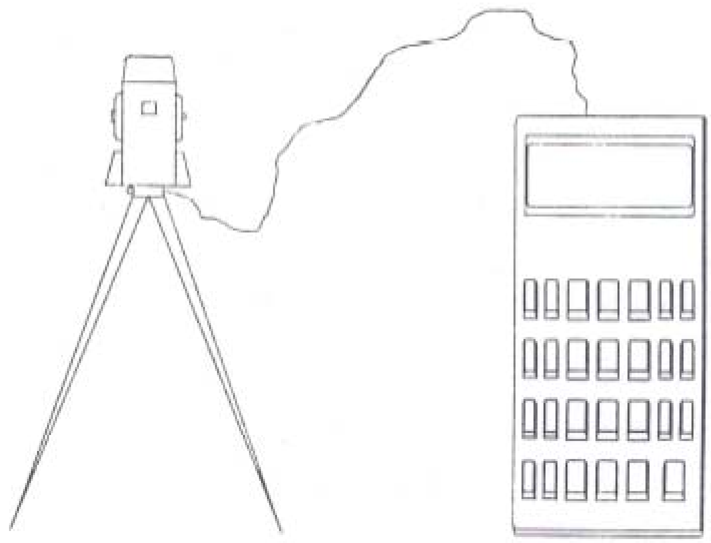
ELECTRONIC FIELD BOOK SYSTEM
EFB
USER'S HANDBOOK



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(1) INTRODUCTION

Florida Department of Transportation Electronic Field Book system (**EFB**) is designed to meet the specialized operational requirements for highway route surveying.

The Electronic Field Book is a system of:

- Surveying Instrument(s) (usually Total Stations)
- Software
- Computer Platform(s)

The computer platform for field operations is a rugged, hand-held Personal Computer (PC) operating under a Disk Operating System (DOS).

The computer platform for office operations is a desk top PC, operating under DOS. Files may be transferred to any other operating system as desired.

The software is designed to be simple and consistent with current field practice. The software-hardware combinations are also device (field computer, total station) independent. The goal of the system is to provide both an automatic and manual field book for the gathering of conventional survey data, in a format that may be easily and efficiently used in the highway design process. The software also uses state-of-the-art methodology and data processing techniques to improve the accuracy of results delivered to the designer or mapper. The EFB permits uniformity and efficiency in the data gathering process, while not sacrificing the flexibility of the manuscript field book.

This documentation is intended to describe the operation of the Electronic Field Book system on the hand-held computer for field operations. The documentation serves as a description of software operation that is common to all supported hand-held computer hardware and the field operation of the system.

Processing the data collected is explained in separate publications.

(2) BASIC CONCEPTS

As with any computer, the EFB cannot make intuitive decisions about the environment in which it operates. Therefore, the surveyor "guides" the EFB through the survey tasks by structuring his data in screens designed for specific types of data, which are then recorded in chronological order, thus producing the complete record of field operations. The data are placed in the screens by responding to prompts, and the screens are selected through the use of menus.

The menus, which open specific data screens, are the means by which the EFB is guided through a job.

(a) **Point Naming**

Point names used by the Department will adhere to the abbreviations found in Appendix C - Standard Abbreviations found in this document.

For EFB a system of alphanumeric point names consisting of two parts was developed:

- the alphanumeric ***prefix*** designated by the surveyor
- a numeric ***suffix*** assigned by the system.

Users will select an alphanumeric prefix of up to seven characters. The numeric suffix, serial in nature, will be assigned by the system. The suffix will be from one to seven characters, depending on the length of prefix chosen by the user. The length of the prefix and suffix combined will not exceed eight characters. Many thousands of points of the same alpha name, each differentiated by a unique numeric suffix can be accepted by such a system.

A point previously observed or occupied may be used at a later time in the survey by simply typing in the complete point name designation of the object (prefix and suffix) as it was earlier designated.

Some examples of point names are:

PAVT5
TREE16
FH27
MH2
FL88
RR92
DR16

Notice that in each case the numeric suffix is attached to the prefix to make the *complete* point name! A prefix of seven alphanumeric characters is the maximum that is allowed to be assigned by the surveyor. In such a case where seven characters are chosen as a prefix, the point name has only nine possible suffixes (i.e. JOHNSON1 through JOHNSON9). Although using long prefixes is allowed, it is inadvisable to do so since it limits the total number of point names that can be used in a project, and can often be cumbersome to type on a limited keyboard.

The following will illustrate the magnitude of point names available with such a point designation system:

A1.... A9999999
AA1 .AA999999
AAA1AAA99999
AAAA1AAAA9999
AAAAA1AAAAA999
AAAAAA1AAAAAA99
AAAAAAA1AAAAAAA9

'A' represents a possible alphanumeric character (A through Z).

You can see from the previous example that the total number of point names available is very large. Since this also provides flexibility, and the opportunity for meaningful abbreviations, the surveyor should use the simplest prefix in the point naming that is meaningful to him. He would select a prefixes that will be easily remembered and will intuitively suggest the objects observed in the field.

(b) **Reference Naming** - (B: field of Setup, HVD Obs and SOR Obs screens)

In many instances, it becomes necessary to communicate the *OFFICIAL* designation of an object. This is especially true when using the results of previous surveys and their monumentation, such as the National Geodetic Reference System (NGRS). Points monumented by the United States Coast and Geodetic Survey, National Geodetic Survey, U.S. Army Corps of Engineers, Departments of Transportation, or other organizations are often designated with a name, stamped on the monument. The EFB has the capability to use these designations, but they are used as *reference* to the point name. Another, and perhaps more important use of reference names is to indicate to the segment manager which points potentially contain control information.

The *reference name* is used for communicating the stamping, or "official" designation of a mark or object for others who may subsequently tie to the object. The reference name is the way to associate common points between all other data sources, and past or future surveys. The reference name is also the means by which the segment manager knows that points potentially contain control information; coordinates or azimuths. When the data are brought back into the office, CAiCE will interrogate the incoming data, looking for reference names. If a reference name is found, it will attempt to find control coordinate or azimuth data for that point in a control database set up by the user. If the reference name found in the field data does not have control information in the control database, the user will have the opportunity to add some control information to the control database for that given name.

An example of a reference name would be the stamping on an NGS horizontal control station. The surveyor notes the designation (stamping) of that mark with a reference name. The surveyor <u>must</u> also assign a point name for use by the EFB for the NGS station.

Any monumentation set while collecting data having a particular stamping or designation of importance would also be given a reference name (that of the designation), since others may use that monumentation at some later date, and will need to be able to "reference" back to work performed establishing it (ie. it's coordinates). This is the manner in which the surveyor may update his control database, once the processing of the data is completed.

The Reference Name should be entered into the B: field the first time that the point is utilized in that particular segment. If it is a point to be used to establish new Control it will be preceded with a period (.). If it is existing known control that has already been entered into the data base from a previous segment, enter the name reference only without the period. The Reference name will have the county designation, date, series and number of BLC, for example 8691A01. If NGS or other control, enter the stamping on the mark as found in the field.

Reference names are keyed in exactly as they are stamped. Reference names are limited to 16 alphanumeric characters however, and may contain special characters such as dashes (-), spaces (a space used in a reference name will be printed as an underbar), and periods (.). In some instances, a reference name may exceed 18 characters as stamped on the monument. In this instance, the user must abbreviate in some way. Most data screens support some form of comments, and notes to this effect may be placed there.

An example of a reference name that might be keyed is:

LOGAN_TOWER_1934 **Note: The underbar (_) is printed when a space is input in the reference name field on the data screens.**

060-92-A05 **Note: The period (.) indicates this point will be added to the Control Database.**

WARNING: It is extremely important for the field surveyor to use the reference name capability for designating which points are control and their identity, and to carefully key in reference names to avoid misspelling. If the field surveyor is careless in typing, the ability to automatically create control files for the project during processing will be lost, and he may not be able to even perform important processing steps!

The warning above alluded to a case where the surveyor neglects to use reference names at all. This is a bad decision since the CAiCE processor relies on being able to "reference" control, for which the reference name was provided. If you are establishing control for the first time, and cannot decide on a reference name, it is a good idea to type the survey point name as the reference name.

(c) **Planimetric Information**

1. **Geometry - The geometric use of a point, when that point is part of a multi-point object.**

Many objects may be designated with a single point, such as a telephone pole, or a valve cover. When larger objects are to be designated, such as the edge of pavement along a length of highway, *many points* are often used. When an observation is made to locate an object, the EFB requires that information about that object be input to indicate the object's ***potential*** relationship in multiple-point configurations called chains. The information required is what is known as the *geometry* of the point.

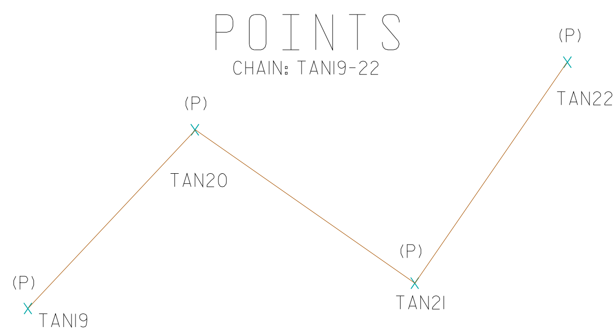
For all practical purposes, there are simply three geometric elements that exist that are of significance in field surveying; individual points, lines, and curves. The geometric relationship between points becomes important when we begin to associate many points together, such as our edge of pavement example previously. When we speak in these terms, the geometric elements (more than one point) that concern us are lines and curves, since "a point is a point". The surveyor will attach geometric relationship information to every object (point) he locates using the EFB.

For EFB surveying, all geometry attached to a point is one of two types:

Point (***P***) - a single location for an object wholly defined by one unique set of coordinates, or the intersection point of straight lines (tangents) in a line string.

Curve (***C***) - a point on a *circular* arc, or a point on a *smooth* curve (spline) passing through a series of non-linear points.

A point geometry, **P**, indicates that the point in question will <u>never</u> be used in a curve. To explain this a bit further, we need to have an object in mind, such as a tree. A tree will seldom be used as part of a curve, therefore the geometry for the location of that tree should be *P*, for point. Points connected together (a *chain*) may also have been given the geometry type of *P* for point. This is true, for example, when the surveyor connects the points representing poles supporting a power line. The location of the poles are given a *P* geometry, since they all lie as points-of-intersection (PI's) of the wire span.



A curve geometry, **C**, indicates that the point in question is part of a curve. The *C* geometry would be used to indicate <u>any</u> point lying on a curve. More importantly, the curve geometry is used for points to indicate critical places of curvature, such as the PC's, POC's, PT's, etc.

Identifying the geometry of the points located in the field is therefore minimized to simply ***P***, for point, or ***C***, for curve. The geometry of points eases construction of complicated elements as we will see later.

2. **Types of curves**

To simplify the EFB, only two types of curves are supported in the EFB. The first type of curve defined for the EFB is the **circular arc** which is a curve with a constant radius. When surveying a circular arc, it is only necessary to locate points actually on the curvature of the arc. The radius, and other geometric elements of the arc are solved from the relationship of the points surveyed.

The second type of curve is what is known as a **smooth curve**. A smooth curve *best fits* a curve passing through points defining the curve itself. A good example of an object that may be located with the smooth curve is a stream. There is no defined geometry for a stream, but the meandering of the stream can be shown to pass through survey locations modeled by the smooth curve.

To present how the circular arc, and the smooth curve are defined in the field, a few simple rules should be kept in mind when deciding how observations are to be taken:

- **Three (3) curve points in sequence define a <u>circular arc</u> (PC, POC, PT)**

A special case of a circular arc may be defined in the field by a single curve point, provided the back and ahead tangents are properly defined by *P* points.

- **A <u>smooth curve</u> is defined by four or more curve points in a**

The EFB user is responsible for indicating the geometry of every point he observes or occupies. As mentioned, there are only two choices:

- The observed point is a **<u>P</u>**-Point location (i.e. a tree, fire hydrant, PI of two intersecting lines, etc.)

- The observed point, **<u>C</u>**-Point, is on a circular arc or spline curve (i.e. edge of a meandering stream, a horizontal curve in the road, etc.)

It is possible that the assigned geometry of a point has no meaning. Such is the case when a tree, for instance, is accidentally given a *C* geometry type. The system does not care whether a single location for an object is *P* or *C*. When locations are tied together, it becomes very important that the surveyor correctly define the geometry. The *tying* of points together is how the geometrics of line work will be expressed, which is known as the chain.

3. **Chains -** **A named (chain name) series of points that have been previously located and their geometry (<u>P</u> -or- <u>C</u>) for each point in the series is defined.**

Geometry of points is important when points are associated together to describe the shape of objects. The association of points is what is known as a ***chain***. A chain is the *ordered* connection of points that define the boundary of an object. An analogy of how a chain is constructed is the child's drawing game *Connect the Dots*. The line work (chain) connecting the dots (points) is exactly how objects containing multiple points are described. Understanding this, the "chained" association of points with their corresponding geometry(s) on the individual points in the chain creates circular arcs, smooth curves, and straight lines.

This series of points, the chain, is listed by the surveyor in the order that indicates the succession of points along an object. The line work connecting the successive points define the limits of the object.

Like a point, a chain has a **chain name**. The chain name has a prefix and suffix, and follows the same general rules as point names. A chain name may contain a total of eight characters, where the last numerals are maintained by the EFB.

A chain may be ***stationed***, which makes it a baseline, or otherwise known as a ***route***. If a chain is stationed, observations may be made to points referencing the stationed chain, which is commonly known to the surveying community as location by station and offset.

The stationing of a chain is input in standard station notation or as a whole number and decimal fraction. An example is:

10+00 or 1000 for station 10+00.000
-or-
13+66.273 or 1366.273 for station 13+66.273

The stationing defines the beginning length for the <u>**first point**</u> in the chain listing, and as progression is made down the chain list, the stationing <u>increases</u>. The station value is not input for any other point in the chain list, but may be computed in the office by the geometry package(s) available for the EFB. A chain can represent a three-dimensional object, and is controlled by the X,Y,Z coordinates (or Station, Offset, Elevation) of every point included in the chain listing. If any point in the chain listing does not contain a Z ordinate, the chain will be two-dimensional only. If the surveyor includes a point in the chain listing where only an elevation or Z ordinate value may be computed, the chain will be ignored altogether. A two-dimensional chain would be any sequence of points where not all of the points in the chain listing contain computable Z ordinates.

Chains not only represent topographic features, but may be *design* elements of the route alignment. An example of this is a chain containing the critical points that comprise a highway route, which are the PC's, PT's, and PI's.

4. **Chain lists**

Since a chain is simply a listing of points in sequence, the surveyor must identify the ordering of the points in the **chain list**. The EFB allows any point previously observed to be included in a chain list.

Since the surveyor defined the geometry of points (**P**oint location or **C**urve location) at the time of observation, **arcs**, **smooth curves**, and **straight lines** between points will be generated automatically based upon the sequence of points as they occur in the chain list. The surveyor does not have to define the elements of curves (radius, length, degree of curve, etc.).

5. **Rules for chain lists**

X Points used to define a chain are listed in the order that the line work (or curve work) connecting the points is to follow (not necessarily the chronological (time) order in which they were surveyed).

Example: ABC1,ABC17,ABC2	point ABC2 must have been observed prior to ABC17, yet ABC17 can occur earlier in the chain list

- Individual points, or groupings of points in the chain list are separated by commas, which indicates connection will be made between the individual points, or the groups.

Example:	XSECT1,BX45,TL1	indicates that line work will connect point XSECT1 to point BX45, and connect point BX45 to point TL1

- A group of points to be connected in **ascending** order which share the *same* name prefix, may be listed by the name prefix only, thereby ***globally*** including all points with that prefix in the chain. The order runs from the lowest numbered suffix to the highest numbered suffix.

Example:	XSECT	if seven (7) XSECT points existed, this global listing connects XSECT1 to XSECT2, XSECT2 to XSECT3, and so on until XSECT7 is reached.

- In the case of a global listing, the order of points may be ***reversed*** by placing a dash (**-**) in front of the listed global prefix to indicate the points are to be taken in **descending** order.

Example:	-XSECT	if seven (7) XSECT Points existed, this global listing connects XSECT7 to XSECT6, XSECT6 to XSECT5, and so on until XSECT1 is reached.

- A limited ***range*** of points may be listed by placing a dash between the beginning point and the ending point of the range desired. The order of the points, ascending or descending, is indicated by the magnitude of the point suffix that occurs earliest in the list.

Example:	XSECT1-45	indicates that point XSECT1 through point XSECT45 are to be chained in ascending order, connecting XSECT1 to XSECT2, XSECT2 to XSECT3, XSECT3 to XSECT4, and so on until XSECT45 is reached.

The range may also be listed in descending order, where XSECT45-1 indicate the reversed list of the previous example.

X A double comma(**,,**) between individual points, global listings, or ranges in a chain list indicates a ***gap*** or break between the point before and after the double comma (gap).

Example: XSECT1-15,,18-22 indicates there is **NOT** to be a connection of line work between point XSECT15 and point XSECT18, however the ranges indicated in the listing (XSECT1-15 and XSECT18-22) are to connected.

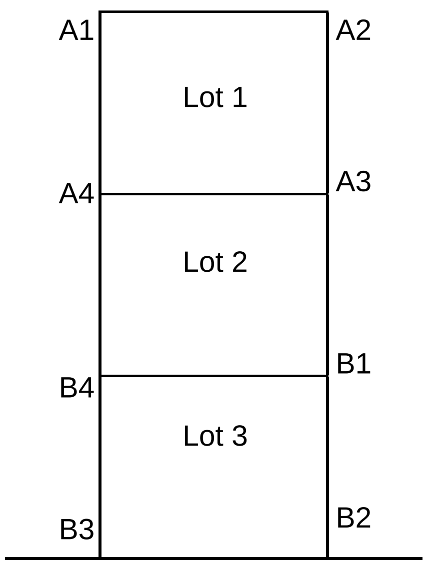
A chain list does not have to be *singular*, which means any number of points with differing point name prefixes may be used in the list.

Example: RD,PAVT1-44,DWY6-14,,15-22,PAVT45-71,,72-108,-LAKE

The point name prefix is *implied* or carried through the list until a new point name prefix is encountered. A more expanded listing of the previous example would look like: RD,PAVT1-PAVT44,DWY6-DWY14,,DWY15-DWY22,PAVT45-PAVT71,,PAVT72-PAVT108,-LAKE

The user will probably elect to use the abbreviated methods of listing the chain to reduce the amount of typing in the field.

The following example should illustrate how the concepts of *global* listings, *reversed* listings, and *ranges* are used to simplify chain lists. Several examples of valid chain lists are given to describe the lots shown below. The use of the *comma* separator and *gap* is also demonstrated.



LOT1 could be listed as:
A1,A2,A3,A4,A1 -or-
A1-4,A1 -or-
A1-4,1 -or-
-A,4 -or-
A4-1,1 etc.

LOT2 and LOT3 could be listed as:
A4,A3,B1-4,A4,,B1,B4 -or-
A4,A3,B,1,,B4,A4 -or-
B,1,A3-4,B4 etc.

LOT1 and LOT3 could be listed as:
A1-4,1,,B1-4,1 -or-
A4-1,4,,B4-1,4 -or-
A,1,,B,1 -or-
-B,4,,A,1 etc.

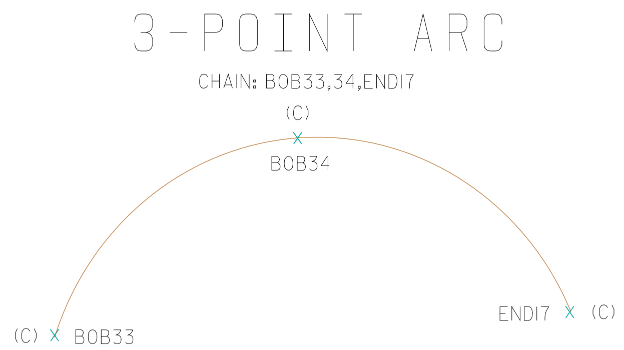
The previous examples demonstrate a variety of ways a *similar* chain can be defined. EFB allows the surveyor flexibility for chain listings. There are many ways to list a chain and achieve the same results. The list is as simple as the surveyor desires, though correct ordering of the list is required to properly describe the object. The lists may become very cryptic as the surveyor attempts to optimize the definition.

Now that we have demonstrated how the chain list is assembled, we will look at how the geometry of points in the chain list affect the graphical presentation of the chain. Remember that it is the ***P*** and ***C*** geometry typing of points in the list that influence the way arcs, smooth curves, and line strings are generated in the EFB.

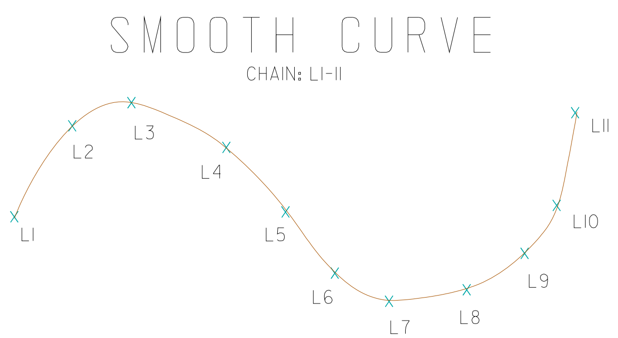
The geometrics of the chain is derived from the geometry of the points included in the chain listing. Since points included in the listing will contain either a **P** or **C** (point or curve respectively) as their geometry type, the frequency of the **C** geometry type will determine how lines and curves in the chain are to be constructed.

Curves are determined in three ways:

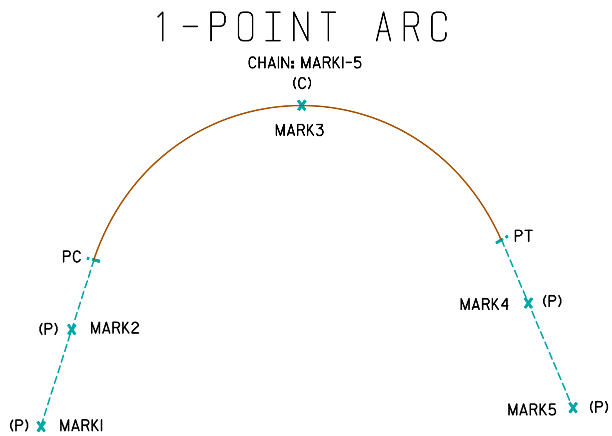
X	If three (3) points with geometry type *C* are encountered sequentially then a circular arc is generated, where the <u>first</u> point is the **PC**, the <u>second</u> a **POC** and the <u>third</u> the **PT**.



X	If four or more (4 -> N) points with geometry type *C* are encountered sequentially then a smooth curve is fitted through the points. The first point encountered is the beginning of the smooth curve and the last one encountered is the end.



X	If a <u>pair</u> (2) of points with the geometry type *P* precede a <u>single</u> point with the geometry type *C*, then are followed by another <u>pair</u> points with the geometry type *P*, The first pair define the *back tangent* of the curve, the second pair define the *ahead tangent* of the curve, and the point with the *C* geometry type defines the **POC**. In this case the **PC** and **PT**



are computed internally by the EFB.

Note: If two type *C* points are encountered in sequence, they are treated as type *P* points, and will be connected by <u>line segments</u>.

```
Examples:

1)    P                 2)    P                          3)    P (BACK TANGENT)
      P                       P                                P (BACK TANGENT)
      C (PC)                  C (BEGIN SMOOTH CURVE)           C (POC)
      C (POC)                 C                                P (AHEAD/BACK TANGENT)
      C (PT)                  C                                P (AHEAD/BACK TANGENT)
      P                       C                                C (POC)
      C (PC)                  C                                P (AHEAD TANGENT)
      C (POC)                 C (END SMOOTH CURVE)             P (AHEAD TANGENT)
      C (PT)                  P
      P                       P
```

Example 3) would have the *PC* and *PT* points computed and inserted automatically by the EFB when the chain is graphically presented at the computer as the following diagram illustrates:

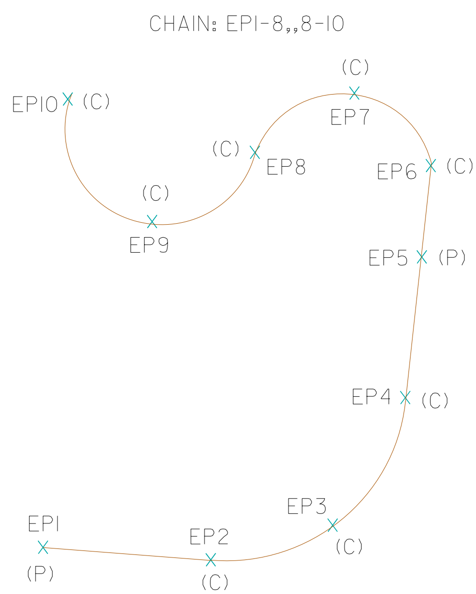
```
FROM CHAIN LIST            INTERPRETED AS
              P
              P
              C   (POC)
              P
              P                        P
              C   (POC)                P
              P                        PC (CREATED/INSERTED BY EFB)
              P                        C
```

PT	C
P	PT
P	P
PC	P

Example 4:

FROM CHAIN LIST		INTERPRETED AS
P		P
P		P
C	(POC)	PC (CREATED/INSERTED BY EFB)
P		C
P	(PC)	PT
C	(POC)	P
P	(PT)	P
P		PC
P		C
		PT
		P
		P

More complicated geometries, such as compound and reverse curves may be shown with *creative* chain lists. Situations like compound and reverse curve are easily handled as the following figure illustrates:



(d) **Vertical Information**

We have seen the importance of points and chains in the description of the planimetric or *XY* location of objects. We also saw how the geometry

of a point affects how a curvilinear object may be represented. We will now focus our attention on the vertical or *Z* location of objects and the points and chains which comprise them.
The ground surface or sub-surface is often located by the surveyor with a variety of techniques. One of the most familiar to most surveyors is *elevation* referenced to a vertical datum.

Terrain Modeling software has given us the ability to accurately represent the ground or other super/subterranean surfaces. Cross sections may be derived at any orientation or interval along a desired line that passes through the observation data (***model***). Observations taken as *cross sections*, or *random points* may be included in three dimensional chains (representing ***break lines*** or otherwise known as terrain discontinuities) are used to create computer models of the surfaces.

The *Triangulated Irregular Network* (**TIN**) is one method that the computer generates models of the surfaces.

Random points may represent the locations of planimetric objects. If a tree is located by the surveyor, and the rodman held the base of the target pole at the ground, the elevation computed from that observation may be used in a TIN.

Cross section data may also be used in a TIN model since the observations that represent the cross sections are usually ground observations. A TIN model could be created exclusively from cross section observations, without additional ground observations between the surveyed stations or having additional three-dimensional chains representing break lines. The resultant TIN model would be weaker because there would be no data *along* breaks in the terrain, and the computer will have to interpolate between sections.

The most important data that may be used in a TIN model are the **break lines**. A break line is surveyed by observing points along the breaks of a particular object, then associating those points together as a chain. This describes the profile of the terrain passing through the points that are included in the chain.

1. **Attribute -** **a sub-classification of a point to inform the processing programs what relationship that point's elevation ordinate has to a surface.**

The ***attribute*** of a point is used to tell the EFB how the elevation computed for that point will be related to a particular surface.

There are four attribute(s) defined for the EFB:

G - Ground Point - a point whose computed elevation is <u>on</u> the specified surface.

