the right one at 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.
	CLEAR MEMORY: The Memory Clear function will erase all of the main system memory and any memory card that is merged with it. When using the TDS-48GX software, all survey data is stored to independent memory and therefore will not be effected by a MEMORY CLEAR. I will, however, clear the system libraries

	and erase all TDS-48GX setup parameters (Device type, Repetition modes ext.). You will need to re-install you TDS-48GX system libraries and 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 **[F]** for NO. This will clear all calculator main memory. If you respond with an **[A]** for YES the 48 will try to recover the memory and a clear will not be performed.
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. If your 48 is still dead contact HP for repairs.	
One of 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. If the problem card is a RAM: • Check its battery. See schedule below. • Check the position of the Read/Write switch. Switch it back and forth several times and then be sure it ends in the Write position; which is toward the center of the card. • 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-48GX Main (AAA)	Typically, every 30 days when used as a data collector.
RAM card (Lithium)	Once a year.

INDEX

INDEX

INDEX

INDEX

INDEX

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