These points may occur individually, or are often connected together in a chain to describe a terrain discontinuity or the three dimensional geometry of an object along the surface. This constrains the TIN model to the elevations of the surface.

X - Cross Section - a surface point observed at a station and offset to a particular baseline, whose elevation and position (SO or XY) is used to define an end area profile.

The treatment in a terrain model of the *X* attribute is similar to that of the ground point (*G*) described above, since cross section attributes should ordinarily be on the surface. One difference that should be noted is that these points are surveyed with a unique spatial relationship, therefore the surveyor will want to differentiate these points using the *X* attribute. We will also see later that the program running on the field computer will behave differently when this attribute is selected for a point.

F - Feature Point - a point that indicates a *planimetric* object only, whose elevation is <u>NOT</u> to be used in the surface model.

U - User Point - a point whose elevation is *generally* not to be used when defining the surface for terrain modeling, but has a special meaning for the user, such as utility data.

2. Zone - A tag to differentiate attributes between differing surfaces for terrain modeling.

The ***zone*** may be used to differentiate between different vertical surfaces. The user may desire to perform two independent TIN models of the same general vicinity, such as the existing ground before some construction activity and the *as-built* surface after construction. Points and chains may be retrieved from a database using the zone number as a search key.

The zone is designated for an object (point or chain) by it's zone number. The zone number is a digit from one (1) through nine (9). The user may easily define up to nine different zones for each attribute.

(e) **Identifying Objects**

Until now, we have input into the EFB only how a point or chain is to be used. It is also important to tell the system (and other users of the data) what the object really is, for purposes of graphical representation and information sharing.

1. **Feature Code -** **a group of a maximum eight alphanumeric characters that identifies a point or chain as a particular object.**

A by-product of surveying usually is a scaled map based upon the survey measurements. To do this in an automated fashion, the user must communicate the graphical significance of objects to the computer. This *communication* is accomplished in the EFB by tagging selected points and all chains with **feature codes**. The feature code is information that identifies a point or chain as a particular object. The system will interpret the feature code based upon a table (discussed later) and place symbology or line work for points and chains representing objects.

The symbology and lines have varying shapes, color, thickness (weight) and line style for objects identified by their feature codes.

The user instructs the system as to what the points and chains represent by using feature codes. The feature code indicates which symbol to plot for individual points, and what type of line to plot for chains.

A feature code *could* be assigned to each point observed by the surveyor, however those points included in chains generally do not have to have a feature code. **It is not necessary or recommended to assign a feature code to each point observed.** Only points requiring an individual graphic symbol on a map need be assigned feature codes. Each chain must be assigned a feature code in order for it to be plotted with other than the default line style, weight, and color.

If a series of points in a chain have no graphical significance (except for the chain itself), such as points along an edge of pavement, no feature code need be assigned to the individual points when they are observed. The chain that contains those points to describe the edge of pavement <u>will</u> be assigned a feature code. The converse is true for a power line, for example, that may span many supporting poles. The poles will be assigned the appropiate feature code because each pole is a planimetric map item. The chain connecting the poles representing the power line must also be assigned the correct feature chain feature code. The poles themselves <u>are</u> graphically significant, as well as the chain representing the power line.

2. **Graphically mixing chains and points**

Chains will plot with the graphics associated with the chain feature code. Individual points in the chain will plot with the cells associated with their individual feature codes.

3. **Feature code organization**

Appendix D of this documentation lists the feature codes to be used by the Department. It also contains a brief description of the object(s).

4. **Feature code options: <u>Adding Text</u>**

It is important to minimize the total number of feature codes used, because a long list is cumbersome in the field, and yet retain enough codes to effectively define most objects. Some objects that may be encountered in a field survey may not have been assigned feature codes. User defined text extensions to the feature codes may be used in those situations.

The **description** is a text annotation that follows the feature code, and separated from it by a dash (-). Since the feature code field is 18 characters long, a surveyor can use descriptions to place additional information about a point or chain in the EFB. If the feature code itself is eight characters, then nine characters are available for the description (one character is used by the dash(-)). An example is a tree. For example, TREE is the default feature code for any tree in the current FDOT feature table. To describe a tree fully, the description could be used, as shown on the next page.

Example: TREE-48" WHITE OAK

Thus any size and species of tree is easily accommodated with the typed-in description.

EFB also supports aliases in its feature code list. Entering an alias code will cause the system to automatically substitute the current alpha numeric equivalent feature code from the cross-referenced TS_FEAT.COD file. This is useful if feature codes are complicated, and a more simple designation would be appropriate for field personnel. This feature code will be substituted into the F: field when entry is terminated by .

Text alone without a symbol may also be displayed in the graphics at a point, by the use of special feature code “99.” Only the text extension is displayed.

Example: 99-PLACE TEXT HERE

For descriptions that exceed the 18 character limitation, the comment field (described later) could also be used.

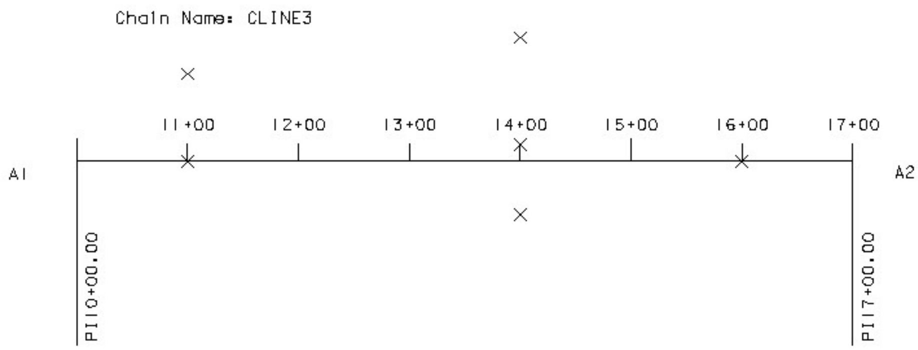
5. **Feature code options: <u>HVD Cross Sections</u>**

A unique option for feature codes exists when <u>cross sections</u> are taken with the use of the total station. The total station measures **<u>H</u>**orizontal direction, **<u>V</u>**ertical (Zenith) direction, and slope **<u>D</u>**istance (HVD). When the total station is used in a cross sectioning mode, the feature code acquires a computational rather than graphical significance. The feature code for cross section operations with a total station <u>must</u> contain the **<u>alignment name</u>** (a valid chain name) to which the observations will be referenced, the **<u>station number</u>** along the chain, and the **<u>orientation</u>** to the chain of the point observed. This information is used to tell the EFB that a *greater weight* is given to the station value as measured in the field, than the station value that may be computed in the geometry system from the coordinate values computed from the HVD observations. The feature code *field* (a *field* is an area in a data screen to input a particular type of data) is affected by the contents of the attribute field. When the attribute of a <u>point</u> is set to **<u>X</u>**, the feature code must take the following format:

alignment name, station number, orientation

The following example will better illustrate how this works:

Consider the alignment between points A1 and A2. A chain was created between these points with station of 10+00 at A1. Since the stationing increases as you progress along the chain in the order of the listing, A2 will have a greater stationing value than A1. The symbol (X) indicates where the HVD cross section observations were taken.



In the illustration above, for every series of shot(s) taken left or right of the baseline "CLINE3", there is a required shot taken on the baseline. This is necessary for the processing program that resolves HVD cross section data to be able to compute the offset distance from the baseline, without having information about the chain geometry.

The feature codes are shown that are used with an attribute of X. Proceeding along the chain, the following feature codes must be used for the observations taken at the X's, for an X attribute:

CLINE3,11+00,B
CLINE3,11+00,L
CLINE3,13+00,B
CLINE3,14+00,B
CLINE3,14+00,L
CLINE3,14+00,R
CLINE3,16+00,B
CLINE3,16+00,R

Notice that the format of the data keyed in for the example above lists the chain name first, then the station separated by a comma, and then finally the orientation to the baseline also separated by a comma.
The orientation options are:

L - left of baseline, **R** - right of baseline, **B** - on the baseline.

For **EVEN** (100 meter) stations, the XX+00 notation is not required. For stations such as 16+32.581 or 19+18.673, the "+" may be omitted in the list to reduce keystrokes. The station could be typed as 1632.581 and 1918.673 respectively.

6. **Available feature codes**

APPENDIX D lists the default feature codes that have been defined for the EFB. The user may modify the default feature table, and create any numeric feature codes desired. Later in this document, the feature table and it's field description file are presented and fully discussed.

(3) THE OPERATION OF EFB FIELD SOFTWARE

EFB is the name used throughout the remainder of this documentation for the computer program operating on the hand-held computer used to gather data.

EFB is a single program. The DOS name for the program may be ***HUSKY.EXE, RHC44.EXE*** *or* ***MICROPLM.EXE***, although the executable may be renamed to whatever the user wishes. EFB was designed to guide the surveyor through the data collection operation. Imbedded in EFB are routines that perform checks for data integrity to help ensure the data gathering process proceeds smoothly and with minimum error. The user is appropriately warned of a variety of potential problem situations. The program also uses two companion files that reside on the RAM disk of the hand held computer in the field. The first, ***TS$MENU.DAT***, is used to define the appearance of the menus that appear in EFB, and the layout of the functions that EFB can perform. The second companion file, ***TS_FEAT.COD***, is used by the feature code confirmation system and contains the short descriptions of the feature codes displayed on the screen when a supported feature code is keyed in.

For EFB to operate properly, the program must know where to place data and where to find the TS$MENU.DAT and TS_FEAT.COD files on the RAM disk. This is accomplished by setting some ***environment variables*** (see your DOS manual for a complete description of the DOS environment). The environment variable ***TSDATA*** tells EFB on what disk and directory to read and write all survey data. The environment variable ***TSMENU*** tells EFB where to find the files TS$MENU.DAT and TS_FEAT.COD. The reason for this is that often on some hand held computers, RAM disk space is limited, therefore sometimes the survey data, or the program and its menu definition, may reside in different places. Ordinarily, a batch file (a DOS text file with a .BAT extension) is used to set these environment variables and start the program. An example of such a batch program is:

ECHO OFF
SET TSDATA=*x*:
SET TSMENU=*y*:
SET TZ=ESTnEDT
CLS
ECHO Please Wait While EFB Loads ...
HUSKY.EXE
CLS

where ***y*** is the drive where the files TS$MENU.DAT and TS_FEAT.COD files reside and ***x*** is the drive where the survey data is read from and written to. The trailing back-slash (\) must be placed at the end of the path to the environment variables. The ESTnEDT string is used to set the number of hours different from Grenwitch time. In Florida, it would be EST5EDT or EST4EDT, depending on whether it was daylight savings or not. Usually the batch file described above is given the name *EFB.BAT* so it is remembered by field personnel and may be easily typed on the field computer keyboard.

(a) **Controlling the System – Menus**

Operation of EFB is based on a system of menus and data screens. A menu item is selected by pressing the appropriate *digit* on the keypad corresponding to the task the surveyor wishes to accomplish.

(b) **Controlling the System - Data Prompts**

Once the user has selected an operation from a menu, a data screen appears for data entry. Maintenance of data screens is performed by a screen manager routine running on the field computer. The screen manager defines the rules of operation and the set of functions that provide cursor movement and data manipulation through ***data fields*** that appear on the data screens.

Data is entered into a data field by pressing the letter key (***prompt letter***) corresponding to the data field desired to be edited. A ***message field*** at the bottom of the data screen displays information about the field selected. The cursor is automatically placed in the chosen field, indicating EFB is waiting for input. This assists the user in placing data in the appropriate locations. When editing of a data field is complete, pressing ENTER returns the cursor to ***standby status*** in the message field at the bottom of the data screen.

A system of locks deactivates portions of the keyboard before and during data field editing to help prevent erroneous data being accidentally input.

In a few instances, a data field is limited to a specific set of data, such as the geometry and attribute data items discussed earlier. In this case, a ***toggle*** limiting selection to an appropriate option is used. In such situations with limited choices of data entry, pressing the prompt letter key repeatedly will toggle through all of the possible options for that field, without requiring the user to enter the field and edit it. **When using a toggle, pressing ENTER is <u>not</u> required to terminate entry and will close the screen, returning the system to the previous menu**.

Data will remain in a data screen until the user is ready to record the information in order to verify that all data fields are correct. A message is displayed (the amount of available space left on the collector) indicating if the record operation was successful. Corrective action may be taken if an error occurred, or if any mandatory items have been left blank. If erroneous data is not detected, and the record operation was successful, the user has an additional opportunity to correct any mistakes using functions described later.

(c) **Files and Data Management**

EFB allows the user to gather survey measurements and data by either automatic entry from electronic surveying equipment or by manual key-in of data at the keyboard. The situation and the type of equipment used will determine how data will be entered.

All files created for a particular project share a common **filename**. Because of this, EFB knows where to place data across multiple data files, and the surveyor only has to deal with a single filename. Each file for a project has an **extension** after the period (.) following the filename. With the use of different extensions, the survey data is segregated into different types of files. Files on the field computer are one of three types:

X *executable* programs (i.e. *HUSKY.EXE*, *EFB.BAT*)

- data files used in the correct operation of the executable programs (*TS$MENU.DAT*, *TS_FEAT.COD*)

- survey data (*filename**.RAW***, *filename**.PRE***, *filename**.CHN***, *filename**.CPX***, *filename**.TAP***).

The contents of the .RAW, .PRE, .CHN, .CPX, and .TAP files will be discussed later, after we have discussed the types of data that the EFB is designed to gather.

(d) Starting EFB

Start-up of EFB on the various hand-held computers depends on the configuration, and type of field computer being used. Normally, the program for the various EFB executables pertaining to a particular computer variety (HUSKY.EXE, RHC-44.EXE or MICROPLM.EXE) will be loaded on a RAM disk on the hand held computer, with the batch file EFB.BAT to start it. Data files TS$MENU.DAT and TS_FEAT.COD would also be loaded to the RAM disk. The disk configuration for each of the hand-held computers varies, and the user should consult the documentation provided by the manufacturer of the field computer being used as to which RAM is best suited for operations.

Note: The user should consult the operations manuals of his particular hand held computer to perform system operations, disk formatting, and first-time program loading. Each system is delivered with a complete set of user documentation, and the user <u>must</u> be thoroughly familiar with the operation of his hand held computer before proceeding any further in this documentation!

EFB is started by typing the name of the batch file at the DOS prompt. The batch file EFB.BAT (described earlier) may be executed that sets the environment variables ***TSMENU*** and ***TSDATA***. EFB is then executed by the batch file.

(e) **The Opening Screens**

The first screen shown to the user upon start-up is the Copyright screen as shown below:

```
   Electronic Field
Book Data Collector
   Copyright 1995
  State of Florida
     Department
         Of
   Transportation
```

After pausing on the above screen a display prompting for the **time zone** to be used for time and date stamping of the observations will be displayed.

```
VER. 2.55 31-JUL-96
 Select Time Zone..
   1) EST   5) EDT
   2) CST   6) CDT
   3) MST   7) MDT
   4) PST   8) PDT

Enter Choice [EDT]:
```

The number corresponding to the <u>local</u> time zone the work will be performed in should be keyed in. The default time zone is Eastern Daylight Time, and pressing  to accept the default at the prompt will suffice, if the default is appropriate.

The time zones available are as follows:

```
EST - Eastern Standard Time
CST - Central Standard Time
MST - Mountain Standard Time
```

```
PST - Pacific Standard time
EDT - Eastern Daylight Time
CDT - Central Daylight Time
MDT - Mountain Daylight Time
PDT - Pacific Daylight time
```

The next screen displayed is the local system time to be used for time stamping of the survey data.

The screen looks like:

```
VER. 2.55 31-JUL-96

  Time: XX:XX:XX
  Time:
```

This screen sets the EFB software clock. A new local time may be keyed in using the same format as the displayed time, followed by pressing ENTER, or simply pressing ENTER will accept the currently set time.

Note: Those who wish to calibrate the system time to Coordinated Universal Time for astronomic observations should anticipate the "tone" on time radio (WWV, etc.) by a few seconds and key in the LOCAL time ahead of that when the CUT will be broadcast. When the "tone" is heard, pressing ENTER simultaneously will set the software clock for the duration of EFB execution for time stamping. The user should set the hardware clock internally with the utilities provided by the manufacture of the computer hardware, which sets the internal clock permanently.

The program clock is set when ENTER is pressed if there is a change in the new time field. ENTER should be pressed accepting the reset time at the exact instant the broadcast tone sounds.

In the same screen, a second prompt for the date is then made, and should be set to the local date. The screen now has the following appearance:

```
Time: XX:XX:XX
Time: nn:nn:nn

Date: MM-DD-YYYY
Date:
```

Like the time, the system date may be changed by typing in new values in the format as the displayed, then pressing . The default date displayed may be accepted by pressing  alone.

After a few seconds, EFB attempts to load the menu file (TS$MENU.DAT) if the environment variables are set. If an error in the menu file is detected, the nature of that error is displayed to the screen for the user. If no error is detected, EFB begins running.

(f) **Main Menu**

Once EFB is running, the opening menu is titled **MAIN MENU**. This menu contains the primary operations that are performed when surveying with EFB. The MAIN MENU screen is shown below:

(g) **Segment Manager - (Main Menu, Option - 1)**

The ***Segment Manager*** is where all file services take place. Under this option, the surveyor has control of the creation, use, and manipulation of segment files. All segments begin in the Segment Manager.

The MAIN MENU is a menu screen. To select an option in a menu screen, press the digit key corresponding to the option desired.

When Segment Manager is selected, the following menu screen will appear:

```
   SEGMENT MANAGER
0: List
1: Create/Activate
2: Next Segment


Segment? ________
```

1. **List Segments - (Segment Manager, Option - 0)**

When ***List Segments*** is selected, EFB will list the current segments by name that are on the RAM disk of the field computer. The segment(s) are listed, a page at a time, as well as their size in bytes.
The amount of remaining memory for additional work is listed in bytes. The RAM disk of the field computer may contain any number of segments, and are listed on sequential screens, provided the entire list can not be displayed at once. Pressing *any key* will display additional pages if there are more than one, eventually clearing the List Segments screen(s) and returning the user back to the Segment Manager menu.

A sample screen showing four segments on the RAM disk looks like:

```
SR319A           4569
SR319B         364482
SR319C          83745
SR319D          66387
371712 free


Any Key to Continue!
```

The List Segments screen also displays which segment is currently being worked on. An ***active segment*** is the segment that data will be added to when surveying begins. The List Segments screen displays the active segment by placing brackets **< >** around the segment name. The active segment may be changed by use of functions in Segment Manager. The screen below shows what the surveyor would see if the segment *SR319C* was active:

```
 SR319A             4569
 SR319B           364482
<SR319C   >        83745
 SR319D            66387
 371712 free


Any Key to Continue!
```

When any key is pressed, the List Segments function returns to the Segment Manager screen.

2. **Editing the *Segment?* prompt - (Segment Manager, Option - S)**

Options 1 and 2 of the Segment Manager menu require that the surveyor indicate the segment that he desires to perform Segment Manager operations on. This is accomplished by editing the field following the ***Segment?*** prompt.

The desired segment is keyed into the segment data field. These options operate on the segment in the data field only, and have no effect on other segments on the RAM disk.

All ***field prompts*** in all subsequent data screens (which will be discussed) contain a capitalized letter, such as the letter ***S*** in Segment. This capitalized letter indicates the key that will place the cursor into the data field next to the prompt for data input. Pressing the ***prompt key*** takes the cursor into the selected field for editing. A message is usually displayed in the message field at the bottom of the data screen indicating the selection. When editing of the field is completed, pressing  brings the cursor back to *standby status* in the message field. Review the Segment Manager screen earlier, as the other options in this screen are discussed.

3. **Create/Activate - (Segment Manager, Option - 1)**

Selecting ***Create/Activate*** will create a segment on the field computer RAM disk that has its files named the same as that indicated in the segment field. When a <u>new</u> segment is created, it becomes the active segment as it is created. This may be confirmed by listing the segments using ***List Segments*** as previously discussed. A message indicates that the segment is being created by displaying:

```
   SEGMENT MANAGER
0: List
1: Create/Activate
2: Next Segment


Segment? EXAMPLE_
MSG>Creating Segment
```

then displaying:

```
   SEGMENT MANAGER
0: List
1: Create/Activate
2: Next Segment


Segment? EXAMPLE_
MSG>Segment Created!
```

Create/Activate has a dual function if it is desired to make an <u>old</u> segment active. Selecting Create/Activate when the old segment name is in the Segment field will activate the old segment. The message field will indicate that a segment is being activated, rather than being created. Again, it is wise to verify the correct segment is active by using List Segments option before continuing. The surveyor will see the following on the display(s) during activation of an old segment:

```
   SEGMENT MANAGER
0: List
1: Create/Activate
2: Next Segment


Segment? OLDSEGMT
MSG>Activating Segmt
```

then displaying:
If any errors are detected in structure of the old data files, EFB will display a message.

4. **Next Segment - (Segment Manager, Option - 2)**

Selecting ***Next Segment*** will cause EFB to create new segment files for the segment named in the Segment? field. The .PRE and .CPX files from the current active segment will be carried forward to the new segment specified in the Segment? field. The user is placed at the Header screen with the new segment name already loaded. After any edits the header screen is ready to be saved.

```
   SEGMENT MANAGER
0: List
1: Create/Activate
2: Next Segment


Segment? OLDSEGMT
MSG>Segmnt Activated
```

Begin by activating the source segment if it is not already active. Then select the Segment? field and enter the name of the new segment and then . Then select <<2>> from the Segment Manager menu. Blank .RAW, .CHN, and .TAP files will be created and the .CPX and .PRE files will be copied from the source segment to the new segment and renamed. The Header screen appears with the units correctly selected, new segment name, and the R: field copied from the previous Header. This Header will not have been recorded in the new segment yet. It can be edited at this time and then must be recorded.

(h) **Data Transfer - (Main Menu, Option - 2)**

EFB has **<u>no</u>** internal ability to transfer programs and data to and from the Host PC computer.

Users should consult the manuals and documentation from the manufacturer of the particular field computer being used for their serial communications options.

(i) **Functions**

It is appropriate to introduce the concept of ***functions*** at this time, since we will use one of them to record the Header into the segment file on the RAM disk. Manipulation of data and data screens are performed also through the use of ***functions***. The *function keys* are assigned to the numeral keys <<1234567890>> on the field computer, and are active only when the cursor is in standby status in the message field, <u>not</u> when editing a data field is taking place. All that is required to activate a function is to press the appropriate numeral key, and the function selected is performed.

Pressing  to complete a function is not required, although some functions that potentially have detrimental effects on the data processing <u>will</u> require the surveyor to confirm his choice of action (usually a confirmation prompt) before the function executes. The location of each function is mapped to a particular numeral key for individual data screens. There are <u>never</u> more than ten functions per data screen to remember, and many functions perform similar operations in all data screens as well will see later.

(j) **Survey - (Main Menu, Option - 3)**

Upon selecting ***Survey***, the Survey menu screen appears. This screen indicates the available surveying ***tasks*** supported by EFB. As you can see below, the Survey screen has many options. The options will be discussed one at a time and in great detail, since they are the "meat" to using EFB as a data collection system.

```
        SURVEY
1:Header  6:SOR-Obs
2:Calib   7:Remarks
3:Test    8:Chains
4:Setup   9:Taping
5:HVD-Obs 0:Search

MSG>
```

Surveying operations are divided into general categories, or tasks. The tasks currently supported are as follows:

HEADER	User information about the Segment
CALIBRATION	User information about environment, crew and instrument, selection of instrument, and instrument testing
TEST	A test screen for Axis and Peg testing
SETUP	Data about the point the instrument occupies
HVD-Obs	Data about the point the target occupies, and measurement data (horizontal angle, zenith angle, and distance combinations)
SOR-Obs	Data about the point the target occupies, and measurement data (station, offset, and rod reading combinations)
REMARKS	General remarks during the data collection process
CHAIN	Construction of curvilinear geometric objects (chains)
TAPING	Remote taping operations independent of the setup
SEARCH	Searches for a data record by setup, reference name, prefix, or point name

A detailed description of the tasks will be included when discussion of the data screens used to perform the task is presented.

The general philosophy of EFB data collection is that the user should have total flexibility, subject to statutory and contractual requirements. There are no *system* requirements for data structure, such as the number of angle or distance repetitions. Survey structure, which deals with such subjects as precision and accuracy, connectivity and control, are left to the user and the appropiate Department references.

(k) **Header**

The ***Header*** contains the opening pieces of information that go in the EFB observation file (the observation file is a binary file called ***filename.RAW***).

The Header is the first record in any EFB segment. The Header only occurs once per segment. The Header contains descriptive information about the *nature* of the segment itself. The data items to be placed in the Header include a toggle for units of measurements between English and Metric, a ***segment name*** (which should not be confused with the segment file name input in the Segment Manager screen), and space for a short paragraph of ***remarks***. There is only one Header in an EFB segment. The only data <u>required</u> for the Header is a segment name and the units. The segment name in the Header allows a longer, and more descriptive name than the *segment filename* input in the Segment Manager screen.

The header data screen:

```
U:________HEADER
N:________________
R:_________________
___________________
___________________
___________________
___________________
MSG>
```

<<U>>: Units of linear measurements

HEADER Screen title

<<N>>: Segment name field

<<R>>: Remarks field about nature of the segment

MSG> Message block for communicating status of operations to the surveyor

The segment name may be up to 18 characters in length. An example would be:

I-75 COLUMBIA CO.

Remarks are used to input a brief description about the work to be performed. The surveyor has space to input up to 98 characters (including spaces) for the description. An example would be:

Additional lane widening of i-75 from Georgia line to Alachua co. North line, x-sections and topo

When typing in remarks, or any long listings of data, EFB will automatically wrap the text to the next line to keep all of the text visible on the screen. A warning beep will indicate when the end of the data field is reached.

The actual screen the surveyor sees after input of the above example is:

```
U:METRIC  HEADER
N:I-75_COLUMBIA_CO_
R:additional lane wi
dening of I-75 from
Georgia line to Alac
hua Co. north line,
x-sections and topo_
MSG>
```

Information is placed in the screen by manipulation of the cursor. This is done by pressing the ***prompt key*** on the keyboard representing the letter in the field to be edited or by toggling. The cursor is then placed in the selected data field for editing (most cases) or by toggling between the embedded values or strings, as in the case of the **U:** field, and a corresponding message will appear in the message field explaining the action that has been taken. The field may now be edited.

The **U:** field toggle will allow the choice between English or Metric units. Once this header screen has been recorded the units will have been selected for the project and cannot be changed from within the software. The decimal precision of distance inputs will be to the millimeter (.001) for metric units. If English units are selected the precision is set to the hundreth of a foot (.01).

When editing is complete, pressing  returns the cursor to ***standby status*** in the message field. With the exception of data ***toggles*** (described later), which change the contents of data fields without a key-in, editing of most data fields takes place in the manner just described.

When editing any data screen, the information input remains in the ***screen manager*** until the user decides to record the information to the segment data file(s) on the RAM disk. This allows the user to correct mistakes prior to recording the data permanently.

Functions Available: Header

1. **<u>Record</u>**

   The ***Record*** function is used to record the contents of a data screen to the segment file (***filename.RAW***) located on the RAM disk. When selected, the Record function checks the contents of the data screen to ensure that the required data is input in the right format. If an error is detected, the surveyor is warned with the appropriate message printed in the message field. If an attempt to record the data screen is successful, the number of available bytes on the RAM disk is displayed in the message field, indicating the Record function was successful in its operation. The Record function will <u>always</u> be on <<0>>, for all data screens.

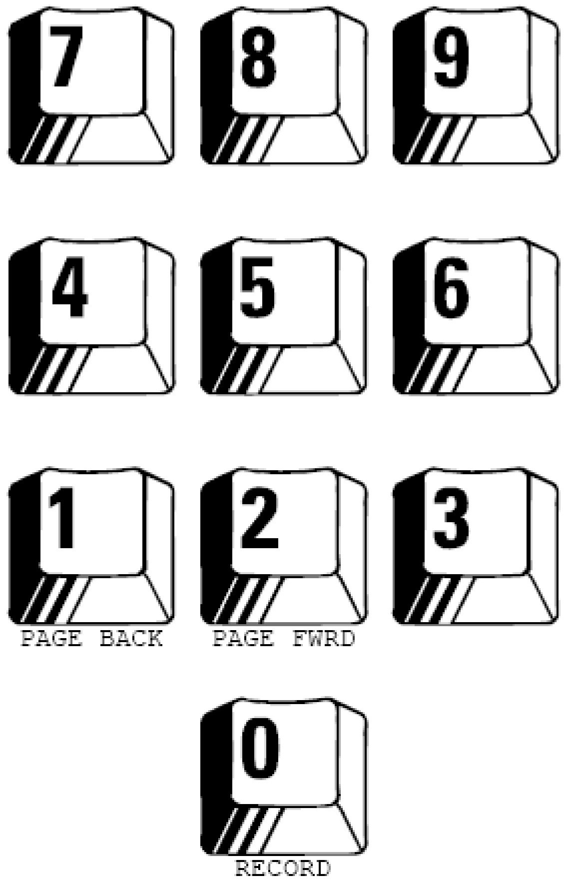
2. **<u>Page Back/Page Forward</u>**

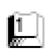
   Two functions exist that allow the surveyor to effectively "turn the page" of the field book to any of the previously recorded data screens. The ***Page Backward*** and ***Page Forward*** will display each recorded data screen (<<1>> and <<2>> for ***Page Backward*** and ***Page Forward*** respectively). The functions operate in a revolving manner, displaying the next/previously recorded screen in sequence depending on whether the surveyor is Paging Back or Paging Forward. The functions will also "revolve" past the end or beginning of the recorded data as the following illustration depicts:

```
 ← ← ← ← ←  PAGE BACKWARD  ← ← ← ← ←
→ → → → → → → → → → → → → → → → →

(beginning of file)           (end of file)

 → → → → →  PAGE FORWARD → → → → → →
← ← ← ← ← ← ← ← ← ← ← ← ← ← ← ← ←
```

This allows the user to page continuously in either direction where the paging does not end with either the beginning or the ending of the recorded data, similar to a Rolodex.

The function key map for the Header is:



	RECORD	Records the current data screen to the segment file on the field computer.
	PAGE BACK	Pages Backward through all recorded data screens, displaying them as recorded to the user
	PAGE FORWARD	Pages Forward through all recorded data screens, displaying them as recorded to the user.

(l) **Calibration** - (Survey Menu, Option 2)

The ***Calibration*** contains information about the environment, the field crew and the instrument being used. The Calibration is both useful and necessary to maintain a complete record of the condition of the environment during the survey. Since the Calibration also contains field crew information, its data can be used to determine who held what responsibility during the survey. The most important function of the Calibration pertains to the surveying instrument. It is at the time of Calibration that the user selects in EFB the electronic total station (if any). EFB will then set up the proper communications protocol for the selected total station. Systematic error testing is also performed for the instrument at the Calibration, if the testing option is chosen.

A Calibration is a required record after the Header, and must also be performed each time the user re-activates a segment. The axis test of the instrument should also be performed if the observer (instrument man) changes, if a duration of time passes since the previous test, or if significant environmental change has taken place. A new Calibration is required if the type of instrument has changed.

The systematic error testing implemented in the Calibration is performed for two types of instruments, an angle measuring device (theodolite, total station) and the level.

1. **Axis Testing**

The ***axis test*** in the Calibration is actually three tests designed to measure two systematic errors and one random error that occur when using an angle measuring instrument. The axis test answers the following questions:

- How well does an observer point at a target?
- What is the horizontal axis collimation error of the instrument?
- What is the vertical axis collimation error of the instrument?

It is important to note that a test for the observer's ability to read a vernier or scale for manual instruments is not tested! EFB was designed around electronic reading total station operations, where an observer's reading error is not a consideration, however reading

error of optical scales and micrometers is an important contributor of error in surveying operations and should be recognized as such.

The axis test provides data to the processing programs that allow for the appropriate reduction/correction of the raw observations for the determined error values. The results are also displayed to the user in a remarks screen and stored as a remarks record in the .RAW file immediately following the calibration record.

The axis test is comprised of pointing at a fixed target several times in the face 1 (***direct***) telescope orientation, then transiting the telescope and pointing at the same target an equal number of times in the face 2 (***reverse***) telescope orientation. The values of the horizontal and zenith angles to the target are used to perform the computations for the three errors described above.

CAUTION: Some instruments are not capable of performing this test, since their telescopes cannot be plunged or they are incapable of outputting a zenith angle if a distance is not measured (or if the telescope is in reversed or Face II direction). The GEODIMETER 140 is one such instrument. You must follow the instrument manufacturer's instructions for eliminating the collimation errors using their test procedures in such cases.

2. **Level Testing**

The ***level*** test (sometimes referred to as a *peg* test) is designed to test if the line-of-sight of a level is truly normal to gravity. This test is described in the *Florida Department of Transportation Location Manual*, Procedure 550-030-004. EFB prompts the user for rod readings on two rods (A & B) from different setups (SET1 & SET2), then instructs him to adjust the cross hairs if necessary.

Both axis and level testing are companion to the Calibration and the option to perform the test is selected from within the Calibration data screen.

The Calibration Screen:

```
   CALIBRATION  C:_
T:___ P:____W:______
O:___ B:__________
N:___ M:__________
R:___________
E:__ D:__ S:___
I:__________ L:_ A:_
MSG>
```

CALIBRATION Screen title

T	Temperature, input in degrees Fahrenheit
P	Atmospheric pressure, input in inches of mercury (Hg)
W	Weather code (see Weather Code Table)
O	Observers initials
N	Note keeper's initials
R	Rodman(s) initials(initial groups separated by a space example: R:HEC BMD CBM)
B	Brand of instrument (*toggle*)
M	Model of instrument (*toggle*)
I	Identification (serial number) of instrument
E	EDM absolute error value in millimeters manufacturer's specifications)
D	Distance dependent error in parts per million (ppm - per manufacturer's specifications)
S	Stadia constant for instrument (manufacturer's specifications)
L	Level testing (peg test) selector (**Y** or **N**)branches to the Test screen if **Y**es

A Axis testing (collimation, inclination and pointing) selector (**Y** or **N**) branches to the Test screen if **Y**es

C Comments indicator (**Y** or **N**), branches to comments screen pertaining to the Calibration

3. **Toggles**

A ***toggle*** is used to reduce the number of key-strokes to input the proper data, when the number of options for that data is limited.

Pressing a prompt letter key repeatedly (which is a toggle) will cycle the available data options in the data field. This process may be repeated until the desired option appears. Pressing ENTER is not required (because the cursor is in standby status, remaining in the message field) after using a toggle.

The first toggle we will discuss is found in EFB for the selection of the ***Brand*** and ***Model*** of instrument used for the surveying observations. Since EFB supports a limited number of total stations, a toggle is used to aid the surveyor with the selection of the instrument.

In Calibration, the B key will toggle through all the available supported **B**rands of electronic total station. When pressing the B key, other data fields are also changing, namely the model field, EDM standard error field, and the EDM parts-per-million error field. When a particular brand is selected, model is also a toggle and is limited to the valid instruments of the selected brand. The EDM standard error, parts-per-million error, and stadia factor are automatically input for all instruments currently supported in EFB.

If an instrument is not supported by EFB, use the Brand toggle to indicate the family the instrument belongs to ("Theodolite" for angle measuring devices, "Level" for levels), and manually key in the EDM standard error, ppm error, and stadia factor using the methods of editing a data field already presented.

4. **Weather**

Weather information is placed into the Calibration screen by editing the fields designated. The ***temperature*** is input in degrees Fahrenheit, and the ***pressure*** is input in inches of mercury. The ***weather code*** is a six digit number, where any single digit may only be a 0, 1, or 2. EFB automatically checks the ranges of the data for the weather items. For the weather code, EFB enforces the appropriate digits allowed for input. The weather code table is used to determine the weather code digits.

WEATHER CODE TABLE:

	CODE DIGITS			
	ITEM	0	1	2
1	PROBLEM INDICATOR	No Problem Encountered	Not Affecting Observations	Possibly Affecting Observations
2	VISIBILITY INDICATOR	Good (Over 15 mi.)	Fair (7 mi. To 15 mi.)	Poor (Under 7 mi.)
3	TEMPERATURE INDICATOR	Normal Range (32°F to 80°F)	Hot (Over 80°F)	Cold (Below 32°F)
4	CLOUD COVER INDICATOR	Clear (Below 20 %)	Partial (20% to 70%)	Overcast (Over 70%)
5	WIND INDICATOR	Calm (Under 5 mph)	Moderate (5 mph to 15 mph)	Strong (Over 15 mph)
6	HUMIDITY INDICATOR	Dry (Below 30%)	Normal (30% to 70%)	Muggy (Over 70%)

The weather code has six digits, each digit being either a **0**, **1** or **2**. The sequence of digits is read from the left side of the table, where the first digit in the code corresponds to the problem indicator, the second to the visibility, and so on.

An example weather code for a day where:

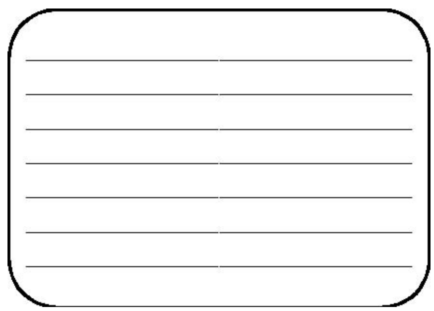
- The weather is possibly affecting observations
- fair visibility
- very cold temperature (18 degrees F.)
- clear sky
- strong winds
- moderate humidity

would be input as: 212021

The Calibration screen is a data screen, therefore the use of the screen manager data input into the remaining data fields is the same as discussed earlier. The data fields are entered by pressing the appropriate key corresponding to the prompt letter. When editing of the field is complete, pressing <<enter>> places the cursor into standby status in the message field. A message in the message field will indicate the action taken when a prompt letter key is pressed.

5. **Comments**

Comments for a Calibration, and all remaining data screens that will be discussed are handled by a *branch* to a long *field screen*, which is performed by selecting the <<c>> prompt letter key. When the <<c>> prompt key is pressed, the message field responds and asks whether or not the user desires to make ***comments***, which is replied by either a ***Y*** for yes, or a ***N*** for no. If the reply is yes, the branch is made to the comments field for editing. This field is edited in the same manner as any other data field, except that it is presented as an entire screen. The un-edited field looks like:



When finishing editing, press <<enter>> to store the comment. The user may return to any comments field previously edited, and resume editing by the same process.

6. **Functions Available: Calibration**

a. **Record**

The ***Record*** function is used to record the contents of a data screen to the segment file (***filename.RAW***) located on the RAM disk. When selected, the Record function checks the contents of the data screen to ensure that the required data are input in the right format. If an error is detected, the surveyor is warned with the appropriate message printed in the message field. If an attempt to record the data screen is successful, the number of available bytes on the RAM disk is displayed in the message field. The Record function will always be on <<0>>, for all data screens.

b. **Page Back/Page Forward**

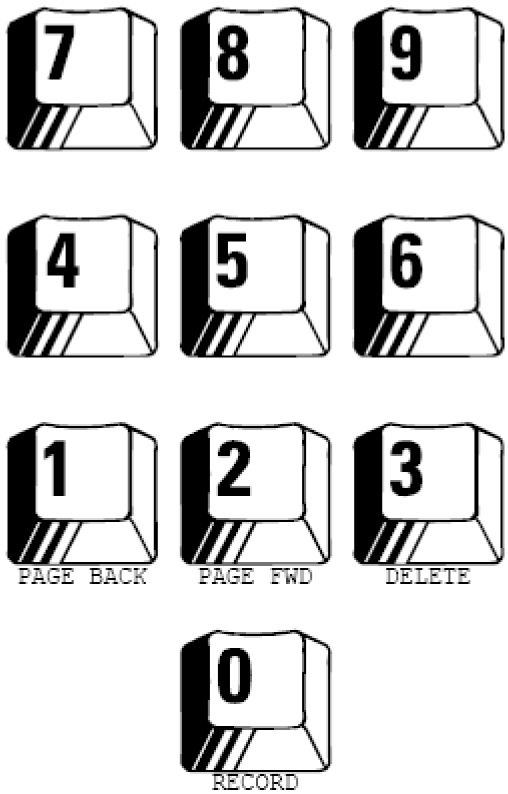
Two functions exist that allow the surveyor to effectively "turn the page" of the field book to any of the previously recorded data screens. The ***Page Backward*** and ***Page Forward*** will display with each press of the function key (<<1>> and <<2>> for Page Back and Page Forward respectively) the next/previously recorded screen in sequence.

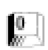
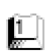
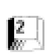
c. **Delete**

The ***Delete*** function places a delete tag in the current record. This causes two things to happen. First, the ***display list*** is modified so that a delete-tagged record cannot be viewed again on EFB. Secondly, the records tagged as deleted will be ignored by the processing software. All tagged observations will remain in the .RAW file as part of the permanent record of the survey. The .RAW file can be converted to an ASCII .OBS file, which may be opened with a text editor and all records, tagged and untagged, may be viewed.

To delete a record in any screen that supports the Delete function, page to the recorded data screen with the Paging functions. Select the Delete function by pressing the <<3>> key on the numeric keypad. EFB will then require two (2) levels of confirmation by responding to **Y**es/**N**o prompts in the message field before the record is deleted. For the data screens that support the Delete function, this function will always be located on <<3>>.

The function key map for the Calibration is:



	RECORD	Records the current data screen to the segment file on the field computer.
	PAGE BACK	Pages Backward through all recorded data screens, displaying them as recorded to the user
	PAGE FORWARD	Pages Forward through all recorded data screens, displaying them as recorded to the user.

Delete — Deletes the data screen from the display list and tags the permanent record.

Reminder: When a screen is recorded, the EFB will respond with a message of the remaining space in bytes.

(m) **Test Operations - (Survey Menu, Option - 3)**

When either the Axis or Level test is selected (only one may be selected for each Calibration record) by toggling the prompt to **Y**es, the Test screen is spawned as soon as the Calibration is recorded. Then the following screen appears:

```
    Axis Test  M:_
H:____________ N:__
V:____________ I:_

    Level Test
A:______ B:______
C:______ D:______
MSG>
```

- Test Mode (**A**xis or **L**evel) selected in Calibration
- Horizontal direction in DDD MM SS.S format
- Vertical direction in DD MM SS.S format
- Number (1,2,...) of *recorded* pointing for the current telescope orientation
- Current telescope orientation (**D**irect or **R**eversed)
- Rod reading for Setup 1, Rod A in Level Test
- Rod reading for Setup 1, Rod B in Level Test
- Rod reading for Setup 2, Rod A in Level Test

`Rod reading for Setup 2, Rod B in Level Test`

The operation of the instrument in test mode will depend on the test selected (Axis or Level).

1. **Executing Axis Test**

   To perform the Axis Test, using either manual key-in, or by using the automatic total station, the horizontal and zenith direction to a target must be ***pointed*** a number of times. The objective is to measure the direction to a target at least one time in both the direct and reversed telescope orientation. In this way the effects of systematic error in the instrument may be computed by the processing programs. Corrections are then applied automatically to the survey observation data to counter the effects of the systematic errors in the instrument. The second objective of axis testing is to model (by computing standard deviations from the mean direction(s) pointed) the observer's ability to precisely point on a target, both horizontally and vertically. Therefore, it is desirable to make more than one pointing to the target for both direct and reversed telescope orientations.

   The following steps are taken to complete the Axis test:

   - Point the instrument at a fixed target, beginning in either Direct or Reversed telescope orientation.

   - Manually key in the Horizontal and Zenith direction to the target, or ***Poll*** (see function description) the total station to make a measurement. The Telescope orientation (**D** or **R**) will be maintained automatically for you by EFB.
   - If you are satisfied with the values on the screen, record the test data using the Record function. EFB will notify you if the telescope orientation has been changed if this is the first time an Axis test pointing has been made. The number of recorded pointings made with the telescope in the first orientation is incremented (1,2,3,...) and displayed in the N: field.
   - Repeat steps 1) through 3) until you are ready to change telescope orientations.

   - When the telescope orientation is changed to the opposite face as in steps 1) through 4) and a pointing made, EFB will notify the user in the message field.

- Repeat steps 1) through 3) in the opposite telescope orientation. The number of recorded pointings will then decrement (...,3,2,1) until an equal number of pointings has been made. When an equal number of pointings in the opposite telescope orientation has been made and recorded, EFB notifies the user that the test is complete.

Consider the axis test shown in the following table:

	Horizontal			Zenith		
D	0	0	1.0	105	0	10.0
D	0	0	1.0	105	0	12.0
D	359	59	58.0	105	0	10.0
D	0	0	1.0	105	0	12.0
R	180	0	1.0	254	59	46.0
R	179	59	57.0	254	59	48.0
R	179	59	54.0	254	59	45.0
R	180	0	2.0	254	59	45.0

The remark screen:

```
       REMARKS
R:Axis Test;    N:   4
 HD    0  0   0 SD 1.5
 HR 179 59 58 SD 3.7
 VD 105  0 11 SD 1.2
 VR 254 59 46 SD 1.4
 COR H  -1.0 V   1.5
```

The message "`Check Results`!" will be displayed when the collimation correction is large, or the standard deviations of the pointings are larger than the collimation correction values.

If the user exits testing, he will not be allowed to record any additional data until the testing is completed. He may return to the test at any time from the Survey Menu to complete the testing and the Calibration.

2. **Functions Available: Axis Test**

a. **<u>Record</u>**

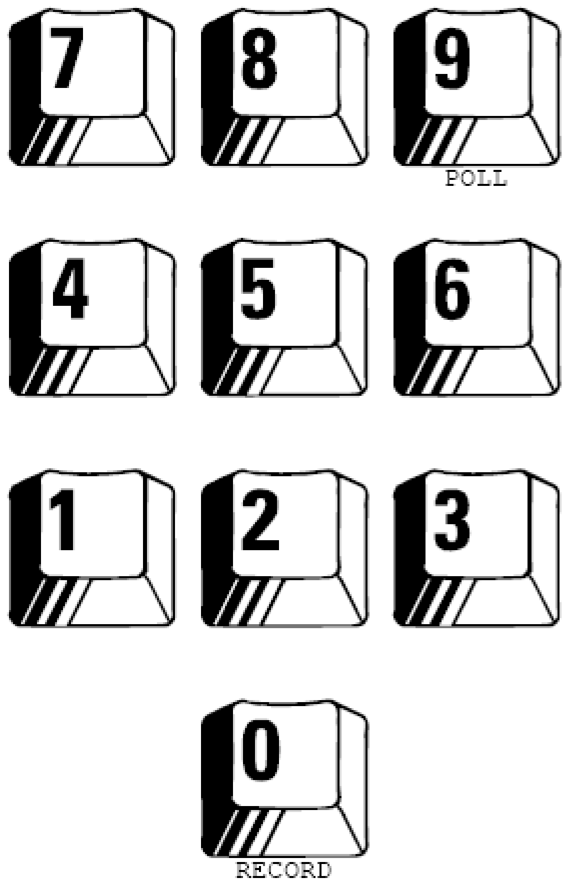
The ***Record*** function is used to record the contents of a data screen to the segment file (*filename.RAW*) located on the RAM disk. When the Record function is selected, the function checks the contents of the data screen to ensure that the required data is input, and in the right format. If an error is detected, the surveyor is warned with the appropriate message printed in the message field. If the attempt is successful, the number of available bytes on the RAM disk is displayed in the message field. The Record function is on <<0>>, for all data screens.

b. **<u>Poll</u>**

If your total station is one of the Brand/Models supported by the EFB, to ***poll*** the total station to measure, use 9. The poll function invokes the measurement process on the total station *remotely* via an interface cable. The data are then transmitted to the field computer over the same cable when the measurement cycle is complete. The data are placed on the display screen for review.

Some electronic total stations require that the instrument be placed in the correct operational mode to make a measurement. Once the instrument is placed in the correct mode (either manual or automatically - consult your instrument documentation and APPENDIX A of this document for details), press <<9>> to request measurement data. Appendix A contains a listing of supported total stations, and short form instructions on their operation.

The function key map for the Axis Test is:



RECORD	Records the current data screen to the segment file on the field computer
POLL	Initiates the measurement cycle on automatic total stations supported by EFB

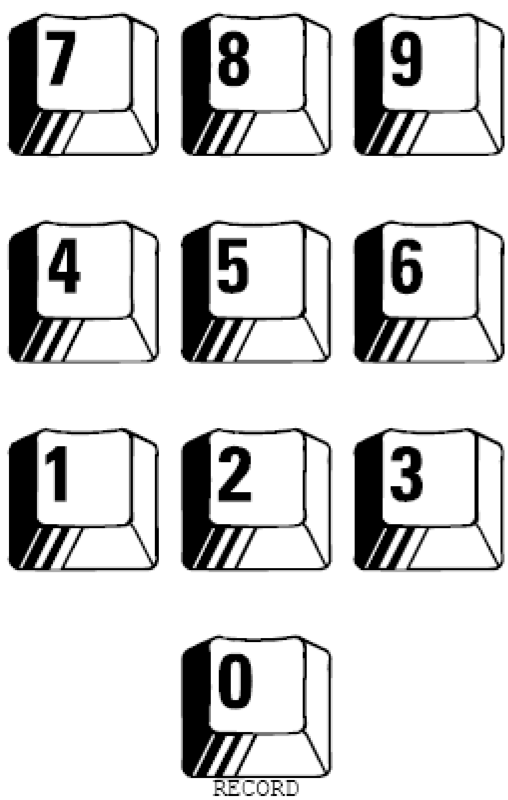
3. **Executing Level Test**

To perform the Level Test, the user is required to key in four (4) rod readings, on a set of rod(s) designated ***A*** and ***B***. The first two readings are made from a setup (***SET1***) on line and midway between the rods. After the rod readings on ***A*** and ***B*** are keyed into their appropriate fields A: and B:, the level is moved (to ***SET2***) very near the rod designated as rod ***A***. Two additional rod readings are made on ***A*** and ***B*** and are keyed into the test screen in fields C: and D:, respectively. When the screen is recorded, the line of sight is computed. If the level is out of adjustment, EFB instructs the surveyor to move his cross hair to the *correct* reading for ***SET2*** rod ***B***.

4. **Functions Available: Level Test**

Record - The ***Record*** function is used to record the contents of a data screen to the segment file (*filename.RAW*) located on the RAM disk. The Record function checks the contents of the data screen to ensure that the required data are input in the right format. If an error is detected, the user is warned with the appropriate message printed in the message field. If the record attempt is successful, the number of available bytes on the RAM disk is displayed in the message field. The Record function will always be located on <<0>>, for all data screens.

The function key map for the Level Test is:



 RECORD Records the current data screen to the segment file on the field computer

(n) **Setup - (Survey Menu, Option - 4)**

The Setup is a record used to store the location of the instrument setup. The Setup is used for both theodolite (HVD) and leveling (SOR) operations. The required data for a Setup includes the name of the occupied point, the geometry, attribute, zone, and the measured instrument height above the mark. The measured instrument height is usually not of significance for *differential* leveling operations, but becomes critical in theodolite operations where *trigonometric* leveling is done.

The geometry, attribute and zone defaults (P, G, 1) are shown in the sample screen.

Note: A new Setup record is mandatory after each Calibration, even if the location of the instrument is unchanged.

The Setup screen:

```
METRIC   SETUP  C:N
N:________G:PA:GZ:1
F:____________________
B:________________
I:______


MSG>
```

SETUP Screen title

 User assigned point name (point naming previously discussed)

 Geometry (P - point, C - curve, as discussed previously, Note that this is at toggle!)

 Attribute (G - ground point, F – feature point, U - user defined, as discussed previously. Note, this is a toggle!)

Zone (1 through 9, as discussed previously)

Comments indicator (Y - yes, N - no, branches to ‘Comments’ screen)

Feature code (discussed previously)

Reference name (discussed previously)

Instrument height (measured in feet) above the mark

The coordinates (XYZ or XY or Z) of the setup must be determined by the processing programs, and are dependent upon the observations made to control points, or points previously observed or occupied. These types of observations will be discussed throughout this user guide and the EFB processing user guide, and are referred to as ***redundant observations***.

A ***redundant observation*** is any observation made to

- a control point
- a previous or future setup point
- any point that has been observed from another setup.

Redundant observations are very important because they make up the survey ***network*** and are used to solve the coordinates of the setup points, from which all side shots will later be computed. Redundant observations are also used in the computation of the statistics about the accuracy and precision of the survey. The more *over-determined* the solution is, the stronger the statistical profile of the solution.

The surveyor must use good field judgement to determine how many observations should be made of a point to solve its coordinates and eliminate errors (*blunders*), yet avoiding wasted observations. It is recommended as a minimum that the surveyor make one direct and one reversed telescope pointing to each redundant point (for theodolites) which will barely account for systematic errors.

For leveling observations (surveying with a level), the XY coordinates are seldom able to be determined (due to inappropriate observations), and only the Z ordinate will be solved. The *usability* of the Z ordinate of the mark below the setup for trigonometric leveling is strictly dependent on the accuracy with which the height of the instrument over the setup point is measured.

Note: The Setup record requires an instrument height measurement. Since this value is measured by hand and entered by hand, great care in obtaining it must be stressed. An error in this value will cause an error in the computed elevations of all points observed from that setup and in the setup itself, and will propagate throughout the network. The instrument height for spirit leveling is usually irrelevant, because the level usually does not occupy a defined point. Thus any convenient value may be entered for a level setup.

Functions Available: Setup

a. **Record**

The ***Record*** function is used to record the contents of a data screen to the segment file (***filename.RAW***) located on the RAM disk. When selected, the Record function checks the contents of the data screen to ensure that the required data is input in the right format. If an error is detected, the surveyor is warned with the appropriate message printed in the message field. If an attempt to record the data screen is successful, the number of available bytes on the RAM disk is displayed in the message field. The Record function will always be located on <<0>>, for all data screens.

b. **Page Back/Page Forward**

Two functions exist that allow the surveyor to effectively "turn the page" of the field book to any of the previously recorded data screens. The ***Page Backward*** and ***Page Forward*** will display with each press of the function key (1and 2for Page Back and Page Forward respectively) the next/previously recorded screen in sequence.

c. **Modify**

Modify allows the editing of certain fields on previously recorded screens. To use Modify, the user must page forward or page backward to the desired screen, then edit the field that needs correcting using the normal options for data entry/edit.

Once the data fields have been manually corrected, the modify function is selected by pressing <<6>>. EFB will require one confirmation before the modification takes place. The previous version of the Setup screen is removed from the display list (just like the delete function). Modify retains the previous version of the Setup data internally, and is marked in the field observation file (*jobname.OBS*) by the letter *M* in column two of the .OBS file (See file format specifications).

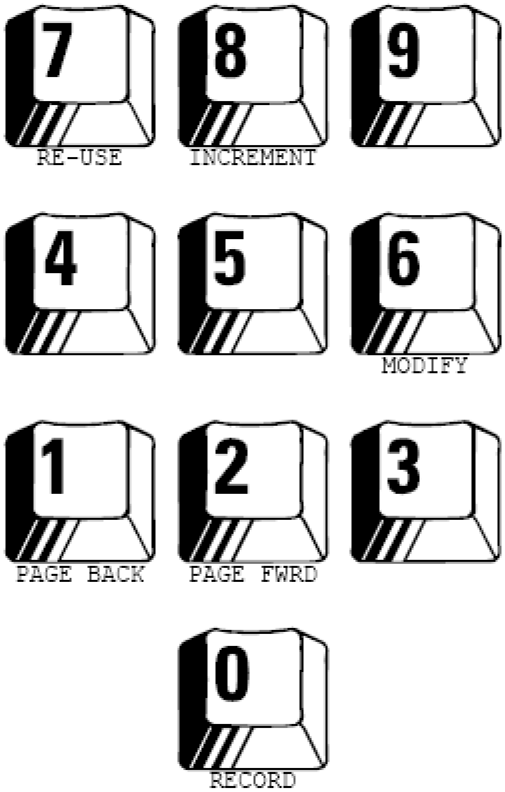
d. **Re-use**

Re-use allows the surveyor to re-use a point currently on the screen. This function may be used in combination with the roll and page functions to retrieve previously observed points. The re-use function would be used quite often during angle turning or leveling operations. Re-use retrieves the associated information about the point, to minimize unnecessary key-in of previously input information. Re-use is assigned to <<7>>.

e. **Increment**

Increment will fetch the next available suffix for the point name currently in the name field on the screen. Increment also maintains the associated data about a point, but the user has the option after the Increment to change the associated information with normal field editing techniques as previously described. Increment is assigned to <<8>>.

The function key map for the <u>Setup</u> is:



RECORD	Records the current data screen to the segment file on the field computer
PAGE BACK	Pages Backward throughall recorded data screens, displaying them as recorded to the user.
PAGE FORWARD	Pages Forward through all recorded data screens, displaying them as recorded to the user.
MODIFY	Modifies the current data screen with the edits that were made, and tags

		the previous version as modified
	RE-USE	Allows the use of the current point information for additional Setups on that point
	INCREMENT	Increments point namesuffix of the current point name to the next available point name

f. OBSERVATIONS

Combinations of horizontal direction, zenith direction, distance (*slope* or *horizontal*), station, offset, and rod-reading (three wire support for upper hair, cross hair, and lower hair) are supported. The valid observation type combinations are as follows:

```
HVD      SOR
HD       SO
HV       R
VD
H
D
```

The letter **H** represents a measurement of the horizontal direction to a point from the setup, **V** represents the zenith direction, and **D** represents the distance. Station-offset location is also represented by **S**, **O**, and **R** where station, offset, and rod reading combinations are supported. Since HVD is different from SOR, two types of Observation screens are provided in the EFB. They are selected from the SURVEY menu as HVD-Obs and SOR-Obs.

(o) **HVD Observations**

```
SETUP1  M:HVDR:FC:N
N:________G:PA:GZ:1
F:__________________
B:________________
H:_________T:_______
V:_________E:_______
D:___________P: 1I:D
MSG>
```

In addition to the data fields the screen has two information items. At the upper left corner of the screen the current setup is displayed. This feature is also active when paging through the data. Every HVD or SOR observation in EFB knows implicitly the setup from which it was made. This was accomplished with the addition of a temporary file on the collector which has the segment name and an extension of .STP. This file can be ignored by the user.

At the bottom of the screen is the message **MSG** field which displays pointing errors for HVD and HV observations as soon as the HVD fields are filled. This is a test of the current horizontal direction, mark-to-mark elevation difference, and horizontal distance against the mean of those measurements previously recorded at the current setup, in position set number one. The absolute values of the results are displayed prior to recording to allow for remeasuring if the results are not satisfactory. After recording, the message field displays the remaining memory. When a point name from the current setup is reused the message "Mult. Turns" appears in the message block. This message disappears when a data field is selected for subsequent observations.

Consider the following data for three observations to the same point from the current setup that have already been recorded, assuming an instrument height of 1.524 m:

```
SETUP1  M:HVDR:FC:_
N:POINT1__G:PA:GZ:1
F:__________________
B:________________
H: 70 45 37T:  1.045
V: 89 31 24E:_______
D:  511.210 SP: 1I:D
MSG>44449792 Free
```

```
SETUP1  M:HVDR:FC:_
N:POINT1__G:PA:GZ:1
F:__________________
B:________________
H:250 45 25T:  1.045
V:270 28 47E:_______
D:  511.230 SP: 1I:R
MSG>H012 D.020 Z.035
```

```
SETUP1  M:HVDR:FC:_
N:POINT1__G:PA:GZ:1
F:__________________
B:________________
H: 70 45 34T:  1.045
V: 89 31 23E:_______
D:  511.250 SP: 1I:D
MSG>H003 D.030 Z.015
```

If the fourth repetition looked like the following screen then the message field would display:

```
SETUP1   M:HVDR:FC:_
N:POINT1__G:PA:GZ:1
F:__________________
B:________________
H:250 45 22T:  1.045
V:270 28 49E:_______
D:  511.230 SP: 1I:R
MSG>H010 D.000 Z.027
```

The results are displayed as soon as the HVD fields are completed and prior to recording, so that the reasons for unsatisfactory tests can be determined and the point remeasured if necessary.

When EFB detects a traverse condition, that is when the instrument moves ahead to a point observed from a previous setup (not necessarily the last occupied point), EFB will compute the difference in horizontal distance between the two setups and the mark-to-mark elevation difference if a complete HVD observation to the previous point is made. This helps to ensure that the correct SETUP/POINT pair has been identified, and that the instrument and target heights are reasonable. EFB displays the message "Traverse Point" in the message block as soon as the previous setup point is entered in the name field. The computation takes place at the first HVD observation to SETUP from POINT, and prior to recording.

Continuing the example from above, the following can be computed from the data:

mean horizontal distance:	511.212 m
mean mark-to-mark elevation change:	4.748 m

If the instrument is moved ahead to POINT1 and an observation to SETUP1 is made, a typical screen would look like:

```
POINT1  M:HVDR:FC:_
N:SETUP1__G:PA:GZ:1
F:__________________
B:________________
H:359 49 31T:  1.567
V: 90 32 39E:_______
D:  511.250 SP: 1I:D
MSG>D0.015 Z0.151
```

In the above screen, the Z value is fairly high and indicates a possible error measuring the height of target or height of instrument. In such a case, the cause should be investigated while in the field.

- [N] User assigned point name (point naming was previously discussed)
- [G] Geometry (P - point, C - curve, as discussedpreviously)
- [A] Attribute (G - ground point, F - feature point, X-cross section, as discussed previously)
- [M] Mode of measurement (HVD, HD, HV, VD, H, D) toggle
- [R] Distance Resolution (F - fine or C - coarse)toggle for instruments that support this option
- [Z] Zone (1 through 9, as discussed previously)
- [C] Comments (Y - yes, N - no, branches to a commentsscreen)
- [F] Feature code (discussed previously)
- [B] Reference name (discussed previously)
- [H] Horizontal direction in Degrees, Minutes, andSeconds
- [V] Zenith direction in Degrees, Minutes, and Seconds
- [D] Distance in US Survey feet (with suffix of S-slope, H-horizontal) note: defaults to slope distance
- [P] Position set number
- [I] Telescope orientation (D - direct, R - reversed)
- [T] Target height in feet (a negative [-] target height indicates the target is below the object

being located by the amount entered).

- Eccentricity of target to the object (Left, Right, Front, or Back)

1. **Components of The HVD Observation**

a. **Eccentricity**

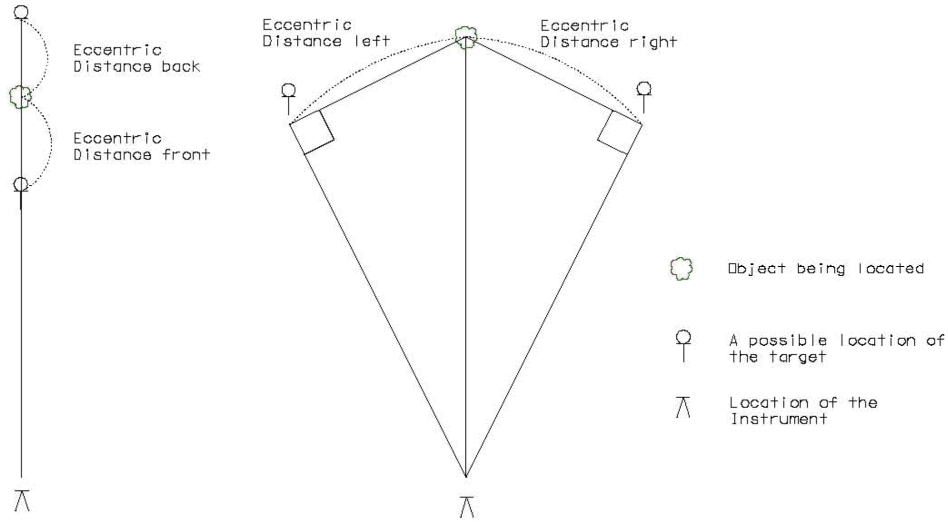
In some cases when making field measurements, it becomes impossible for the rodman to physically occupy the center of an object that will be located. For this reason, ***eccentricity*** (rod target is eccentric to the object) is employed as an option for some HVD observation types (HVD, HD).

Eccentricity is the measured distance from the target to the object. The line projected between the instrument and the object defines a primary axis, and a secondary axis is defined by a line projected between the instrument and the target being located orthogonal (90 degrees) through the secondary axis to the object. Directions **F**ront, and **B**ack are measured along the primary axis, where *front* is on line between the instrument and the object being located; *back* is on line behind the object. Eccentric observations measured **L**eft, and **R**ight are from the secondary axis with respect to the instrument's point of view. The default is front.

The following diagram will illustrate how eccentricity is referenced. The target is either *left* of, *right* of, *front* of, or *back* of the object being located.

Note: the software traps on input for values greater than 30.00 feet or 9.999 meters, which was selected as the greatest distance the rodman could measure with ordinary equipment while maintaining orthometric orientation to the object and instrument. An explicit value of ten meters will return the message "ERROR Too Large!" The value 9.999 will return 10.00 to the display and will be accepted.

The eccentricity is keyed in as the eccentric distance, followed by the eccentric orientation of the target.



Some example eccentric key-ins would be:

`9.99F`	`for a target 9.99 meters in front of the object`
`6.61L`	`for a target 6.61 meters to the left of the object`
`5R`	`for a target 5.00 meters to the right of the object`

Note that there are only a few options for eccentricity, so when the field is activated, the keyboard is enabled only for L, R, F, B, the numerals and ENTER.

b. **Directions**

The direction fields are filled by the user in the same manner a with previous data screens. If an electronic total station is used, the data fields for the horizontal direction, zenith direction and distance may be filled automatically when the *Poll* function is used. If manual data input is required, angular values are input in degrees, minutes and seconds. A space separates the components of the angle during key-in. Some example key-ins would be:

`123 53 27`	`for a direction of 123 degrees, 53 minutes, 27 seconds`
`90`	`for a direction of 90 degrees, 0 minutes, 0 seconds`
`160 25`	`for a direction of 160 degrees, 25 minutes, 0 seconds`

EFB will check to see if an angular value exceeds the limits for maximum degrees (359), maximum minutes (59), or maximum seconds (59.9). The greatest direction value that may be input then is 359° 59' 59.9"; an angular value input of 360° 00' 00" is converted to 0° 00' 00".

If a key-in error is detected, EFB warns the user, and will not allow the erroneous data to be recorded. Zenith angles are automatically checked against the setting for telescope orientation. If the telescope orientation is incorrect for the zenith angle entered, the orientation is toggled automatically and a warning is issued.

c. **Distances**

Distances are input in a manner similar to eccentric distances. The distance value is followed by the type of distance measured (***H*** - horizontal, ***S*** - slope). The default is slope. Some example key-ins would be:

`125.362H`	`A Horizontal distance of 125.362 meters`
`266.28`	`A Slope distance of 266.280 meters`
`987S`	`A Slope distance of 987.000 meters`

If the total station is used, generally the slope distance is transmitted to EFB, and will appear in the Observation screen as such.

d. **Telescope Orientation**

There are only two choices for telescope orientation, ***Direct*** (face I) and ***Reversed*** (face II). Because these choices are limited, the Observation data screen employs a toggle between ***D*** and ***R***, representing direct and reversed, respectively. The telescope orientation is compared to the value of the zenith direction, and toggled automatically if incorrect.

Note: EFB currently supports only zenith angle reading instruments where the zenith is 0 degrees.

e. **Multiple Positions**

Turning multiple positions of the horizontal circle and making multiple observations of a point requires that a point name be *re-used* each time the same point is observed from a given Setup. For this reason, several functions are available to help the user with managing point names and will be discussed later.

Before covering name handling functions, the operation of the ***Position Set Number*** toggle will first be discussed.

The position set number is the number of times the horizontal reading circle has been physically moved (*advanced*). The position set number is allowed to increase in increments of one only, beginning with position number 1. Once the circle has been moved, it is extremely unlikely that it can be reset to the same previous reading *exactly*.

WARNING: If the plates of an instrument have changed <u>electronically</u> by either re-zeroing on a different back sight, or by error, the user <u>must</u> change the position set number for data to be reduced properly!

The position set number is on a toggle key, <<P>>, corresponding to the prompt letter on the HVD Observation screen. The position set number begins with 1, and will toggle back and forth between the current setting and the next higher setting (current setting + 1) until an observation is recorded at the higher setting. When the observation with the higher position set number is recorded, the toggle is increased by one. When the p toggle is selected the message field will display "Confirm? [Y/N]". The user must respond either way to proceed. This is to prevent inadvertently advancing the set number. An example shows how the toggle operates:

```
Operation                Toggle

initial setting        1 <--> 2
record observation     1 <--> 2
with P.S.N. = 1        1 <--> 2
                       1 <--> 2
                       1 <--> 2
record observation     2 <--> 3
with P.S.N. = 2        2 <--> 3
                       2 <--> 3
record observation     3 <--> 4
with P.S.N. = 3        3 <--> 4
```

f. **Measurement With Electronic Total Stations**

If the total station the surveyor is using is supported by EFB, measurement data may be electronically transmitted to the field computer, via the survey data-link cable. (See APPENDIX A for specifications)

Some total stations allow the EFB to set the mode of measurement, while with others the measurement mode must be selected manually. Nearly all total stations support bi-directional communication and therefore may be *polled* to measure and transmit data.

2. **Functions Available: HVD Observation**

a. **<u>Record</u>**

The ***Record*** function is used to record the contents of a data screen to the segment file (***filename.RAW***). When the Record function is selected, the function checks the contents of the data screen to ensure that the required data is input, and in the right format. If an error is detected, the appropriate message is printed in the message field. If an attempt to record the data screen is successful, the number of available bytes on the RAM disk is displayed in the message field. The Record function will <u>always</u> be located on <<0>>, for all data screens.

b. **<u>Page Back/Page Forward</u>**

Two functions exist that allow the user to effectively "turn the page" of the field book to any of the previously recorded data screens. The ***Page Backward*** and ***Page Forward*** will display with each press of the function key (1and 2for Page Back and Page Forward respectively) the next/previously recorded screen in sequence depending on whether the direction is forward or back.

c. **<u>Delete</u>**

The ***Delete*** function places a delete tag in the current record. This causes two things to happen. First, the ***display list*** is modified so that a delete-tagged record cannot be viewed again on EFB. Secondly, the records tagged as deleted will be ignored by the processing software. All tagged observations will remain in the .RAW file as part of the permanent record of the survey. The .RAW file can be converted to an ASCII .OBS file, which may be opened with a text editor and all records, both tagged and untagged, may be viewed.

To delete a record in any screen that supports the Delete function, page to the recorded data screen with the Paging functions. Select the Delete function by pressing 3on the numeric keypad. EFB will then require 2 levels of confirmation by responding to **Y**es/**N**o prompts in the message field before the record is deleted. For the data screens that support the Delete function, this function will always be located on <<3>>.

d. **<u>Roll</u>**

Roll allows the recall and use of pre-observed Point Names and their associated attribute information (Reference Name, Feature Code, Geometry, Attribute, and Zone fields) on the HVD screen. What takes place is the last used suffix (1, 2, 3 ... n) for any given prefix (TREE, FH, CL, etc.) is saved off in a temporary memory area when EFB is running. Note that when you stop running EFB and exit the program, the list is lost. The point names and their data are then available when the roll keys are pressed. Since the name/information data is added chronologically to the Roll list as each prefix is used, a Roll Forward and Roll Backward function is implemented to move you through the available name prefixes and their data. The Roll buffer is a circular list, like a “Rolodex” so either Roll Forward <<5>> or Roll Backward <<4>> will reach all of the available names. Once a name prefix is located, then the Re-Use <<7>> or Increment <<8>> function would be used to get the same name or next available name respectively.

e. **Modify**

Modify allows the editing of certain fields on previously recorded Observation screens. To use Modify, the user must page forward or page backward to the desired Observation screen, then edit the desired fields using the normal options for data entry/edit.

All fields on the Observation screen are modifiable except:

- `point name field`
- `measurement fields (horizontal angle, zenith angle, distance)`

Once the data fields have been corrected manually, the modify function is selected by pressing <<6>>. The original record is tagged and the display list modified to prevent viewing of the unmodified data on the field computer. Tagged data is also ignored by the processing software. All original data, including deleted and modified records, are retained and are available for review and analysis.

f. **Re-use**

Re-use allows the surveyor to re-observe a point currently on the Observation screen. This function may be used in combination with the roll and page functions to retrieve previously observed points. The re-use function would be used quite often during angle turning and leveling operations. Re-use retrieves the associated information about the point, to minimize unnecessary key-in of previously input information. Re-use is assigned to <<7>>.

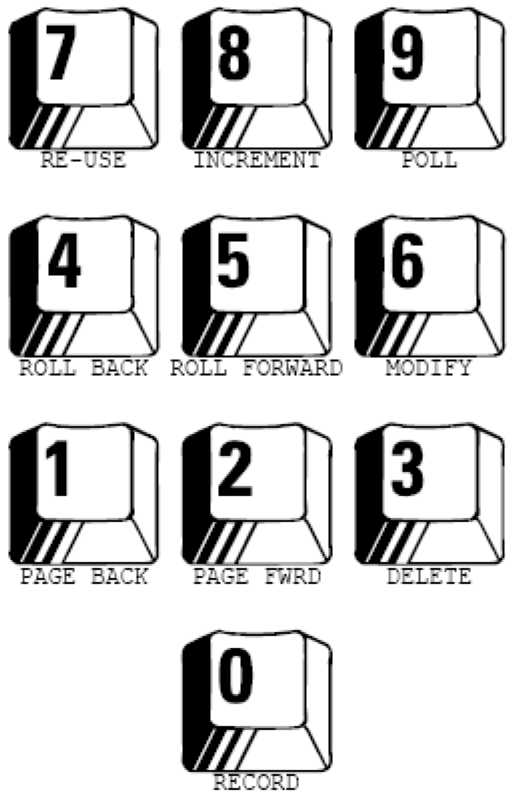
g. **Increment**

Increment will return the next available suffix for the point name currently in the name field on the screen. Increment also defaults the attribute data about a point from the previous use of the point name, but the user has the option after the Increment to change the associated information with normal field editing techniques as previously described. Increment is assigned to <<8>>.

h. **Poll**

For all supported total station Brand/Models, the ***poll*** function is assigned to <<9>>. The poll function invokes the measurement process on the total station *remotely* via an interface cable. The data are then transmitted to the field computer over the same cable when the measurement cycle is complete. The data will be placed on the display screen for review.

Some electronic total stations require that the instrument be placed in the correct operational mode before the instrument is used to make a measurement. Once the instrument is placed in the correct mode (either manual or automatically - consult your instrument documentation and APPENDIX A of this document for details), press <<9>> to request measurement data. Appendix A contains a listing of supported total stations, and short form instructions on their operation with EFB.

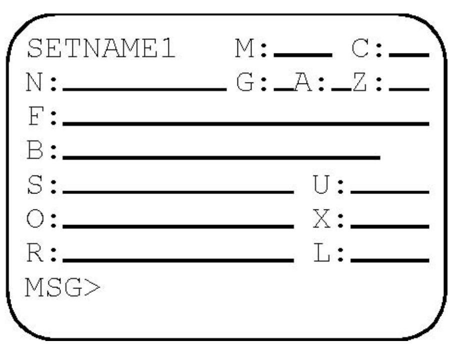


The function key map for the <u>HVD-Observation</u>

	DELETE	Records the current data screen to the internal record on the EFB.
	PAGE BACK	Displays each screen in reverse order of recording.
	PAGE FORWARD	Displays each screen in order of recording.
	DELETE	Marks the current data screen and Observation as deleted so not to be used in processing.

	ROLL BACK	Rolls the Point Name/Data list in backward chronological order
	Roll Forward	Rolls the Point Name/Data list in forward chronological order
	MODIFY	Modifies the current data screen with the edits that were made, and marks the previous version a modified.
	RE-USE	Allows the use of the current point information for additional Observations to that point.
	INCREMENT	Increments the point name suffix of the current point name to the next available point name
	POLL	Initiates the measurement cycle on automatic total stations supported by EFB

(p) SOR Observations - (Survey Menu, Option - 6)



- User assigned point name (point naming was previously discussed)
- Geometry (P - point, C - curve, as discussed previously)
- Attribute G - ground point
F - feature point
U - User defined
- Zone (1 through 9, as discussed previously)
- Mode (SOR, SO, R) of measurement toggle
- Comments (Y - yes, N - no, branches to a comments screen)
- Feature code (discussed previously)
- Reference name (discussed previously)
- Station of point with reference to the Route (alignment)
- Offset ([-] left of Route) of point with reference to the Route
- The name designation of the Route, a stationed chain
- Upper wire reading on the level rod
- Cross hair reading on the level rod
- Lower wire reading on the level rod

The SOR observation screen is ordinarily a *manual* key-in Observation screen. This screen is used to take the variety of SOR Observations (SOR, SO, R) depending on the mode selected, indicated by the **Mode** toggle. The SOR screen may be used to perform level runs when set to the R mode. The mode, as with the HVD screen, determines the required data necessary to record the screen to the RAM disk. Support of three-wire leveling includes built-in checks for the rod readings, and a stadia distance computer (provided the stadia interval factor was entered in Calibration).

1. **Components of The SOR Observation**

a. **Route**

The ***Route*** is the alignment (usually a stationed chain in the field, or a computed geometric chain stored in a Coordinate Geometry package) to which the point will be referenced by station and offset. If SO or SOR mode is used, then the Route name is required data. The name of the route should follow the same naming convention as a chain (prefix+suffix) if an EFB chain is used. If the route is to be computed in the office from a geometry package, the name may use any naming convention supported by that package, up to eight (8) characters in length.

b. **Station**

The ***Station*** is the linear distance *along* the route to which the point being observed is referenced. The station may be keyed in either station format (125+26.321) or the **+** may be omitted (12526.321). When E is pressed, either method of key-in will be converted to station and plus format in the screen.

c. **Offset**

The ***Offset*** is the perpendicular distance to the point being observed from the local tangent at the station specified along the route. The offset may be left of station (the number followed by an L) or may be right of station (the number followed by an R). The default is R. The offset may also be entered as a negative value for left. The default is positive for right. Reasonable maximum ranges have been set for the value of the offset (400 meters or 1200 feet).

Examples:

```
123.571  -    123.571 meters right of
              Station
123.571L -    123.571 meters left of station
335.403R -    335.403 meters right of
              station
-123.571 -    123.571 meters left of station
```

d. **Rod Readings**

The SOR screen has the ability to accept three-wire rod readings made on a level rod using a level. All *solvable* combinations of Upper wire, Cross hair, and Lower wire are acceptable (UXL, UL, UX, XL, X). EFB also checks UXL values to help prevent a rod misreading. If the stadia interval factor was input during Calibration, EFB computes the stadia distance to the level rod provided any two wires are keyed in. A maximum range for the value of a rod reading is set at around thirty (30) feet, and no rod reading of less than zero (negative values) is supported.

Rod readings may be read from an automatic electronic level. This function is implemented on the Poll key 9for electronic levels supported by EFB.

2. **Functions Available: SOR Observation**

a. **<u>Record</u>**

The ***Record*** function is used to record the contents of a data screen. When the Record function is selected, the function checks the contents of the data screen to ensure that the required data is input, and in the right format. If an error is detected, the surveyor is warned with the appropriate message printed in the message field. If an attempt to record the data screen is successful, the number of available bytes on the RAM disk is displayed in the message field. The Record function will always be located on 0, for all data screens.

b. **<u>Page Back/Page Forward</u>**

Two functions exist that allow the surveyor to effectively "turn the page" of the field book to any of the previously recorded data screens. The ***Page Backward*** and ***Page Forward*** will display with each press of the function key (<<1>> and <<2>> for Page Back and Page Forward respectively) the next/previously recorded screen.

c. **<u>Delete</u>**

The ***Delete*** function places a delete tag in the current record. This causes two things to happen. First, the ***display list*** is modified so that a delete-tagged record cannot be viewed again on EFB. Secondly, the records tagged as deleted will be ignored by the processing software. All tagged observations will remain in the .RAW file as part of the permanent record of the survey. The .RAW file can be converted to an ASCII .OBS file, which may be opened with a text editor and all records, tagged and untagged, may be viewed.

To delete a record in all screens that support the Delete function, page to the recorded data screen with the Paging functions. Select the Delete function by pressing <<3>> key on the numeric keypad. EFB will then require two (2) levels of confirmation by responding to **Y**es/**N**o prompts in the message field before the record is deleted. For the data screens that support the Delete function, this function will always be located on <<3>>.

d. **<u>Roll</u>**

Roll allows the recall and use of pre-observed Point Names and their associated attribute information (Reference Name, Feature Code, Geometry, Attribute, Zone fields) on the SOR screen. In addition, the last used Station and Route field are also preserved. For names, what takes place is the last used suffix (1, 2, 3 ... n) for any given prefix (TREE, FH, CL, ect.) is saved off in a temporary memory area when EFB is running. Note that when you stop running EFB and exit the program, the list is lost. The point names and their data are then available when the roll keys are pressed. Since the name/information data is added chronologically to the Roll list as each prefix is used, a Roll Forward and Roll Backward function is implemented to move you through the available name prefixes and their data. The Roll buffer is a circular list, like a "Rolodex" so either Roll Forward <<5>> or Roll Backward <<4>> will reach all of the available names. Once a name prefix is located, then the Re-Use <<7>> or Increment <<8>> function would be used to get the same name or next available name respectively.

e. **Modify**

Modify allows the editing of certain fields on previously recorded Observation screens. To use Modify, the user must page forward or page backward to the desired Observation screen, then edit the desired field using the normal options for data entry/edit.

All fields on the SOR screen are modifiable except:

- point name field

Once the data fields have been manually corrected, the modify function is selected by pressing 6. The previous version of the SOR screen is removed from the display list (just like the delete function). The previous version of the observation data is retained in the .RAW file, and is marked in the observation file (*jobname.OBS*) by the letter *M in column two of the .OBS file*.

f. **Re-use**

Re-use allows the surveyor to re-observe a point currently on the SOR screen. This function may be used in combination with the roll and page functions to retrieve previously observed points. The re-use function would be used quite often during angle turning and leveling operations. Re-use retrieves the associated information about the point, to minimize unnecessary key-in of previously input information. Re-use is assigned to <<7>>.

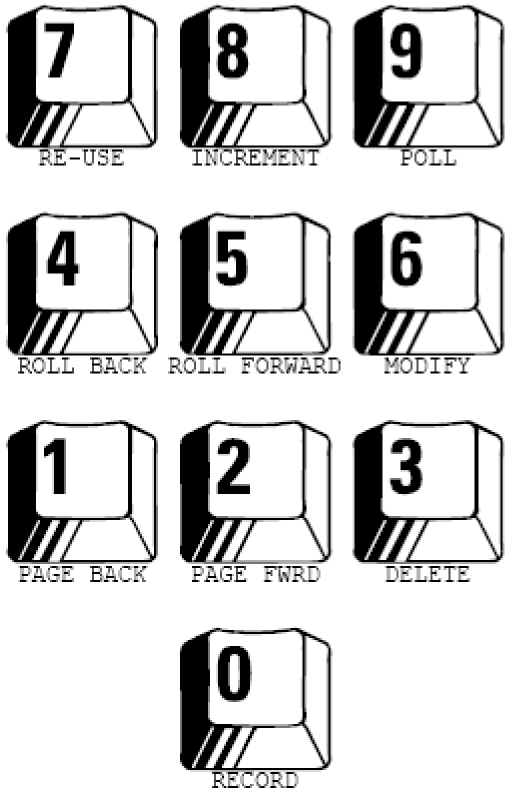
g. **Increment**

Increment will return the next available suffix for the point name currently in the name field on the screen. Increment also defaults the attribute data about a point from the previous use of the point name, but the user has the option after the Increment to change the associated information with normal field editing techniques as previously described. Increment is assigned to <<8>>.

h. **Poll**

For all supported Electronic level Brand/Models, the ***poll*** function is assigned to <<9>>. The poll function invokes the measurement process on the electronic level *remotely* via an interface cable. The data are then transmitted to the field computer over the same cable when the measurement cycle is complete. The data will be placed on the display screen for review.

The electronic levels supported by EFB measure a middle hair reading (X) and a distance to the rod. Since the SOR screen does not support the recording of a distance, the upper wire (U) and lower wire (L) are calculated internally by EFB and placed in the SOR screen. This takes place only if a Stadia factor was input during the calibration. The distance the instrument measured is also displayed to the user in the message field. Appendix A contains a listing of supported electronic levels, and short form instructions on their operation with EFB.



The function key map for the SOR-Observation

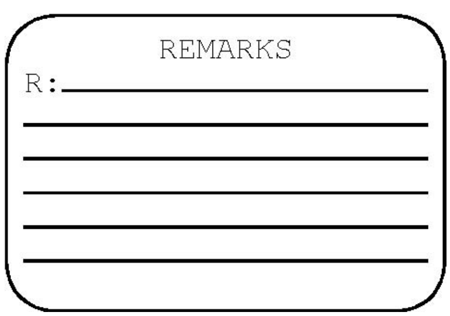
0	RECORD	Records the current data screen to the internal record on the EFB
1	PAGE BACK	Displays each screen in reverse order of recording.
2	PAGE FORWARD	Displays each screen in order of recording.
3	DELETE	Marks the current data screen and Observation as deleted so not to be used in processing

ROLL BACK	Rolls the point name / data list in backward chronological order
ROLL FORWARD	Rolls the point name / data list in forward chronological order
MODIFY	Modifies the current data screen with the edits that were made, and marks the previous version as modified
RE-USE	Allows the use of the current point information for additional Observations to that point
INCREMENT	Increments the point name suffix of the current point name to the next available point name

(q) **Remarks - (Survey Menu, Option - 7)**

Remarks allow the surveyor to input general remarks about anything of importance found in the field. The remarks do not have to be related to any particular observation, setup, etc. Since a comments field is available under most data screens, remarks may supplement the comments, if the comments are not sufficient.

The Remarks screen:



Functions Available: Remarks

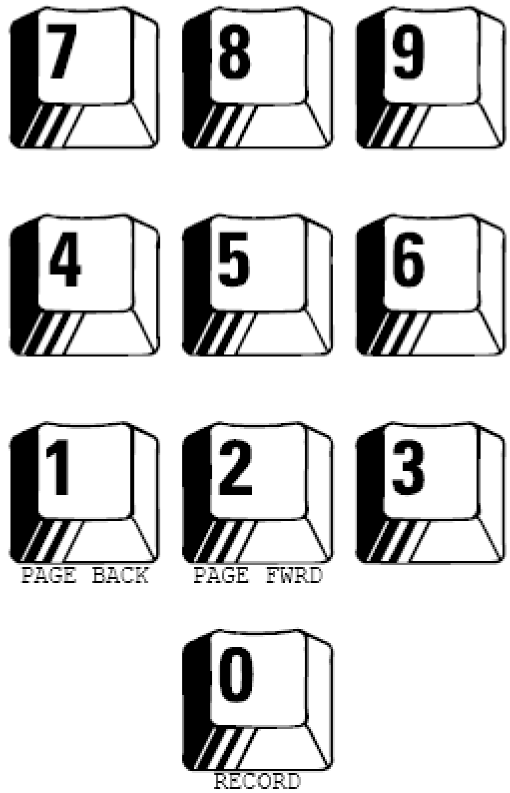
1. **<u>Record</u>**

   The ***Record*** function is used to record the contents of a data screen to the segment file (***filename.RAW***) located on the RAM disk. When the Record function is selected, the function checks the contents of the data screen to ensure that the required data is input, and in the right format. If an error is detected, the surveyor is warned with the appropriate message printed in the message field. If an attempt to record the data screen is successful, the number of available bytes on the RAM disk is displayed in the message field. The Record function will always be located on <<0>>, for all data screens.

2. **<u>Page Back/Page Forward</u>**

   Two functions exist that allow the surveyor to effectively "turn the page" of the field book to any of the previously recorded data screens. The ***Page Backward*** and ***Page Forward*** will display with each press of the function key (<<1>> and <<2>> for Page Back and Page Forward respectively) displaying the next/previously recorded screen in sequence.

The function key map for the Remarks is:



RECORD	Records the current data screen to the segment file on the field computer
PAGE BACK	Displays each screen in reverse order of recording.
PAGE FORWARD	Displays each screen in order of recording.

(r) **Chains - (Survey Menu, Option - 8)**

The rules for constructing chains have been presented earlier. The Chain screen is a data screen. Data fields in the Chain screen may be edited in the same manner as any other data screen. Internal checks for point name validity in chain lists and chain list syntax, are built into the EFB and help ensure that chains are properly listed and can be resolved during processing.

When editing the chain list, EFB checks the syntax of the list and verifies that points contained in the chain list actually exist. If a chain list is found to include point names that have not yet been observed, an error message is displayed requesting corrective action. Syntax errors in the chain list also result in an appropriate warning.

The Chain screen:

```
CHAIN P:_________C:_
N:_________  A:_ Z:_
F:____________________
S:___________
L:____________________
______________________
______________________
MSG>
```

P: Point prefix for points to be placed in chain list by the automatic chain builder

N: User assigned chain name (chain names must obey the same rules as point names)

A: Attribute G - ground chain (break line)
F – feature chain
U - user defined

Z: Zone (1 through 9, as discussed previously)

C: Comments indicator (Y - Yes, N - No, branches to a comments screen if Yes)

F: Feature code field

- Station of the first point in the chain list

- List of points comprising the chain list

1. **Active Edit**

The chain screen allows multiple chains to be active simultaneously. This feature is called ***active edit***. Active edit behaves in a manner similar to the roll function found in the Observation screens, where information is stored in a temporary location in memory to be accessed to the screen in a "rotary list" fashion. The active edit feature *remembers* the contents of <u>unrecorded</u> Chain screens, and places them in a rotary list in memory. A chain record is retrieved from active edit to the Chain screen by *rolling* through the active edit list until the desired chain appears.

Chain records in active edit may or may not have been previously recorded to the chain data file (***filename.CHN***) located on the RAM disk of the field computer. A chain that has just been keyed in is automatically placed in active edit, but will not be recorded to the data file on the RAM disk until the surveyor instructs EFB to do so, which then removes that chain screen from active edit. Recorded chains may also be recalled back into active edit should the need arise to make additions or corrections to the chain information. Because active edit is a temporary storage location for chains, the user should exercise caution when leaving chains in active edit for extended periods of time. A power loss to the field computer (dead batteries) or exiting EFB program abnormally will cause the contents of the active edit list to be lost. A safe strategy to avoid potential data loss from active edit is to record the chain immediately after editing is complete.

A limitation is the amount of chains that may be placed in active edit. **A <u>maximum</u> of 25 chains may be in active edit at a time**, although there is no such limit to the amount of chains that may have been recorded to the chain file.

Chains may be placed in Active Edit in two ways:

- A new chain is created by editing the chain name field (N:), and any other subsequent data fields in the chain screen. If the chain is not recorded, it remains in active edit until the surveyor takes action to remove it. Removal of a chain from active edit is accomplished either by recording the chain, or deleting it.

- A recorded chain may be re-activated by keying the explicit chain name (prefix + suffix) into the chain name field (N:), thereby recalling the chain back to active edit. Again, the chain remains in active edit until the surveyor takes action to remove it. To save a chain recalled from the RAM drive to active edit, the user must record the chain again. If the user does not record the chain again, and power is lost to the data collector, the edited version of the chain is lost, but the original version is still intact in the chain file. If the surveyor elects to delete the chain, it is removed from active edit and deleted from the chain data file.

While chains are in active edit, the attribute, zone, feature code, comments, stationing, and list fields may all be edited using the techniques previously described.

Chains are removed from active edit in the following ways:

- The chain in the chain screen is recorded to the chain data file using the chain record function on <<0>>.

- The chain in the chain screen is deleted using the chain delete function on <<3>>.

As previously stated, each chain is automatically entered into active edit when it is created. Whether or not it gets recorded to the chain data file is at the discretion of the surveyor. When attempting to exit EFB by using the <<esc>> sequence, if any chains are unresolved and remain in active edit, the program will prevent the user from exiting the program, warning that the chain list is not empty. The surveyor must then return to the chain screen and resolve the chains in active edit by either recording them or deleting them. Since active edit chain information is maintained in volatile RAM until recorded, if the surveyor exits the program by rebooting the field computer, or through some other method than the [ESC] key sequence (total system power loss), all chain information in active edit will be lost.

It is important to note that some field computers may be turned off and on again without terminating a running application. The MicroPalm, Husky, and the Paravant RHC-44 are typical examples of field computers that have this capability.

2. **Chain Names**

Chain name requirements follow the same rules as do point names. The system that maintains chain names is also *independent* of the one that maintains point names. It is possible to name a chain with the same name as that of a point. EFB will maintain the suffix portion of the chain name in the same manner as it does for point names.

3. **Required Chain Data**

Required data for a chain includes: **chain name**, **feature code**, **attribute**, **zone**, and the **chain list**.

Note: Due to system limitations, chain lists should be limited to 58 characters. Currently, there is no limit on the number of points that a chain list expands to.

Optional data are ***stationing*,** a point name in the P: field, and ***comments***. A chain will not record (recording a chain removes the chain from active edit) until the required data for the chain is input. The chain may remain partially complete in active edit until the surveyor does either of the following:

- Completes the chain by supplying the required data and records the Chain.
- Deletes the chain from active edit using the Delete function.

4. **Stationing**

A chain may be ***stationed*** by supplying the station of the first point in the chain list. When a chain is stationed, it becomes what is known as an *alignment* or ***Route***. Stationing increases along the chain in the direction prescribed by the chain list, beginning with the first point found in the list. Observations may be made (HVD cross sections and the SO Observation) referencing a stationed chain.

Stationing is input in *standard station notation*. The station *10 plus 25.382 meters* would be typed in as 10+25.382, where the integer before the **+** represents the whole number of 100 meter stations, and the number following the **+** represents the fractional station beyond a whole number station. The station may also be input as a whole number and decimal fraction (1025.382).

5. **Automatic Building of Chain Lists**

The **P:** field enables the automatic chain builder. When a point name ***prefix*** is entered here, and the chain is left in active edit, subsequently surveyed points with that prefix will automatically be entered into that chain list in surveyed order. The automatic feature does not retain control of the list. Thus the list may be edited manually at any time, since it may be necessary to change chain list syntax, like add gaps. Also, the name prefix in the **P:** field may be changed at any time during chain editing. Chains can have their lists populated with points as they are taken in either Setup, HVD, SOR, or Taping modes. A "***Prefix Field***" on the top line of the Chain screen was added with up to 7 characters to indicate which point prefixes shot would be added to the chain list. Once the prefix has been set for a given chain in active edit, any points observed with that prefix will then be checked against all chains in active edit to see if the point needs to be updated to the chain list of that chain. (Note: A given prefix may be used for only one chain in active edit at a time. Once the chain has been either recorded, deleted, or the prefix has been changed to something else by the user, the point prefix is then available for use by other chains in active edit.) The point being updated is always added to the end of the chain list, so it makes it possible for EFB to utilize its built-in "list abbreviation engine" to keep the chain lists as short as possible.

Here are some examples:

Say a chain with a point prefix "XYZ" is entered into Active Edit. Then the user enters the Chain List "XYZ1-12" manually. If a Point XYZ13 is later recorded in either the Setup, HVD Observation, SOR Observation, or Taping Screen(s) the Chain List becomes L:XYZ1-13

The change above seems very subtle and insignificant, but think about the spectrum of possibilities for changes in existing Chain Lists that must be handled correctly:

If the Chain List were previously:

L:XYZ1	then the list would be updated to L:XYZ1,13 (Not in Sequence)
L:ABC1	then the list would be updated to L:ABC1,XYZ13 (Different Prefix)
L:ABC1-4,,	then the list would be updated to L:ABC1-4,,XYZ13 (Following a “,,”)
L:XYZ1-4,	then the list would be updated to L:XYZ1-4,13 (Following a “,”)
L:XYZ1-4	then the list would be updated to L:XYZ1-4,13 (Not in Sequence)
L:XYZ1-12	then the list would be updated to L:XYZ1-13 (This is in Sequence)
L:XYZ1-12,	then the list would be updated to L:XYZ1- 12,13 (Following a “,”)
L:XYZ10,11,12	then the list would be updated to L:XYZ10,11,12-13 (This is in Sequence).

In conjunction with chain editing, comma separation (**,**) between points and GAP separation (**,,**) is still possible. Like with previous versions of EFB, to place a comma, enter the Chain List field by pressing the <<l>> key when in the chain screen. The Chain List will automatically inherit a comma. An example of this is on the following page:

Before editing the Chain List –

```
CHAIN P:XYZ_____C:_
N:CHAIN1__  A:_ Z:_
F:300_______________
S:__________
L:XYZ1-13___________
____________________
____________________
MSG>
```

After pressing the  key –

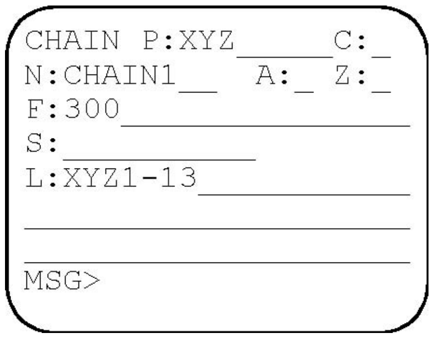
```
CHAIN P:XYZ_____C:_
N:CHAIN1__  A:_ Z:_
F:300_______________
S:__________
L:XYZ1-13,__________
____________________
____________________
MSG>
```

Then, the <<enter>> key may be pressed to indicate that editing is complete. Note here however, that since no additional information (points) are added to the chain list, EFB removes the comma -- L: XYZ1-13 (without the comma). Since EFB is prepared to add additional points to the chain list, it "remembers" that a comma was supposed to be there as additional points are added to the chain list by the automatic chain builder (with a different prefix). As points with different prefixes are added, then the comma will "re-appear" in the list. An example illustrating the above follows:

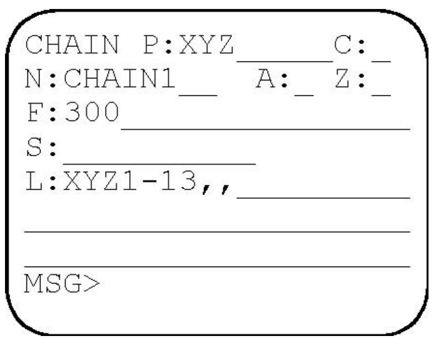
```
CHAIN P:XYZ_____C:_
N:CHAIN1__  A:_ Z:_
F:300_______________
S:__________
L:XYZ1-13,ABC1______
____________________
____________________
MSG>
```

In a similar manner to example above, a GAP added to the end of the chain list (prior to the addition of more points by the automatic Chain builder) also removes a comma. The last comma of the GAP (**,,**) would be truncated off of the chain list as the <<enter>> key was pressed. However, as points get added by the automatic chain builder, the comma reappears in the list. This is shown below:

Before editing the Chain List –



As the GAP is added –



After the  key is pressed

```
CHAIN P:XYZ_____C:_
N:CHAIN1__  A:_ Z:_
F:300______________
S:_________
L:XYZ1-13,_________
___________________
___________________
MSG>
```

As new points are added to the Chain List by the Chain builder –

```
CHAIN P:XYZ_____C:_
N:CHAIN1__  A:_ Z:_
F:300______________
S:_________
L:XYZ1-13,,14-18____
___________________
___________________
MSG>
```

A special function was also implemented to assist the user when dealing with automatic chain construction. This function is called the **Chain Toggle**. This function is assigned to the [**F1**] function key on the keyboard to toggle your screen from either the Setup, HVD, SOR Observation screens, or Taping screen directly to the Chain screen. Therefore, if you are in an observation, Setup, or Taping and want to go immediately to Chains, press [**F1**].

This function is sensitive to the Name field in the Setup, HVD, SOR Observation screens or Taping screens, and will "toggle" directly to the chain that has the point prefix option evoked. This way, if there is multiple chains in active edit, the user can get to the chain directly without having to Page in the Chain screen.

When the chain editing is complete, pressing the [**F1**] a second time will return the user to the screen he was in when he originally pressed the *Chain Toggle* function.

6. **Functions Available: Chains**

a. **Chain Record**

The ***Chain Record*** function is used to record the contents of the chain data screen. When the Record function is selected, the function checks the contents of the data screen to ensure that the required data is input, and in the right format. If an error is detected, the appropriate message is displayed in the message field. When a chain is successfully recorded, it is automatically removed from active edit. The Record function is on <<0>>.

b. **Chain Delete**

Chain Delete is used to discard chains that are no longer needed. This function not only removes the chain from active edit, but also deletes any copy of the chain from the chain data file (***filename.CHN***). This function must be used with care to avoid deleting needed chains. A confirmation is required before any chain is deleted. The user confirms with either a **Y** - Yes, or **N** - No at the confirmation prompt before the delete function takes effect.

c. **Roll**

Roll allows the recall and use of chains in the active edit memory buffer since the name/information data is added chronologically to the Roll list as each prefix is used, a Roll Forward and Roll Backward function is implemented to move you through the available chains and their data. The Roll buffer is a circular list, like a “Rolodex” so either Roll Forward <<5>> or Roll Backward <<4>> will reach all of the available chains.

d. **Chain Directory Function**

The ***Chain Directory*** function lists all recorded chains of the segment. The chain directory function will display chains in the order they were recorded (i.e. last recorded at the bottom).

The display will look like:

```
GRASS1    F9 400-GRAS
BL1       G1 150-CL_0
BL3       G2 150
SIDEWLK2  G9 250
HEDGE1    G9 220-LUGU
LOT 1     F3 600-JONE

<Any Key to Proceed>
```

The Chain Name, the Attribute/Zone, and the first 8 characters of the Feature Code/Description are displayed as a directory.

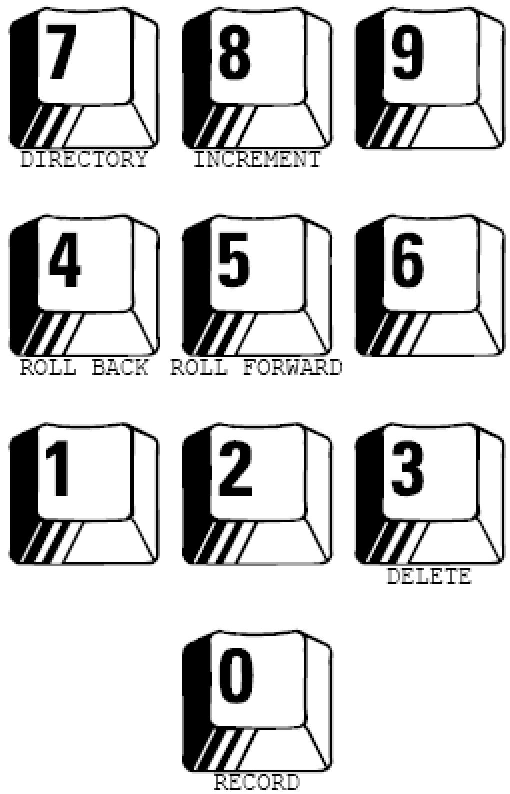
Deleted chains are not reflected in the chain directory function. If the chain *BL2* from the previous example was deleted, attempting to retrieve it into active edit will return the message that the chain does not exist.

The chain directory function is a handy tool for locating the names of chains desired to be brought into active edit. The directory function is assigned to <<7>>.

e. **<u>Chain Increment Function</u>**

The ***Chain Increment*** function works in a manner similar to the increment function for point names, except that the current chain in the chain screen is stored and removed from active edit before the chain name is incremented. In this way, the same information may be used to create a second chain with the same chain name prefix, attribute, zone and feature code.

The function key map for <u>Chains</u> is:



0	RECORD	Records the current chain data screen to the chain data file on the field computer
3	DELETE	Deletes the current chain in the screen from the active edit list and from the chain data file
4	ROLL BACK	Rolls the active edit chain list in backward chronological order
5	ROLL FORWARD	Rolls the active edit chain list in forward chronological order

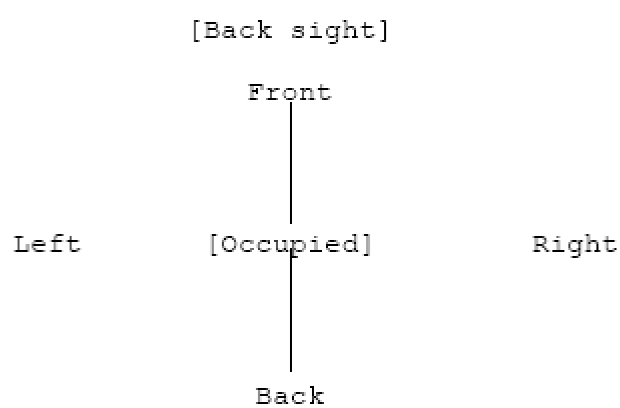
- DIRECTORY — Displays a listing of the recorded chain came prefixes with the highest suffix that has been used
- INCREMENT — Increments the chain name, storing the previous chain in the chain file and removing it from active edit

(s) **Taping - (Survey Menu, Option - 9)**

Taping is an operation remote from the instrument setup. A distance measuring tool such as a cloth tape or rule, and a method to approximate orthogonal angles (90°), is used. Taping is *remote* in the sense that the taping observations are not made from the instrument station. The taping operation begins on two survey points. These ***orientation*** points (index points) are the initial *Occupied* and *Back sight* points.

The taping operation begins at a commencement point, that has been observed previously by a method to determine its XY position. This commencement point is called the initial ***occupied*** point. To orient the taping, an orthogonal direction is given referencing a ***back sight*** point to any new point being established. The angle is referenced from the point of view of the occupied point facing the back sight.

To keep the relationship consistent in EFB field operations, the same convention used in eccentricity of **L**eft, **R**ight, **F**ront, and **B**ack is adopted. The following diagram illustrates how the direction for taping is oriented:



The new point being established is taped from the occupied point, to the **F**ront, **B**ack, **L**eft, or **R**ight of the occupied point with respect to the back sight.

The Taping data screen:

```
METRIC TAPING
N:_________G:_A:_Z:_
O:_________
B:_________
F:____________________
H:_  D:_________
```

Point name for new points being established

Occupied point name for horizontal angle reference, and distance measurement starting location

Back sight point name from horizontal angle reference

Geometry for newly established point   P – point
C –curve

Attribute F - feature point is the only option

Zone (1,2,3...9)

Comments (Y - Yes, N - No, branches to a comments screen)

Feature code

Orthogonal angle from the Back sight point (L - left, R -right, F - front, B - back)

Distance taped from Occupied point to newly established point

1. **Taping Operation**

Because taping is a <u>manual</u> operation, all data input will be keyed in at the keyboard of the field computer. To begin, the explicit point names (prefix + suffix) of the back sight and occupied points must be input. EFB will check that these points exist, and issues a warning if they have not been previously located. The new point name is input following the same procedure as with other data screens. The horizontal angle is input using <<h>> as a toggle through all of the options <u>**F**</u>ront, <u>**B**</u>ack, <u>**L**</u>eft, and <u>**R**</u>ight. The taped distance is then input editing the D: field in the usual manner. If a feature code or comment is desired, it may be input at any time after the point name for the new point has been established. There is only one option for the attribute, **F** - Feature Point, since the coordinates for the point will be determined only for X and Y.

2. **Functions Available: Taping**

a. <u>**Record**</u>

The ***Record*** function is used to record the contents of a tape data screen to the segment tape file (***filename.TAP***) located on the RAM disk. When the Record function is selected, the function checks the contents of the data screen to ensure that the required data is input, and in the right format. If an error is detected, the appropriate message is displayed in the message field. If an attempt to record the data screen is successful, the number of available bytes on the RAM disk is displayed in the message field. The Record function is on <<0>>.

b. <u>**Paging**</u>

Paging in Tape screens is limited only to recorded taping observations. Unlike Observation, Calibration, Setup, and Header screens, the paging is confined to the previously recorded taping observations. Paging operates in a *circular* manner where any recorded tape observation is accessible by using either the ***Page Back*** or the ***Page Forward*** function. The page back function is assigned to <<1>>, and the page forward function is assigned to <<2>>.

c. <u>**Shift**</u>

The ***Shift*** function is used to avoid having to re-key point names when the previous occupied point is desired to be used as the back sight point, <u>and</u> the previous new point is desired to be used as the occupied point for additional taping. This situation occurs most often when taping around the exterior of an object where the points are going to be used to construct a chain. A building is a good example of this. The following before-and-after demonstrates the results of the shift function.

Before the shift | After the Shift

```
METRIC TAPING
N:BLDG1 ____ G:__ A:__Z:__
O:OCCUPID1
B:BKSIGHT1
F:______________________
H:___ D:__________
MSG >
```

```
METRIC TAPING
N:__________ G:__ A:__Z:__
O:BLDG1
B:OCCUPID1
F:______________________
H:___ D:__________
MSG >
```

A new point name may be now entered into the N: field, or the increment function could be used to increment the <u>previous</u> prefix (BLDG in our case) in the N: field.

d. **<u>Increment</u>**

The ***Increment*** function works in a manner similar to all other data screens, with the exception that it *remembers* the last point name in the N: field. The last point name residing in the N: field is incremented, if a different name has not been keyed in. The example using the results of the previous shift function demonstration illustrates this.

Before the increment | After the increment

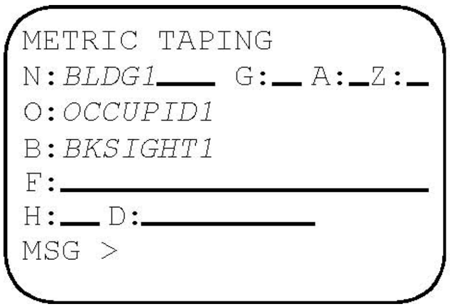
```
METRIC TAPING
N:__________ G:__ A:__Z:__
O:BLDG1
B:OCCUPID1
F:______________________
H:___ D:__________
MSG >
```

```
METRIC TAPING
N:BLDG2      G:__ A:__Z:__
O:BLDG1
B:OCCUPID1
F:______________________
H:___ D:__________
MSG >
```

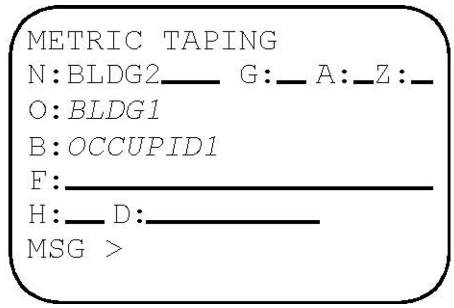
e. **Shift/Increment**

Shift/Increment performs the dual function of both the shift and increment. The use of this function may be better understood with the following illustration:

Before the shift/increment



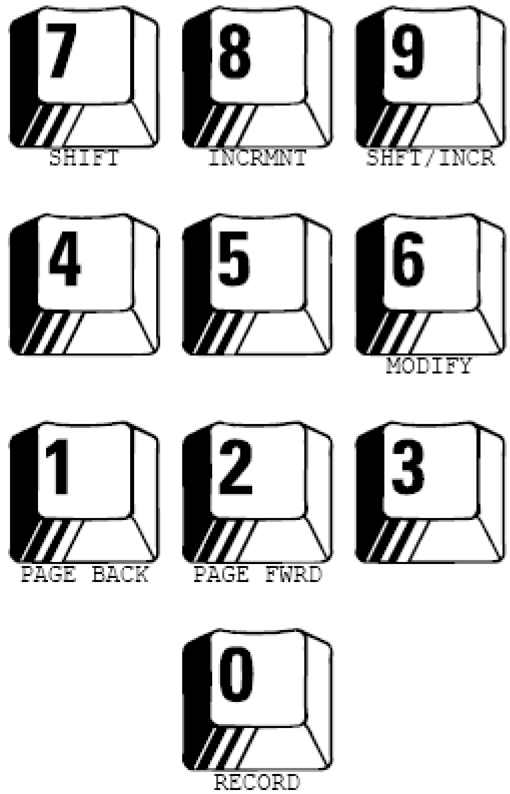
After the shift/increment



f. **Modify**

Modifying a tape screen that was previously recorded operates in a manner similar to the modify function for other observations. The user will use the page function until he arrives at the taping screen that requires modification. The changes are then made to the data in the tape screen using the normal data field editing procedure. When editing is complete, the user should select the modify function on <<6>> digit key. EFB will require the user to confirm this action with a Yes/No response.

The function key map for <u>Taping is</u>:



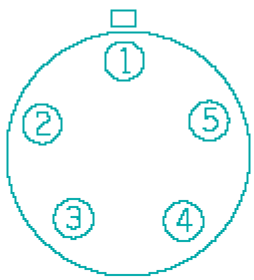
RECORD	Records the current taping data screen to the taping data file on the field computer
PAGE BACKWARD	Displays each screen in reverse order of recording
PAGE FORWARD	Displays each screen in order of recording
SHIFT	Shifts the contents of the N: and O: and B: fields respectively

	INCREMENT	Increments the Point name suffix of the current or “remembered” point name to the next available name
	SHIFT/INCREMENT	Shifts the contents of the N: and O: fields to the location of the O: and B: fields respectively and Increments the Point name in the N: field to the next available name.

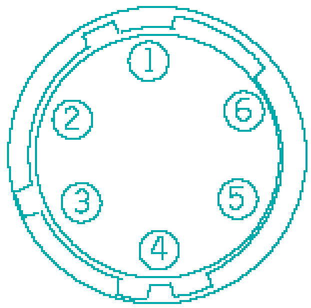
APPENDIX A - Instrument Cable Connections

This APPENDIX describes the tested cable configurations and describes the configuration of electronic total stations for use with the Electronic Field Book, EFB program. You should consult your operations manual for the specific operation of your total station.

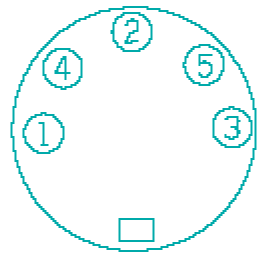
Some cable connectors are shown below for your use:



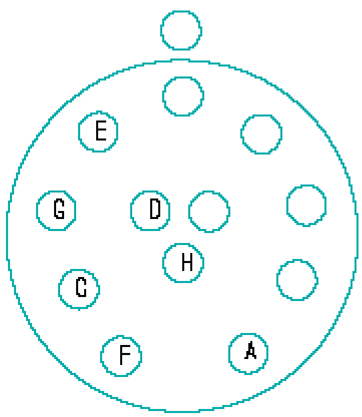
WILD LEMO SOCKET
REAR VIEW



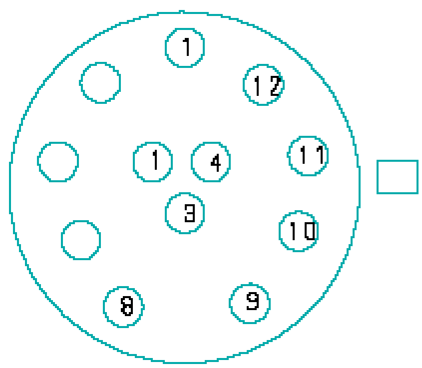
HIROSE CONNECTOR



ZEISS DIN CONNECTOR



PARAVANT RHC-88



PARAVANT RHC-44

(1) **GEODIMETER/GEOTRONICS TOTAL STATIONS:**

Model: 140

Geodimeter 100 series instruments require an Asynchronous Serial Interface device to be used to convert the instrument signal to an RS-232 compatible serial transmission for use with any field computer. The ASI is supplied by your Geodimeter dealer, and is the Geodimeter Serial Interface II, part number 571 135 220.

The DIP switch configuration for the ASI should be set for the following:

Switch	function	setting
1	N/A	CLOSED
2	AUTOMODE	OPEN
3	AUTOMODE	OPEN
4	EVEN PARITY	CLOSED
5	EVEN PARITY	CLOSED
6	NO ECHO	OPEN
7	DELAY	CLOSED
8	RETRANSMISSION	OPEN
9	PROMPT	CLOSED
10	CONTINUOUS	OPEN

Cable Construction:

```
National Data Computer DC 3.0        Geodimeter Serial Interface
II
Husky Hawk 8/16, Titan
Telxon PTC's, etc.

DB 25 Male Connector                          DB 25 Female Connector
--------------------                          ----------------------
      pin #                                              pin #

TD      2 ____________________________________________  3      RD
RD      3 ____________________________________________  2      TD

CTS   ┌──5
      │SG 7 __________________________________________  7      SG
DSR   └──6 __________________________________________  20     DTR
```

Caution ! To avoid possible damage to the ASI and/or the total station, the connection to the instrument battery should be made AFTER connecting the field computer and the ASI to the instrument.

```
MicroPalm PC/5000, PC/4000          Geodimeter Serial Interface II

DB 50 Male Connector                       DB 25 Female Connector
--------------------                       ---------------------
     pin #                                         pin #

RD      19 ____________________________________________ 2      TD
TD      20 ____________________________________________ 3      RD
CTS  ┌──15
     │
     │ SG 1 ____________________________________________ 7      SG
DSRd └──17 ____________________________________________ 20     DTR

Paravant RHC-44                     Geodimeter Serial Interface II

Fischer Connector                          DB 25 Female Connector
-----------------                          ---------------------
      pin #                                         pin #

RD      11 ____________________________________________ 2      TD
TD       3 ____________________________________________ 3      RD
CTS ┌─── 12
    │
    │SG  8 ____________________________________________ 7      SG
DSR └─── 4 ____________________________________________ 20     DTR

Paravant RHC-88                     Geodimeter Serial Interface II

Bayonet Connector                          DB 25 Female Connector
-----------------                          ---------------------
      pin #                                         pin #

RD       G ____________________________________________ 2      TD
TD       H ____________________________________________ 3      RD
CTS  ┌── E
     │
     │ SG A ____________________________________________ 7      SG
DSR  └── D ____________________________________________ 20     DTR
```

Use of the Instrument:

The Geodimeter 100 series instruments in conjunction with the Geodimeter Serial Interface II allows full program control of the total station provided the instrument is manually placed in the "fine" measurement mode(refer to your Geodimeter instrument manual).

To make a measurement:

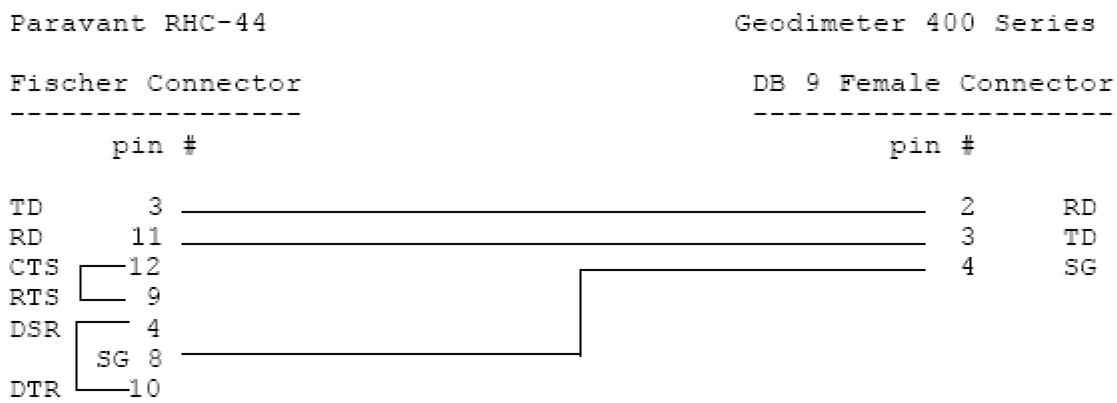
(a) The instrument must be set in fine measurement mode
(b) Point instrument at the target
(c) select the MEASURE/POLL function([9] digit key in the HVD Observation screen)
(d) Wait for measurement cycle to complete and data to appear on field computer screen
(e) If an error is detected, a message will be displayed as to the nature of the error, take corrective action and re-measure if necessary

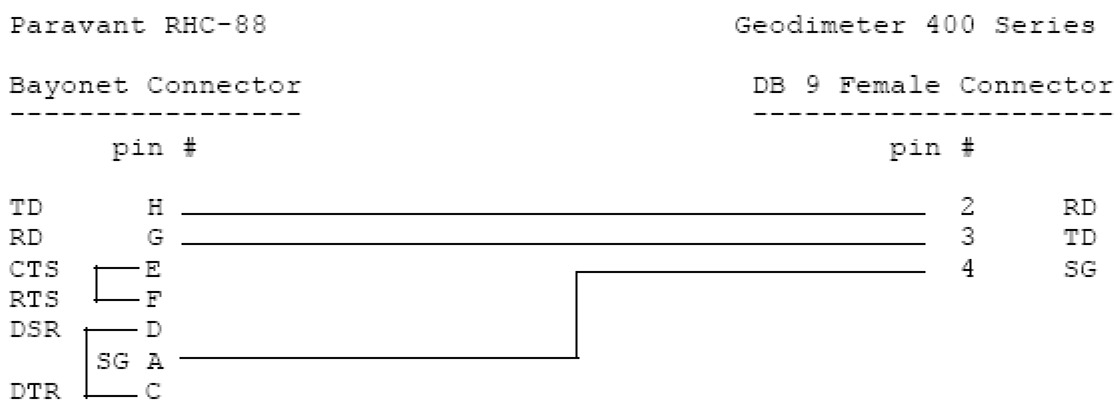
Models: 410, 420, and 440

Geodimeter 400 series instruments support RS-232 serial communications directly from the instrument, however do not allow a remote computer to invoke all measurement cycles. All Distance measurement must be initiated at the instrument by pressing the [A/M] button on the instrument, and upon completion of the measurement cycle, EFB may then Poll for data transmission. If Angle data alone is required, pressing the [A/M] button is not necessary, and the instrument may be polled for angle data.

Cable Construction:

```
National Data Computer DC 3.0              Geodimeter 400 Series
Husky Hawk 8/16, Titan
Telxon PTC's, etc.

DB 25 Male Connector                       DB 9 Female Connector
--------------------                       ---------------------
      pin #                                          pin #

TD        2 ____________________________________     2     RD
RD        3 ____________________________________     3     TD
RTS  ┌─── 4                  ┌─────────────────     4     SG
CTS  └─── 5                  │
DSR ┌──── 6                  │
    │ SG  7 _________________┘
DTR └──── 20

MicroPalm PC/5000, PC/4000                 Geodimeter 400 Series

DB 50 Male Connector                       DB 9 Female Connector
--------------------                       ----------------------
      pin #                                          pin #

TD       20 ____________________________________     2     RD
RD       19 ____________________________________     3     TD
CTS      15                    ┌────────────────     4     SG
RTS      16                    │
DSR ┌────17                    │
    │ SG  1 ___________________┘
DTR └────18
```





Use of the instrument:

To set the instrument serial port for use, the following one-time-only procedure must be followed the first time the instrument is to be used with the field computer. It is NOT necessary to perform this procedure again, unless the user has changed the settings that this procedure has implemented.

(a) Set up and level the instrument following the manufacturer's guidelines
(b) Press the [MNU] key on the instrument
(c) Press the [ENT] button
(d) Select DATA COM option by pressing the appropriate option on keypad
(e) Select DEVICE (option 1) from the DATA COM menu
(f) Select SERIAL (option 2) from the DEVICE menu
(g) At the prompt "serial on?", press the [REG] or [YES] key
(h) At the prompt "COM=1.7.2.1200", press the [ENT] key
(I) At the prompt "U.D.S?", press the [A/M] or [NO] key

(j) At the prompt "TABLE NO.=" press the [0] key, then press the [ENT] key
(k) At the prompt "REQUEST", press the [REG] or [YES] key

EFB may prompt the user to "Configure Instr!" when the user tries to get V data when a distance has not been measured. To configure the instrument, the following must be performed with **each battery change**:

(a) Press [MNU] to display the menu
(b) Select the "Set" option by pressing the [1] button
(c) Press the [ENT] button to display the "Switches" option
(d) Select the "Switches" option by pressing the [6] button
(e) Turn Target Test **off** by responding to the "Targ.test on?" through pressing the [A/M] or [NO] button
(f) Confirm your selection by pressing the [ENT] button
(g) Turn AIM/REG on by responding to the "AIM/REG on?" through pressing the [REG] or [YES] button
(h) Turn Pcode off by responding to the "Pcode off?" through pressing the [REG] or [YES] button

To make a measurement requiring a distance (HVD,HD,VD,D):

(a) Place the instrument in the desired measurement mode following manufacturer's instructions
(b) Point at the prism
(c) Press the [A/M] button on the instrument to start the measurement cycle
(d) Wait for the measurement cycle to finish
(e) Press the [9] key on the field computer to request data transmission

To make a measurement not requiring a distance (HV,H):
(p)
(p) (a)Place the instrument in the desired measurement mode following manufactures' instructions
(p) (b)Point at the target
(p) (c)Press the [9] key on the field computer to request data transmission

(2) **LIETZ TOTAL STATIONS**:

Models: SET2, SET2A, SET2B, SET2C, SET3, SET3A, SET3B, SET3C, SET4-4A, SET4B, SET4C

Some Lietz total stations do not allow a remote field computer to control the instrument measurement mode (SET2/2A, SET3/3A, SET4-4A). These total stations can however, be instructed to begin the measurement cycle and transmit the data by EFB once the measurement mode is selected from the instrument keyboard. The instrument operator will select between theodolite mode, for HV observations, or total station mode for HVD observations. The remaining models support full remote control via RS-232 interface provided in EFB.

Cable Construction:

```
National Data Computer DC 3.0             Lietz Instruments
Husky Hawk 8/16, Titan
Telxon PTC's, etc.
                                       6 pin Hirose Male connector
DB 25 Male Connector                  ( Hirose part no. HR10-7P-6P )
--------------------                   ----------------------------
      pin #                                         pin #

TD       2 ____________________________________________  4     RD
RD       3 ____________________________________________  3     TD
DSR   ┌──6 ____________________________________________  5  6 volts
RTS   ├──4
CTS   └──5
SG       7 ____________________________________________  1     SG
```

```
MicroPalm PC/5000, PC/4000                  Lietz Instruments

                                          6 pin Hirose Male connector
DB 50 Male Connector                    ( Hirose part no. HR10-7P-6P )
--------------------                     ----------------------------
      pin #                                               pin #

TD      20 ____________________________________________  4     RD
RD      19 ____________________________________________  3     TD
DSR  ┌──17 ____________________________________________  5   6 volts
RTS  ├──16
CTS  └──15
SG       1 ____________________________________________  1     SG

Paravant RHC-44                               Lietz Instruments

                                          6 pin Hirose Male connector
Fischer Connector                       ( Hirose part no. HR10-7P-6P )
-----------------                        ----------------------------
      pin #                                               pin #

TD       3 ____________________________________________  4     RD
RD      11 ____________________________________________  3     TD
DSR      4 ____________________________________________  5   6 volts
RTS  ┌── 9
CTS  ├──12
SG   └── 8 ____________________________________________  1     SG

Paravant RHC-88                               Lietz Instruments

                                          6 pin Hirose Male connector
Bayonet Connector                       ( Hirose part no. HR10-7P-6P )
-----------------                        ----------------------------
      pin #                                               pin #

TD       H ____________________________________________  4     RD
RD       G ____________________________________________  3     TD
DSR   ┌─ D ____________________________________________  5   6 volts
RTS   ├─ F
CTS   └─ E
SG       A ____________________________________________  1     SG
```

Use of the instrument for models SET2/2A, SET3/3A, SET4-4A:

The instrument operator must place the instrument in the correct measurement mode for the proper data to be transmitted. The mode needs to be set at the instrument keyboard, corresponding to the type of data EFB is trying to gather.

To place the instrument in theodolite mode (H, HV Observations):

(a) Instrument must be on
(b) Press the [CA] key, then the [] key

To make a measurement with EFB:

Press the POLL function key [9] on the field computer

To place the instrument in total station mode (HVD, HD, VD, D Observations):

(a) Instrument must be on
(b) Press the [CA] key, then the [key, then the [7] key

To make a measurement with EFB:

Press the POLL function key [9] on the field computer

Use of the instrument for models SET2B, SET2C, SET3B, SET3C, SET4B, SET4C:

The EFB/SET interface must be properly set for RS-232 communications to take place. Follow manufacturer's documentation for setting the communications protocol to 1200 baud, No parity, and 1 Stop Bit. It is optional if you would like to invoke the checksum.

To make a measurement with EFB:

Press the POLL function key [9] on the field computer

(3) **PENTAX TOTAL STATIONS:**

Models: PTS-II series

Pentax total stations do not allow a remote field computer to control the instrument measurement mode. The total station can however, be instructed to begin the measurement cycle and transmit the data to EFB once the measurement mode is selected from the instrument keyboard. The instrument operator will select between theodolite mode, for HV observations, or total station mode for HVD observations.

Cable Construction:

```
National Data Computer DC 3.0                 Pentax PTS-II
Husky Hawk 8/16, Titan
Telxon PTC's, etc.
                                      6 pin Hirose Male connector
DB 25 Male Connector                ( Hirose part no. HR10-7P-6P )
--------------------                 ----------------------------
      pin #                                      pin #

TD        2  ____________________________________  2     RD
RD        3  ____________________________________  1     TD
RTS    ┌─4  ____________________________________  3    RTS
CTS    └─5
DSR  ┌── 6  ____________________________________  4    CTS
DTR  ├──20
SG   │   7  ____________________________________  5     SG
CT   └── 8
```

MicroPalm PC/5000, PC/4000				Pentax PTS-II	
DB 50 Male Connector				6 pin Hirose Male connector (Hirose part no. HR10-7P-6P)	
	pin #			pin #	
TD	20	——		2	RD
RD	19	——		1	TD
CTS	15	——		3	RTS
RTS	16				
DSR	17	——		4	CTS
DTR	18				
SG	1	——		5	SG

Paravant RHC-44				Pentax PTS-II	
Fischer Connector				6 pin Hirose Male connector (Hirose part no. HR10-7P-6P)	
	pin #			pin #	
TD	3	——		2	RD
RD	11	——		1	TD
CTS	12	——		3	RTS
RTS	9				
DSR	4	——		4	CTS
DTR	10				
SG	8	——		5	SG

Paravant RHC-88				Pentax PTS-II	
Bayonet Connector				6 pin Hirose Male connector (Hirose part no. HR10-7P-6P)	
	pin #			pin #	
TD	H	——		2	RD
RD	G	——		1	TD
CTS	E	——		3	RTS
RTS	F				
DSR	D	——		4	CTS
DTR	C				
SG	A	——		5	SG

Use of the instrument:
The instrument operator must place the instrument in the correct measurement mode for the proper data to be transmitted. The mode needs to be set at the instrument keyboard, corresponding to the type of data EFB is trying to gather.

To place the instrument in theodolite mode (H, HV Observations):

(a) Instrument must be on
(b) Press the V/H [7] key, to place the instrument into angle measurement mode

To make a measurement with EFB:

Press the POLL function key [9] on the field computer

To place the instrument in total station mode (HVD, HD, VD, D Observations):

(a) Instrument must be on
(b) Press the SLP/V [5] key to place the instrument into an angle/distance measurement mode

To make a measurement with EFB:

Press the POLL function key [9] on the field computer

Note: Make sure instrument is set for Zenith at 0 degrees.

The instrument will automatically go into an AIM MODE, and will cycle until the EDM stabilizes. When the EDM stabilizes, the data is then transmitted to the field computer.

(4) **TOPCON TOTAL STATIONS:**

Models: GTS-3B, GTS-3C, GTS-300 series, GTS-4

Topcon Total stations allow fully automatic control of instrument measurement mode by EFB. A BCC data checking system is employed to ensure the integrity of the transmitted data.

Cable Construction:

```
National Data Computer DC 3.0      Topcon GTS-3B, GTS-3C, GTS-4

Husky Hawk 8/16, Titan
Telxon PTC's, etc.
                                    6 pin Hirose Male connector
DB 25 Male Connector               ( Hirose part no. HR10-7P-6P )
--------------------                ----------------------------
      pin #                                       pin #

TD       2 ____________________________________________ 4     RD
RD       3 ____________________________________________ 3     TD
CTS      5 ____________________________________________ 5    RTS
DSR      6 ____________________________________________ 6    Vcc
SG       7 ____________________________________________ 1     SG

*Note: Pin is high signal level ( +8.4V typ. )
```

```
MicroPalm PC/5000, PC/4000         Topcon GTS-3B, GTS-3C, GTS-4

                                    6 pin Hirose Male connector
DB 50 Male Connector               ( Hirose part no. HR10-7P-6P )
--------------------                ----------------------------
      pin #                                       pin #

TD      20 ____________________________________________ 4     RD
RD      19 ____________________________________________ 3     TD
CTS     15 ____________________________________________ 5    RTS
DSR     17 ____________________________________________ 6    Vcc
SG       1 ____________________________________________ 1     SG

*Note: Pin is high signal level ( +8.4V typ. )
```

```
Paravant RHC-44                       Topcon GTS-3B, GTS-3C, GTS-4

                                        6 pin Hirose Male connector
Fischer Connector                     ( Hirose part no. HR10-7P-6P )
--------------------                   ----------------------------
      pin #                                                pin #

TD      3  ___________________________________________  4     RD
RD     11  ___________________________________________  3     TD
CTS    12  ___________________________________________  5    RTS
DSR     4  ___________________________________________  6    Vcc
SG      8  ___________________________________________  1     SG

Paravant RHC-88                       Topcon GTS-3B, GTS-4, ET-2

                                        6 pin Hirose Male connector
Bayonet Connector                     ( Hirose part no. HR10-7P-6P )
--------------------                   ----------------------------
      pin #                                                pin #

TD      H  ___________________________________________  4     RD
RD      G  ___________________________________________  3     TD
CTS     E  ___________________________________________  5    RTS
DSR     D  ___________________________________________  6    Vcc
SG      A  ___________________________________________  1     SG

*Note: Pin is high signal level ( +8.4V typ. )
```

Use of the instruments

To set the instrument serial port for use, the following one-time-only procedure must be followed the first time the instrument is to be used with the field computer. It is NOT necessary to perform this procedure again, unless the user has changed the settings that this procedure has implemented.

```
Setting up Topcon GTS-3B                                  DISPLAY
------------------------                                  -------

-  Turn on the power switch while pressing
   the[R/L] key continuously for about 1 second         “ 0 SET “
-  Rotate the telescope to make zero-setting            “ FAC.XX.XX “
-  Press the [ ] key                                    “ 00 “
-  Press the [V/H] key twice                            “ 12.00.00 “
-  Press the [R/L] key                                  “ 12.00.01 “
-  Press the [0 SET] key                                “ 12.01.01 “
-  Press the [V/H] key twice                            “ 14 “
-  Press the [0 SET] key                                “ 14 SET “
                                                           *note 1
-  Turn the power off
```

The previous procedure is performed to change the mode "12.00.XX" to "12.01.XX".

*note 1 If the display was " 14 E99 ", turn off the power and repeat the procedure from step 1)

*note 2 When the GTS-3B is used with the TOPCON Data Collector FC-1/2 or Data Entry Keyboard DK-5, The above procedure EXCEPT step 5) must be repeated to restore the original condition of the instrument to " 12.00.00 ".

In this case, step 4) and 6) will differ from the above as follows:

```
Setting up Topcon GTS-3B                                  DISPLAY
------------------------                                  -------

-  Turn on the power switch while pressing
   the[R/L] key continuously for about 1 second         “ 0 SET “
-  Rotate the telescope to make zero-setting            “ FAC.XX.XX “
-  Press the [ ] key                                    “ 00 “
-  Press the [V/H] key twice                            “ 12.00.00 “
-  Omit this step
-  Press the [0 SET] key                                “ 12.01.00 “
-  Press the [V/H] key twice                            “ 14 “
-  Press the [0 SET] key                                “ 14 SET “

-  Turn the power off
```

IMPORTANT: **Make sure the DIP switch in the RS-232 Port is set to NO ECHO. This is accomplished by removing the four screws and pulling out the port cover, which pulls the attached board out. Two dip switches are found on the board and should be set to switch 1 ON, switch 2 OFF.**

```
Setting up Topcon ET-2                                     Display
----------------------                                     -------

-  Turn on the power switch while pressing the           " FAC 10.10 "
   meter/feet selector switch continuously until         "           "
   buzzer sound is stopped.  The display will be
   blank except the meter/feet and the degree/grad
   unit.
-  Operate the [V/H] switch, instrument will show         " 00000000 "
   a flashing first digit (right) will be
   displayed if it is not changed before
-  Move a flashing digit to the 2nd digit.                " 00000000 "
   A flashing digit can be shifted each time by
   operating the [V/H] switch.
-  Operate the [REC] switch, the 2nd digit will           " 00000010 "
   be changed to a "1"
-  Operate the [F] switch.  Nothing but the               "          "
   meter/feet and the degree/grad unit will be
   displayed, indicating the setting is complete.
-  Turn the power off.

*note 1  When the ET-2 is used with the TOPCON Data Collector FC-
           1/2 or Data Entry Keyboard DK-5, The above procedure
           must be repeated with the exception described below to
           get the original condition of the instrument

Setting up Topcon ET-2                                     Display
----------------------                                     -------

-  Turn on the power switch while pressing the           " FAC 10.10 "
   meter/feet selector switch continuously until         "           "
   buzzer sound is stopped.  The display will be
   blank except the meter/feet and the degree/grad
   unit.
-  Operate the [V/H] switch                               " 00000000 "

-  Move a flashing digit to the 2nd digit.                " 00000000 "
   A flashing digit can be shifted each time by
   operating the [V/H] switch.
-  Operate the [REC] switch, the 2nd digit will           " 00000010 "
   be changed to a "0"
-  Operate the [F] switch.  Nothing but the               "          "
   meter/feet and the degree/grad unit will be
   displayed, indicating the setting is complete.

-  Turn the power off.
```

Setting up Topcon GTS-4

This procedure is used to add the ASCII characters CRLF to the end of the data output strings for connection to a computer.

- Turn on the power switch while pressing the [2] key continuously for about 1 second.

DISPLAY

[PARAMETERS SET]

- The parameters menu is displayed

```
PARAMETERS 1/2
1:ANGLE
2:DIST
3:DATA-OUT
```

- Press the [3] Key

```
DATA-OUT
 CRLF:OFF

SET ITEM--SLCT
```

- Press the [F4] Key

```
DATA-OUT
 CRLF:ON

SET ITEM--SLCT
```

- PRESS the [F1] Key

```
DATA-OUT


     <SET>
```

- Display is returned to the Parameters menu

- Turn off the power

To make a measurement with EFB:

- Press the POLL function key [9] on the field computer

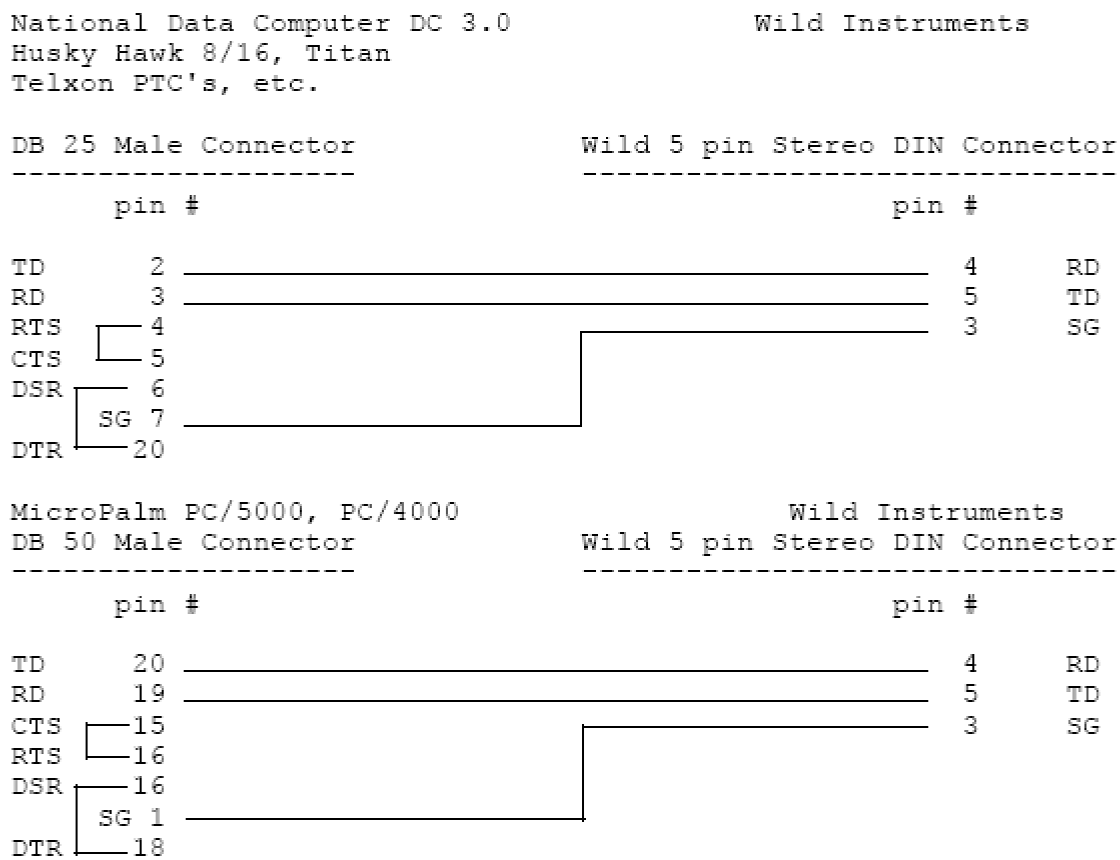
(5) **WILD TOTAL STATIONS:**

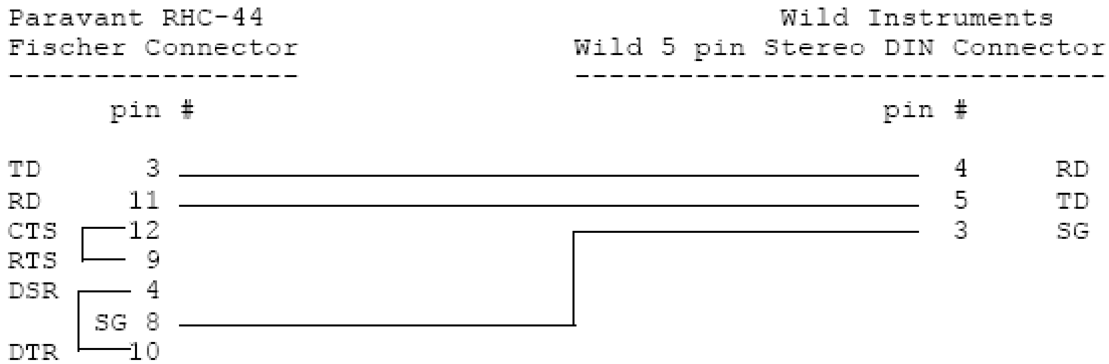
Models: T1000 (old and new style), T1600, T1600, T2000, TC1010, TC1600, TC1610, TC2000, TC2002, TPS Series (Leica)

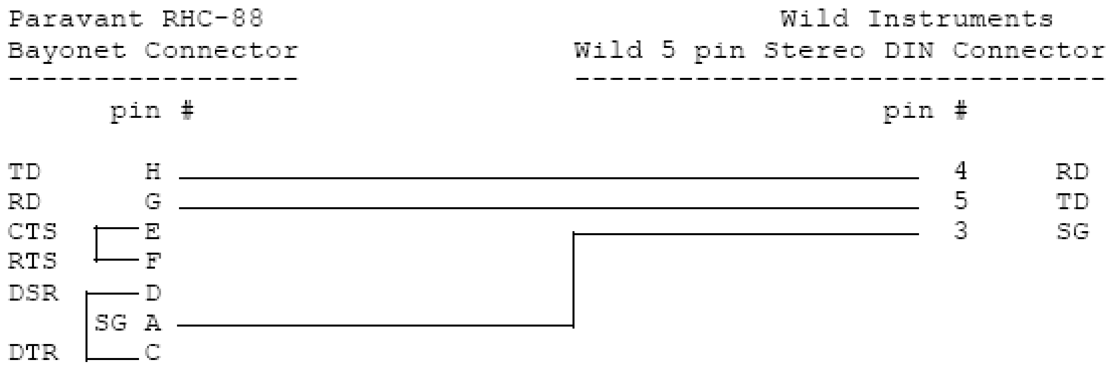
The interface usually requires that each instrument be set to emulate the WILD TC2000.

Note: The old style T1000 will not emulate the T2000

Cable Construction:




Paravant RHC-44
Fischer Connector
pin #
TD 3
RD 11
CTS 12
RTS 9
DSR 4
SG 8
DTR 10
Wild Instruments
Wild 5 pin Stereo DIN Connector
pin #
4 RD
5 TD
3 SG


Paravant RHC-88
Bayonet Connector
pin #
TD H
RD G
CTS E
RTS F
DSR D
SG A
DTR C
Wild Instruments
Wild 5 pin Stereo DIN Connector
pin #
4 RD
5 TD
3 SG

Use of the Total Station instrument:

To set the instrument for use, set serial port to standard parameters (2400,e,crlf), Automatic Index Operating, Units to feet, 360 degrees sexagesimal, and to emulate the TC2000 keyboard (not appropriate for T1000 old style). See your instrument documentation to establish these parameters.

Use of the NA2000 Electronic Level:

To set the instrument for use, set for single measurement, Fix to Metre:4 decimals, feet: 3 decimals, Recording Off, Units to feet, and serial port to standard parameters (2400,e,crlf). See your instrument documentation to establish these parameters.

To make a measurement with EFB:

- Press the POLL function key [9] on the field computer when in the HVD observation screen for total stations, or press the POLL function key [9] on the field computer when in the SOR observation screen for the NA2000 electronic level.

(6) **ZEISS TOTAL STATIONS:**

Models: ELTA 3, ELTA 4, ELTA 6

Cable Construction:

```
National Data Computer DC 3.0       Zeiss ELTA 3, ELTA 4, ELTA 6
Husky Hawk 8/16, Titan
Telxon PTC's, etc.

DB 25 Male Connector       5 pin male stereo DIN 41 524 connector
--------------------       -------------------------------------
      pin #                                     pin #

TD      2 ____________________________________  5     RD
RD      3 ____________________________________  4     TD
DSR     6 ____________________________________  3     DSR
SG      7 ____________________________________  2     SG
RTS    ┌─4
CTS    └─5

MicroPalm PC/5000, PC/4000         Zeiss ELTA 3, ELTA 4, ELTA 6

DB 50 Male Connector       5 pin male stereo DIN 41 524 connector
--------------------       -------------------------------------
```

```
      pin #                                              pin #

TD     20 ____________________________________________  5      RD
RD     19 ____________________________________________  4      TD
DSR    17 ____________________________________________  3      DSR
SG      1 ____________________________________________  2      SG
RTS  ┌──16
CTS  └──15

Paravant RHC-44                  Zeiss ELTA 3, ELTA 4, ELTA 6

Fischer Connector         5 pin male stereo DIN 41 524 connector
--------------------      --------------------------------------
      pin #                                              pin #

TD      3 ____________________________________________  5      RD
RD     11 ____________________________________________  4      TD
DSR     4 ____________________________________________  3      DSR
SG      8 ____________________________________________  2      SG
RTS  ┌── 9
CTS  └──12

Paravant RHC-88                  Zeiss ELTA 3, ELTA 4, ELTA 6

Bayonet Connector         5 pin male stereo DIN 41 524 connector
--------------------      --------------------------------------
      pin #                                              pin #

TD      H ____________________________________________  5      RD
RD      G ____________________________________________  4      TD
DSR     D ____________________________________________  3      DSR
SG      A ____________________________________________  2      SG
RTS   ┌──F
CTS   └──E
```

Use of the instruments:

Mode of the instrument and EDM resolution is fully controlled via EFB.

To make a measurement with EFB:

- Press the POLL function key [9] on the field computer

APPENDIX B - Standard Connector Configurations

Standard Pin Outs - IBM PC, XT, AT, and compatible

25 Pin Function (async)

pin #	function
1	Ground
2	Data Transmit
3	Data Receive
4	Request To Send (RTS)
5	Clear To Send (CTS)
6	Data Set Ready
7	Signal Ground
8	Carrier Detect
9	Data Set Test (DST)
10	Data Set Test (DST)
11	Unassigned
12	Secondary Carrier Detect
13	Secondary Clear To Send
14	Secondary Data Transmit
15	XMIT (DCE)
16	Secondary Data Receive
17	RCVR Clock (DCE)
18	Unassigned
19	Secondary Request to Send
20	Data Terminal Ready (DTR)
21	Signal Quality Detector
22	Ring Indicator
23	Data Signal Rate Selector
24	XMIT Clock (DCE)
25	Unassigned

9 Pin Function (async)

pin #	function
1	Carrier Detect
2	Receive Data
3	Transmit Data
4	Data Terminal Ready
5	Signal Ground
6	Data Set Ready
7	Request To Send
8	Clear To Send
9	Ring Indicator

26 Pin Function (async)

pin #	function
1	System +5 volts
2	EPROM interface
3	Data set ready/serial-1
4	System primary battery voltage
5	Ring indicator/serial-1
6	Data carrier detect/serial-1
7	receive data/serial-1
8	Data terminal ready/serial-1
9	Request to send/serial-1
10	Clear to send/serial-1
11	Unassigned
12	Transmit data/serial-1
13	Unassigned
14	Ring indicator/serial-2
15	EPROM interface
16	Data set ready/serial-2
17	Receive data/serial-2
18	Data carrier detect/serial-2
19	Data terminal ready/serial-2
20	Transmit data/serial-2
21	Clear to send/serial-2
22	Request to send/serial-2
23	Unassigned
24	Unassigned
25	System ground
26	System ground

50 Pin Function (async)

pin #	function
1	SG1
15	CTS1
16	RTS1
17	DSR1
18	DTR1
19	RD1
20	TD1

RHC-88 Bayonet Connector

Signal	Pin #
SG prim.	A
SG scnd.	B
DTR	C
DSR	D
CTS	E
RTS	F
RD	G
TD	H
CHARGE	J
Vcc Pro	K

RHC-44 Fischer Connector

Signal	pin #
SG	8
DTR	10
DSR	4
CTS	12
RTS	9
RD	11
TD	3

APPENDIX C - Standard Abbreviations

There are hundreds of abbreviations used in surveying and engineering and almost every office has some of its own particular designations for special applications. The following is a cross section of many of the more commonly used shorthand expressions derived from "Survey Drafting - Wattles", "Boundary Control and Legal Principles-Brown, Landgraf, and Uzes", "FDOT Roadway and Traffic Design Standards", "FDOT Location Survey Manual", "FDOT R/W Mapping Manual", and "The American Heritage Dictionary".

Some modifications were made to maintain uniqueness for every element. To assure as much conformance to the English speaking language, adherence to abbreviations found in the dictionary was a precedence as much as possible. Due to the maximum of eight characters required by Electronic Field Book (EFB), abbreviations were kept as short as possible. In most cases words of three characters or less were not abbreviated, unless they could be abbreviated with one letter without conflict with another abbreviation (ex. Ton).

The intent of this appendix is to be inclusive of all the sources quoted above and is available in Microsoft Word format from the Survey Section, Surveying & Mapping Office in Tallahassee, if it is desirable to create an abbreviated listing.

A .... EFB Traverse Point
AADT .... Annual Average Daily Traffic
ABC .... Asphalt Base Course
ABD .... Abandoned
ABS .... Acrylonitrite-Butadiene-Styrene Pipe
AB .... Anchor bolt
ABV .... Above
AC .... Acre(s)
ACC .... Access
ACEL .... Acceleration
ACP .... Asphalt Coated Pipe
ACPV .... Asphalt Concrete Pavement
ACT .... Actuated
ADJ .... Adjoining
ADJT .... Adjust
ADL .... Additional
ADT .... Average Daily Traffic
AH .... Ahead
AL .... Aluminum
ALT .... Alternate
AM .... Midnight until Noon
ANG .... Angle
AOS .... Apparent Opening Size
AP .... Asphalt Pavement
APPL .... Applied or Application
APR .... Approach
APRS .... Approach Slab
APX .... Approximate
ARCH .... Architecture
ART .... Artificial
ARW .... Additional Right of Way
AS .... Assembly
ASP .... Asphalt
ASPC .... Asphaltic Concrete
AT .... Aerial Target
ATTN .... Attenuator
AUX .... Auxiliary
AV .... Average
AVE .... Avenue
AWG .... American Wire Gage
AX .... Axle
AZ .... Azimuth
AZMK .... Azimuth Mark

B .... Base
BA .... Barrel
BAR .... Barrier
BARW .... Barrier Wall
BAS .... Basin
BASC .... Bascule
BBL .... Bubble
BC .... Bottle Cap
BCATV .... Buried Cable Television
BCCMP .... Bituminous Coated Corrugated Metal Pipe Culvert
BCPA .... Bituminous Coated Pipe Arch Culvert

BCPCMP .... Bituminous Coated and Paved Corrugated Metal Pipe Culvert
BCPPA .... Bituminous Coated and Paved Pipe Arch Culvert
BCT .... Breakaway Cable Terminal
BDY .... Boundary
BE .... Buried Electric
BEG .... Begin or Beginning
BFLY .... Butterfly
BIN .... Bin
BIT .... Bituminous
BK .... Book
BL .... Base Line
BLC .... Geodetic Base Line Control
BLDG .... Building
BLK .... Block
BKHD .... Bulkhead
BLVD .... Boulevard
BM .... Bench Mark
BNCH .... Bench
BNK .... Bank
BOB .... Bottom of Bank
BOC .... Back of Curb
BOD .... Bottom of Ditch
BOG .... Back of Gutter
BOR .... Border
BOS .... Beginning of Survey
BOT .... Bottom
BOW .... Back of Walk
BP.. Borrow Pit
BPWR .... Buried Power, Size Unknown
BR .... Branch
BRDG .... Bridge
BRG .... Bearing
BRGT .... Bearing Tree
BRK .... Brick
BRKWY .... Breakaway
BS .... Back sight
BT .... Buried Telephone
BTD .... Buried Telephone Duct
BTOB .... Back to Back
BTT .... Buried Telephone Toll
BU .... Bushel
BUS .... Business
BVC .... Beginning of Vertical Curve
BW .... Barbed Wire
BWF .... Barbed Wire Fence
BX .... Box
BXC .... Box Culvert
BZ .... Bronze

C .... EFB Control Point
(c) .... Calculated
CA .... Controlled Access
CAN .... Canal
CAP .... Capacity
CAPS .... Capital Letters
CATV .... Cable Television Line
CATVS .... Cable Television Service Box
CB .... Catch Basin
CBC .... Concrete Box Culvert
CBS .... Concrete Block Structure
CBW .... Concrete Barrier Wall
CC .... Cubic Centimeter
CCEW .... Center to Center Each Way
CCB .... Concrete Block
CCF .... Concrete Floor
CCR .... Curb Cut Ramp
CD .... Cross Drain
CEM .... Cement
CEMD .... Cemented
CEMT .... Cemetery
CERT .... Certified
CF .... Curb Face
CFS .... Cubic Feet per Second
CG .... Curb and Gutter
CGD .... Cattle Guard
CH .... Chain
CHAN .... Channel
CHCH .... Channel Change
CHD .... Chord
CHG .... Change
CHX .... Chiseled cross
CI .... Cast Iron
CINL .... Curb Inlet
CIP .... Cast Iron Pipe or Corrugated Iron Pipe
CIPL .... Cast in Place
CIR .... Circle
CKT .... Circuit
CL .... Center Line
CLF .... Chain Link Fence
CLG .... Ceiling
CLM .... Column
CLMT .... Column Tower
CLNO .... Cleanout
CM .... Concrete Monument
CMB .... Concrete Median Barrier
CML .... Commercial
CMON .... Cast Monument
CMP .... Corrugated Metal Pipe
CMPA .... Corrugated Metal Pipe Arch
CMPST .... Camp stove
CNT .... Control
CNTL .... Controller
CNTR .... Contour
CO .... County
COA .... Course Aggregate
COL .... County Line

COM .... Common
COMM .... Commercial
COMP .... Composite
CON .... Conduit
CONC .... Concrete
CONCV .... Concave
COND .... Conditional
CONS .... Construction
CONT .... Continued or Continuation
CONTR .... Contractor
COOR .... Coordinate
COP .... Copper
COR .... Corner
CORR .... Corrugated
CP .... Concrete Pipe
CPD .... Compound
CPE .... Corrugated Polyethylene Pipe
CPVT .... Concrete Pavement
CR .... County Road
CRA .... Clear Recovery Area
CRS .... Course
CRSA .... Course Aggregate
CRSO .... Crossover
CS .... Curve to Spiral
CSL .... Concrete Slab
CSP .... Corrugated Steel Pipe
CST .... Central Standard Time
CT .... Central Time
CTLVR .... Cantilever
CTOC .... Center to Center
CTR .... Center
CU .... Cubic
CUFT .... Cubic Foot
CUL .... Cul-de-sac
CULV .... Culvert
CUR .... Curve
CUYD .... Cubic Yard
CY .... City
CYL .... Cylindrical
CYLL .... City Limits Line
CZ .... Clear Zone

D .... Degree of Curvature
(D) .... Deed
DA .... Drainage Area
DAM .... Dam
DBH .... Diameter Breast Height
DBI .... Ditch Bottom Inlet
DBL .... Double
DCEL .... Deceleration
DCK .... Dock
DCS .... Degree of Curvature (Spiral)
DD .... Dry Density
DDHV .... Directional Design Hour Traffic
DE .... Difference in Elevation

DEF .... Deflection
DEG or E .... Degree
DEL .... Delineators
DEPT .... Department
DESC .... Describe or Description
DESMT .... Drainage Easement
DET .... Detour
DGNS .... Design Speed
DH .... Drill Hole
DHV .... Design Hourly Volume
DHW .... Design High Water
DI .... Drop Inlet
DIA .... Diameter
DIAG .... Diagonal
DIFF .... Difference
DIM .... Dimension
DIP .... Ductile Iron Pipe
DIS .... District
DISCH .... Discharge
DISP .... Disposal
DIST .... Distance
DIV .... Divided or Division
DK .... Dike
DLS .... District Location Surveyor
DMBL .... Demobilization
DMH .... Drop Manhole
DMP .... Dumpster
DMPS .... Dump Station, Sanitary Sewer
DN .... Down
DO .... Door
DOC .... Document
DOT .... Department of Transportation
DPI .... Ditch Point Intersection
DR .... Drive
DRA .... Drainage Retention Area
DRM .... Deep Rod Mark
DRN .... Drain
DRNB .... Drainage Bottom
DRNP .... Drainage Pipe
DRS .... District Right of Way Surveyor
DS .... District Secretary
DSK .... Disk
DSL .... Design Service Life
DST .... Daylight Savings Time
DT .... Daylight Time
DTCH .... Ditch
DTCHC .... Ditch Center
DTCH I .... Ditch Inlet
DTCHP .... Ditch Pavement
DTOE .... District Traffic Operations Engineer
DUP .... Duplicate
DWG .... Drawing
DWY .... Driveway

E .... East

EA .... Each
EB .... Eastbound
EC .... End of Curve
EDM .... Electronic Distance Measure
EDT .... Eastern Daylight Time
EFB .... Electronic Field Book
ELAST .... Elastomeric
ELE .... Electric
ELECS .... Electric Service Box
ELEO .... Electric Outlet
ELEV .... Elevation
ELLIP .... Elliptical
EM .... Edge of Mangrove
EMBK .... Embankment
EMUL .... Emulsified
ENCL .... Enclosure
ENG .... Engineer
EOP .... Edge of Pavement
EOS .... End of Survey
EQ .... Equal or Equation
EQUIP .... Equipment
ER .... End of Return
ERWL .... Existing Right of Way
ESMT .... Easement
EST .... Eastern Standard Time
ESTM .... Estimate
ET .... Eastern Time
ETC .... Et Cetera (and so forth)
ETOE .... End to End
EVC .... End of Vertical Curve
EW .... End wall
EXC .... Excavation
EXST .... Existing
EXP .... Expansion
EXT .... Extension

F .... Fahrenheit
(F) .... Field
(FA) .... Field Adjusted
FA .... Federal Aid
FABX .... Fire Alarm Box
FAC .... Florida Administrative Code
FAP .... Federal Aid Project
FAU .... Faucet
FB .... Field Book
FC .... Fill Cap
FCE .... State Plane Coordinates (East Zone)
FCN .... State Plane Coordinates (North Zone)
FCW .... State Plane Coordinates (West Zone)
FCG .... Facing
FD .... Floor Drain
FDN .... Foundation
FDOT .... Florida Department of Transportation
FDR .... Fire Door
FE .... Floor Elevation

FED .... Federal
FES .... Flared End Section
FETS .... Flared End Terminal Section
FH .... Fire Hydrant
FHWA .... Federal Highway Administration
FI .... Furnish and Install
FIN .... Finish
FL .... Flow Line
FLA .... Florida
FLDC .... Flood Control
FLEX .... Flexible
FLM .... Flume
FM6 .... 6" Force Main
FM8 .... 8" Force Main
FM10 .... 10" Force Main
FM12 .... 12" Force Main
FM16 .... 16" Force Main
FM20 .... 20" Force Main
FNC .... Fence
FND .... Found
FNQ .... Fuse (Type Slow Burn)
FO .... Fiber Optics Line
FOC .... Face of Curb
FOL .... Following
FP .... Flag Pole
FPS .... Feet per Second
FQ .... Final Quantity
FR .... Front
FRM .... Frame
FRAC .... Fractional
FRNG .... Frangible
FREQ .... Frequency
FRB .... Frame Barn
FRCH .... Frame Church
FRS .... Far Side
FS .... Foresight
FT .... Foot or Feet
FTG .... Footing
FTOF .... Face to Face
FURN .... Furnish
FUT .... Future
FWD .... Forward

G .... Gram
(G) .... Grid
GA .... Gage or Gauge
GAL .... Gallon
GALV .... Galvanized
GAR .... Garage
GAS .... Gas Line
GC .... Grade Change
GD .... Gutter Drain
GEOM .... Geometric or Geometry
GI .... Gutter Inlet
GIP .... Galvanized Iron Pipe

GL .... Grade or Ground Line
GM .... Gas Main
GOVT .... Government
GND .... Ground
GP .... Galvanized Pipe
GR .... Guard Rail
GRA .... Guard Rail Anchor
GRD .... Grade
GRP .... Grade Point
GRV .... Grove
GS .... Glare Screen
GT .... Gate
GTR .... Gutter
GV .... Gas Valve
GVC .... Gas Valve Cover
GVL .... Gravel
GYA ....Guy Anchor
GYP .... Guy Pole
GYW .... Guy Wire

HA .... Hectare
HAT .... Hub and Tack
HD .... High Density
HDW .... Head wall
HE .... Head
HED .... Hedge
HH .... Heavy Hex
HI .... Height of Instrument
HML .... High Mast Lighting
HMP .... Half Mile Post
HNDRL .... Handrail
HO .... House
HOA .... Hand/Off/Automatic
HOR .... Horizontal
HP .... High Pressure
HR .... Hour
HS .... High Strength
HT .... Height
HVL .... High Voltage Line
HW .... High Water
HWL .... High Water Line
HWM .... High Water Mark
HWY .... Highway
HYD .... Hydraulic

I .... External Angle (Delta)
ICHG ....Interchange
ID .... Inside Diameter
IMC .... Intermediate Metal Conduit
IMP .... Improvement
IN .... Inch
INC .... Incorporated
INCL .... Included or Inclusive
INCN .... Incinerator
IND .... Industrial

INFO .... Information
INL .... Inlet
INST .... Instrument
INSTL .... Install
INT .... Intersection
INTK .... Intake
INTR .... Interior
INV .... Invert
IP .... Iron Pipe
IR .... Iron Rod
IS .... Island

JB .... Junction Box
JUNC .... Junction
JT .... Joint

K .... Peak Hour Factor
KIP .... 1000 Pounds (Force)
KM .... Kilometer
KN .... Known
KSI .... KIPS per Square Inch
KV .... Kilovolt
KVA .... Kilovolt Amperes

L .... Length of arc
LA .... Limited Access
LAKE .... Lake
LAT .... Latitude
LB .... Land Surveying Business
LBR .... Limerock Bearing Ratio
LC .... Long Chord
LEV .... Level
LF .... Linear Foot
LFS .... Lift Station
LG .... Large
LGTH .... Length
LIN .... Linear
LK .... Lock
LL .... Lane Line
LLW .... Lower Low Water
LMRK .... Limerock
LOB .... Line of Balance (PDMS)
LOC .... Limits of Construction
LONG .... Longitude
LP .... Light Pole
LS .... Length of Spiral
LT .... Left
LTD.. Lighted
LUM .... Luminaire
LV .... Levee
LW .... Light weight
LWL .... Low Water Line
LWP .... Lighter Wood Post
LYT .... Layout

M.....Meter
MACH.....Machine
MAG ..... Magnetic
MAINT ..... Maintenance
MAR ..... Marsh
MATL ..... Material
MAX ..... Maximum
MB ..... Map Book
MBM ..... 1000' Board Measure
MBX ..... Mailbox
MDPT ..... Midpoint
ME ..... Meter, Electric
MEAS ..... Measure
MED ..... Median
MEDB ..... Median Barrier
MEDBI ..... Median Barrier Inlet
MEDI ..... Median Inlet
MEMB ..... Member
MES ..... Mitered End Section
MESS ..... Message
MG ..... Meter, Gas
MH ..... Manhole
MHC ..... Manhole Cover
MHE ..... Manhole, Electric
MHHW ..... Mean Higher High Water
MHS ..... Manhole, Sewer
MHT ..... Mean High Tide
MHW ..... Mean High Water
MHWL ..... Mean High Water Line
MI ..... Mile
MID ..... Middle or Midway
MIL ..... 1000th of an Inch
MIN or ' ..... Minute
MISC ..... Miscellaneous
MK ..... Mark
MLLW ..... Mean Lower Low Water
MLT ..... Mean Low Tide
MLW ..... Mean Low Water
MLWL ..... Mean Low Water Line
MM ..... Millimeter
MN ..... Main
MO ..... Midordinate
MOBL ..... Mobilization
MOD ..... Modify or Modified
MON ..... Monument
MONW ..... Monitoring Well
MOT ..... Maintenance of Traffic
MP ..... Mile Post
MPH ..... Miles per Hour
MS ..... Multi-Sign
MSS ..... Multi-Sign Support
MSNRY ..... Masonry
MSL ..... Mean Sea Level
MTD ..... Mounted
MUN ..... Municipal or Municipality
MW ..... Meter, Water

N ..... North
NA ..... Not Applicable
NAT ..... Natural
NAV ..... Navigation
NB ..... Northbound
NC ..... Nail and Cap
ND ..... Nail and Disk
NDCBU ..... Neighborhood Delivery and Collection Box Unit
NE ..... Northeast
NGS ..... National Geodetic Survey
NGVD ..... National Geodetic Vertical Datum
NHW ..... Normal High Water
NIC ..... Not In Contract
NL ..... Nail
NM ..... Net Mile
NO ..... Number
NOM ..... Nominal
NONT ..... Non Traffic
NORM ..... Normal
NOS ..... National Oceanic Survey
NRCP ..... Non-reinforced Concrete Pipe
NS ..... Near Side
NT..... Nail and Tin
NTS ..... Not To Scale
NW ..... Northwest
O ..... Ocean
OA ..... Overall
OBS ..... Observation
OC ..... On Center
OD ..... Outside Diameter
OE ..... Overhead Electric
OF ..... Outfall
OH ..... Overhang
OHD ..... Overhead
OHS ..... Overhead Sign
OHW ..... Ordinary High Water
OM ..... Odd Marker
OP ..... Ornamental Plant
OPASS ..... Overpass
OPT ..... Option or Optional
OR ..... Official Records
ORC ..... Orchard
ORDN ..... Ordinance
ORG ..... Organization
ORIG ..... Original
OT ..... Overhead Telephone
OTOO ..... Outside to Outside
OUT ..... Outlet
OHD ..... Overhead
OZ ..... Ounce

P ..... Point

(P) .... Plat
PAR .... Parallel
PART .... Participation
PAT .... Patio
PC .... Point of Curvature
PCBC .... Pre-cast Concrete Box Culvert
PCC .... Point of Compound Curvature
PCE .... Permanent Construction Easement
PCP .... Permanent Control Point
PCULV .... Pipe Culvert
PDS .... Pedestrian
PE .... Professional Engineer
PED .... Pedestal
PEN .... Penetration
PG .... Page
PGR .... Profile Grade
PGRL .... Profile Grade Line
PH .... Phase
PI .... Point of Intersection
PIL .... Piling
PIP .... Pipe
PIPEN .... Pipe Encasement
PIR .... Pier
PIT .... Pit
PK .... Parker Kalan nail
PKD .... PK nail and Disk
PKG .... Parking
PL .... Property Line
PLEQ .... Playground Equipment
PLG .... Plug
PLS .... Professional Land Surveyor
PLN .... Planters
PM .... Noon until Midnight
PMON........ Poured Monument
PMP .... Pump
PMPIS .... Pump Island
PND .... Pond
POB .... Point of Beginning
POC .... Point on Curve
POL .... Point on Line
POR .... Porch
POS .... Position
POST .... Point on Semi-Tangent
POT .... Point on Tangent
PP .... Power Pole
PQ .... Plan Quantity
PR .... Pair
PRC .... Point of Reverse Curvature
PRCST .... Pre-cast
PRE .... Preliminary
PREST .... Pre-stressed
PRF .... Post and Rail Fence
PRIM .... Primary
PRIN .... Principle
PRIV .... Private
PRM .... Permanent Reference Monument
PROB .... Probability
PROG .... Programmed
PROJ .... Project
PROP .... Property
PROV .... Provisions
PRSE .... Pressure
PS .... Pedestrian Signal
PSE .... Plans, Specifications, and Estimates
PSI .... Pounds per Square Inch
PST .... Post
PT .... Point of Tangency
PTIME .... Pre-Timed
PUB .... Public
PVC .... Polyvinyl Chloride
PVI .... Point of Vertical Intersection
PVT .... Pavement
PVTN .... Point of Vertical Tangency
PW .... Pressure Water
PWR .... Power Line

Q .... Peak Discharge
QUAD .... Quadrant
QTR .... Quarter
QTRS .... Quarter Section Line

R .... Radius
RA .... Right Angle
RBAC .... Rock Base Asphaltic Concrete
RBST .... Rock Base Surface Treatment
RC .... Reinforced Concrete
RCP .... Reinforced Concrete Pipe
RCPA .... Reinforced Concrete Pipe Arch
RD .... Roadway
RDSD .... Roadside
REC .... Record
RECT .... Rectangular
RECV .... Recovery
REF .... Reference
REFL .... Reflective
REIN .... Reinforced
REJUV .... Rejuvenation
RELOC .... Relocated
REM .... Removable or Removed
REPL .... Replace
REQ .... Required
RES .... Residence
RESV .... Reservation
RET .... Retention
RETW .... Retaining Wall
REV .... Revised or Revision
REVS .... Reverse
RHW .... Insulation
RIP .... Riparian
RL .... Reference Line

RLS .... Registered Land Surveyor
RM .... Reference Monument
RND .... Round
RNG .... Range
RP .... Reference Point
RPM .... Raised Reflective Pavement Marker
RR .... Railroad
RRCL .... Railroad Centerline
RRMP .... Railroad Milepost
RRS .... Railroad Switch
RRWS .... Railroad Warning Sign
RRX .... Railroad Crossing
RS .... Rate of Superelevation
RSF .... Resurface
RSVR .... Reservoir
RT .... Right
RW .... Right of Way
RWL .... Right of Way Line
RWY .... Railway

S .... South
SAHM .... Sand Asphalt Hot Mix
SAN .... Sanitary
SAT .... Stake and Tack
SB .... Southbound
SBAC .... Shell Base Asphaltic Concrete
SBRM .... Sand Bituminous Road Mix
SBST .... Shell Base Surface Treatment
SC .... Spiral to Curve
SCH .... Schedule
SCST .... Sand Clay Surface Treatment
SCT .... Scattered Trees
SD .... Side Drain
SDG .... Sounding
SEE .... Southeast
SEAW .... Seawall
SEC or " .... Second
SECT .... Section
SED .... Sediment
SEDB .... Sediment Basin
SEDP .... Sediment Pond
SEF .... Sanitary, Effluent
SEP .... Separator
SEQ .... Sequential
SEW .... Straight End wall
SF .... Shrinkage Factor
SG .... Sub Grade
SGL .... Single
SGN .... Sign
SGNT .... Sign Truss
SH .... Sheet
SHLDR .... Shoulder
SHP .... Shared Pole
SHR .... Shrub
SHRY .... Shrubbery
SHW .... Seasonal High Water
SIG .... Signal
SIGA .... Signal Arm
SIGP .... Signal Pedestal
SIGC .... Signal Controller
SILO .... Silo
SL .... Sea Level
SLD .... Straight Line Diagram
SLP .... Slope
SMA .... Signal Mast Arm
SP .... Standpipe
SPA .... Space
SPCG .... Spacing
SPD .... Special Drainage
SPEC .... Specifications
SPEW .... Special End wall
SPGR .... Specific Gravity
SPH .... Sprinkler Head
SPK .... Spike
SPL .... Spillway
SPR .... Spring
SQFT .... Square Foot
SQIN .... Square Inch
SQYD .... Square Yard
SR .... State Road
SRF .... Split Rail Fence
SRV .... Service
SRVB .... Service Box
SRVC .... Service Cabinet
SS .... Sanitary Sewer
SSS .... Sign, Single Support
SSMD .... Solid State Modular Design
SSP .... Signal Span Pole
SSTA .... Substation
SSTR .... Substructure
ST .... Spiral to Tangent
STA .... Station
STAB .... Stability
STB .... Staub
STC .... Storm Clean out
STD .... Standard
STG .... Strong
STK .... Stake
STL .... Steel
STMD .... Stamped Disk
STMP .... Stamped Plate
STOR .... Storage
STP .... Steps
STR .... Street
STRT .... Straight
STRC .... Structure
STRM .... Stream
STRMC .... Stream Center
STS .... Storm Sewer
STTK .... Storage Tank

STWY .... Stairway
STY .... Story
SU .... Single Unit
SUBD .... Subdivision
SUBS .... Subsoil
SUBGR .... Sub grade
SUP .... Setup Point
SUPP .... Supports
SUR .... Survey
SURF .... Surface
SW .... Southwest
SWF .... Stock (Hog) Wire Fence
SWG .... Signal with Gate
SWK .... Sidewalk
SWP .... Swamp
SYS .... System

T .... Tangent Length of Curve
TA .... Turn Arrow
TB .... Telephone Booth
TBM .... Temporary Bench Mark
TC .... Tangent to Curve
TCB .... Temporary Concrete Barrier
TCP .... Terra Cotta Pipe
TCZ .... Traffic Control Zone
TE .... Temporary Easement
TEL .... Telephone Line
TELEG .... Telegraph
TELP .... Telephone Pole
TELS .... Telephone Service Box
TEMP .... Temperature
TER .... Terrace
TF .... Traffic
TFD .... Traffic Detection Loop
TFS .... Traffic Signal
TFSP .... Traffic Separator
TG .... Tide Gage
TH .... Test Hole
THEO .... Theoretical
THPL .... Thermoplastic
THW .... Insulation
THK .... Thickness
TK .... Tank
TL .... Traverse Line
TMP .... Temporary
TMPW .... Temporary Wall
TN .... Town
TNPK .... Turnpike
TOB .... Top of Bank
TOC .... Top of Curb
TOD .... Top of Ditch
TOPO .... Topographic or Topography
TOS .... Top of Slope
TOT .... Total
TP .... Turning Point

TPD .... Telephone Pedestal
TR .... Tract
TRANS .... Transition
TRB .... Trash Bin
TRD .... Treadle
TREAT .... Treatment
TREE .... Tree
TRNF .... Transformer
TS .... Tangent to Spiral
TSC .... Length of Tangent (Spiral Curve)
TWP .... Township
TX .... Tractor Crossing
TYP .... Typical

U .... Upright
UD .... Underdrain
UDBX .... Underdrain Box
UEW .... T-Type End wall
UG .... Underground
UND .... Under
UNL .... Unloaded
UNPS .... Unpaved Shoulder
UNTR .... Untreated
UP .... Utility Pole
UPASS .... Underpass
UPSTR .... Upstream
URD .... Under Roadway
USCGS .... U. S. Coast and Geodetic Survey
USGS .... U. S. Geological Survey

UTIL .... Utility
UTM .... Universal Transverse Mercator

VAC .... Vacant
VAL .... Valley
VAR .... Variable
VB .... Valve Box
VC .... Valve Cover
VCG .... Valve Cover, Gas
VCL .... Vertical Center Line
VCP .... Vitrified Clay Pipe
VCS .... Valve Cover, Sewer
VCW .... Valve Cover, Water
VEH .... Vehicle
VERC .... Vertical Curve
VERP .... Vertical Panel
VERT .... Vertical
VF .... Vertical Foot
VG .... Visible from ground
VH .... Verified Horizontal Position
VIT .... Vitrified
VLV .... Valve
VMS .... Variable Message Sign
VNT .... Vent
VNTG .... Vent, Gas

VNTS .... Vent, Sewer
VOL .... Volume
VP .... Vent Pipe
VPD .... Vehicles Per Day
VRMS .... Volts Root Mean Square
VV .... Verified Vertical Elevation
VVH ..... Verified Vertical Elevation and Horizontal Position
VW .... Variable Width

W .... West
WALL .... Wall
WB .... Westbound
WC .... Witness Corner
WCR .... Water Cement Ratio
WD .... Wood
WDL .... Woods Line
WE .... Well
WEDG .... Waters Edge
WEW .... Winged End wall
WH .... Water Heater
WHS .... Warehouse
WK .... Walk
WIN .... Window
WL .... Water Line

WM .... Water Main
WP .... Witness Post
WPB .... Wiring Pull Box
WPI .... Work Program Item
WPMP .... Water Pump
WRG .... Wiring
WT .... Weight
WV .... Water Valve
WVC .... Water Valve Cover
WWF .... Welded Wire Fabric

X .... X ordinate (Easting)
XB .... Cross Section on Baseline
XING .... Crossing
XO .... Cross Over
XRD .... Cross Road
XS .... Cross Section

Y .... Y ordinate (Northing)
YD .... Yard Drain
YR .... Year

APPENDIX D - Pocket Guide

POCKET GUIDE FOR DEPARTMENT OF TRANSPORTATION EFB

FUNCTION KEYS:

HEADER SCREEN

KEY [0] **RECORD HEADER** SAVES CURRENT SCREEN TO INTERNAL FILE ON THE FIELD COMPUTER

KEY [1] **PAGE BACKWARD** PAGES THROUGH THE DATA SCREENS PREVIOUSLY SAVED IN REVERSE CHRONOLOGICAL ORDER

KEY [2] **PAGE FORWARD** PAGES THROUGH THE DATA SCREENS PREVIOUSLY SAVED IN CHRONOLOGICAL ORDER

CALIBRATION SCREEN

KEY [0] **RECORD CALIBRATION** SAVES CURRENT SCREEN TO INTERNAL FILE ON THE FIELD COMPUTER

KEY [1] **PAGE BACKWARD** PAGES THROUGH THE DATA SCREENS PREVIOUSLY SAVED IN REVERSE CHRONOLOGICAL ORDER

KEY [2] **PAGE FORWARD** PAGES THROUGH THE DATA SCREENS PREVIOUSLY SAVED IN CHRONOLOGICAL ORDER

KEY [3] **DELETE CALIBRATION** MARKS THE CALIBRATION SCREEN DELETED AND REMOVES IT FROM THE DISPLAY LIST

TEST SCREEN

KEY [0] **RECORD POINTING** SAVES CURRENT SCREEN TO INTERNAL FILE ON THE FIELD COMPUTER

KEY [9] **POLL** CAUSES TOTAL STATION TO MEASURE AND TRANSMIT THE OBSERVATION DATA TO THE FIELD COMPUTER

SETUP SCREEN

KEY [0] **RECORD SETUP** SAVES CURRENT SCREEN TO INTERNAL FILE ON THE FIELD COMPUTER

KEY [1] **PAGE BACKWARD** PAGES THROUGH THE DATA SCREENS PREVIOUSLY SAVED IN REVERSE CHRONOLOGICAL ORDER

KEY [2] **PAGE FORWARD** PAGES THROUGH THE DATA SCREENS PREVIOUSLY SAVED IN CHRONOLOGICAL ORDER

KEY [6] **MODIFY** DATA SCREEN MARKS PREVIOUS VERSION OF DATA SCREEN AS MODIFIED AND APPENDS THE MODIFIED VERSION AS KEYED-IN

KEY [7] **RE-USE** USES THE CURRENT POINT NAME AND POINT DATA FOR ADDITIONAL SETUP

KEY [8] **INCREMENT** GETS THE NEXT AVAILABLE SUFFIX FOR THE CURRENT POINT NAME FOR A NEW POINT TO BE OBSERVED

OBSERVATION SCREEN - HVD & SOR

KEY [0] **RECORD OBSERVATION** SAVES CURRENT SCREEN TO INTERNAL FILE ON THE FIELD COMPUTER

KEY [1] **PAGE BACKWARD** PAGES THROUGH THE DATA SCREENS PREVIOUSLY SAVED IN REVERSE CHRONOLOGICAL ORDER

KEY [2] **PAGE FORWARD** PAGES THROUGH THE DATA SCREENS PREVIOUSLY SAVED IN CHRONOLOGICAL ORDER

KEY [3] **DELETE OBSERVATION** MARKS THE OBSERVATION SCREEN DELETED AND REMOVES IT FROM THE DISPLAY LIST

KEY [4] **ROLL BACKWARD** ROLLS THROUGH A CURRENT LISTING OF CHAIN NAMES AND DATA IN THE CHAIN ACTIVE EDIT LIST

KEY [5] **ROLL FORWARD** ROLLS THROUGH A CURRENT LISTING OF CHAIN NAMES AND DATA IN THE CHAIN ACTIVE EDIT LIST

KEY [6] **MODIFY** DATA SCREEN MARKS PREVIOUS VERSION OF DATA SCREEN AS MODIFIED AND APPENDS THE MODIFIED VERSION AS KEYED-IN

KEY [7] **RE-USE** USES THE CURRENT POINT NAME AND POINT DATA FOR ADDITIONAL OBSERVATIONS

KEY [8] **INCREMENT** GETS THE NEXT AVAILABLE SUFFIX FOR THE CURRENT POINT NAME FOR A NEW POINT TO BE OBSERVED

KEY [9] **POLL** CAUSES TOTAL STATION TO MEASURE AND TRANSMIT THE OBSERVATION DATA TO THE FIELD COMPUTER

REMARKS SCREEN

KEY [0] **RECORD REMARKS** SAVES CURRENT SCREEN TO INTERNAL FILE ON THE FIELD COMPUTER

KEY [1] **PAGE BACKWARD** PAGES THROUGH THE DATA SCREENS PREVIOUSLY SAVED IN REVERSE CHRONOLOGICAL ORDER

KEY [2] **PAGE FORWARD** PAGES THROUGH THE DATA SCREENS PREVIOUSLY SAVED IN CHRONOLOGICAL ORDER

CHAIN SCREEN

KEY [0] **RECORD CHAIN** SAVES CURRENT CHAIN SCREEN TO INTERNAL FILE ON THE FIELD COMPUTER

KEY [4] **ROLL BACKWARD** ROLLS THROUGH A CURRENT LISTING OF CHAIN NAMES AND DATA IN THE CHAIN ACTIVE EDIT LIST

KEY [5] **ROLL FORWARD** ROLLS THROUGH A CURRENT LISTING OF CHAIN NAMES AND DATA IN THE CHAIN ACTIVE EDIT LIST

KEY [7] **DIRECTORY** SHOWS A LISTING OF ALL CHAINS IN ORDER OF RECORDING THAT WERE NOT DELETED

KEY [8] **INCREMENT** GETS THE NEXT AVAILABLE SUFFIX FOR THE CURRENT CHAIN NAME AND RECORDS THE CHAIN INCREMENTED

TAPING SCREEN

KEY [0] **RECORD TAPE** SAVES CURRENT SCREEN TO INTERNAL FILE ON THE FIELD COMPUTER

KEY [1] **PAGE BACKWARD** PAGES THROUGH THE TAPE SCREENS PREVIOUSLY SAVED IN REVERSE CHRONOLOGICAL ORDER

KEY [2] **PAGE FORWARD** PAGES THROUGH THE TAPE SCREENS PREVIOUSLY SAVED IN CHRONOLOGICAL ORDER

KEY [6] **MODIFY TAPE** SCREEN MARKS PREVIOUS VERSION OF TAPE SCREEN AS DELETED AND REPLACES IT WITH THE CURRENT VERSION

KEY [7] **SHIFT** REPLACES THE PREVIOUS OCCUPIED AND BACK SIGHT POINTS WITH THE PREVIOUS NEW POINT AND OCCUPIED POINT RESPECTIVELY, CLEARS NAME FIELD FOR NEW POINT NAME KEY-IN

KEY [8] **INCREMENT** GETS THE NEXT AVAILABLE SUFFIX FOR THE CURRENT POINT NAME FOR A NEW POINT TO BE TAPED

KEY [9] **SHIFT-INCREMENT** REPLACES THE PREVIOUS OCCUPIED AND BACK SIGHT POINTS WITH THE PREVIOUS NEW POINT AND OCCUPIED POINT RESPECTIVELY, INCREMENTS THE CURRENT POINT NAME

ROLL THROUGH'S

CALIBRATION SCREEN:

KEY [B] **BRAND** SELECTS INSTRUMENT FROM A LISTING OF SUPPORTED TOTAL STATIONS, THEODOLITES, LEVELS, ETC.

KEY [M] **MODEL** SELECTS MODEL OF THE SELECTED BRAND OF INSTRUMENT

SETUP, OBSERVATION SCREENS:

KEY [G] **GEOMETRY** TYPE (**P**OINT OR **C**URVE) OF THE OBJECT BEING OBSERVED

KEY [A] **ATTRIBUTE** (**G**-GROUND POINT, **F**-FEATURE POINT, **X**-CROSS SECTION, **U**-USER DEFINED) OF THE OBJECT BEING OBSERVED, INDICATES RELATIONSHIP OFTARGET TO GROUND SURFACE

KEY [Z] **ZONE** (1 through 9) OF THE OBJECT BEING OBSERVED, INDICATES WHICH SURFACE THE ATTRIBUTE REPRESENTS

OBSERVATION SCREEN:

KEY [P] **PLATE POSITION** SETTING (INCREMENTS UP FROM 01 -> NN, TOGGLING BETWEEN N AND N+1 UNTIL AN OBSERVATION IS RECORDED AT N+1)

KEY [I] INSTRUMENT **TELESCOPE** ORIENTATION (**D**IRECT [face 1] OR **R**EVERSED [face 2])

DATA TYPES:

DISTANCES - INPUT AS A SCALAR QUANTITY (MEASURED DISTANCE) FOLLOWED BY THE TYPE OF DISTANCE MEASURED [123.12 S OR 624.34 H]

S - SLOPE DISTANCE (DEFAULT WHEN NO DISTANCE TYPE IS INPUT)

H - HORIZONTAL DISTANCE.. MEASURED IN THE HORIZONTAL PLANE

ECCENTRICITY - INPUT AS A SCALAR QUANTITY (MEASURED OFFSET FROM TARGETLOCATION TO OBJECT BEING LOCATED) FOLLOWED BY ECCENTRICPOSITION INDICATOR

F - FRONT OF OBJECT... TARGET IS ON LINE BETWEEN INSTRUMENT AND OBJECT BEING LOCATED

B - BACK OF OBJECT.... OBJECT BEING LOCATED IS ON LINE BETWEEN INSTRUMENT AND TARGET

L - LEFT OF OBJECT.... TARGET IS AT RIGHT ANGLES TO THE LEFT OF OBJECT BEING LOCATED WITH RESPECT TO THE INSTRUMENT

R - RIGHT OF OBJECT... TARGET IS AT RIGHT ANGLES TO THE RIGHT OF OBJECT BEING LOCATED WITH RESPECT TO THE INSTRUMENT

FEATURE CODE FIELD OPTIONS

THE FEATURE CODE FIELD ALLOWS SEVERAL OPTIONS FOR PLOTTING SYMBOLS REPRESENTING OBJECTS LOCATED, ASSOCIATED TEXT, AND ALIGNMENT INFORMATION

SYMBOLS

AN ALPHANUMERIC STRING REPRESENTING THE OBJECT TO BE PLOTTED IS PLACED AS THE FIRST DATA ITEM IN THE FEATURE CODE FIELD (SEE FEATURE CODE LISTING)

F:TELP

SYMBOLS WITH TEXT

THE TEXT TO BE PLOTTED WITH THE SYMBOL IS PLACED AFTER THE ALPHANUMERIC STRING, SEPARATED BY A DASH(-)

F:TELP-WOOD PWR POLE AT&T

TEXT ONLY

A SPECIAL FEATURE CODE (CODE 99) IS USED TO PLACE TEXT AT A LOCATION

F:99-TEXT PLOTTED HERE

TEXT WILL BE PLOTTED AT THE LOCATION OF THE TARGET NEXT TO THE SYMBOL BEING PLOTTED IF THE SYMBOL FEATURE CODE WAS SELECTED

FEATURE CODES WILL DETERMINE LINE TYPE FOR CHAINS BEING PLOTTED

ALIGNMENT DATA FOR TOTAL STATION CROSS SECTIONS

A SPECIAL CASE OF THE FEATURE CODE FOR CROSS SECTIONS OBSERVED WITH HVD OBSERVATION TYPE

WHEN THE ATTRIBUTE IS SET TO X (A:X) THE **ALIGNMENT NAME,** FOLLOWED BY THE **STATION NUMBER,** AND **ORIENTATION** OF THE SHOT MUST BE IN THE FEATURE CODE FIELD SEPARATED BY COMMAS

ALIGNMENT NAME - MUST BE A VALID CHAIN NAME

STATION NUMBER - MAY BE INPUT AS A INTEGER STATION (1000.00 SAME AS 10+00)
- MAY BE INPUT IN STATION NOTATION (10+00)

ORIENTATION - INDICATOR FOR SHOTS TAKEN
L - LEFT OF THE ALIGNMENT
R - RIGHT OF THE ALIGNMENT
B - ON THE ALIGNMENT

FEATURE CODES FOR POINTS - only assigned when graphical representation is required

MONUMENTATION

AT .... Aerial Target
CMON .... Cast Monument
DH .... Drill Hole, Plug
DRM .... Deep Rod Mark
IRC .... 5/8" Iron Rod & Cap
NL .... Nail, Spike, Pin
OM .... Other Described Monument
PIP .... Pipe, Rod, Bar
PMON .... Poured Monument
PST .... Post, Stake, Staub
RRMP .... Railroad Milepost
SAT .... Hub & Tack Monument
STMD .... Stamped Disk
STMP .... Stamped Plate

PLANTS

OP .... Ornamental Plant
SHR .... Shrub, Bush
SHRC .... Coniferous Shrub
SHRD .... Deciduous Shrub
STM .... Stump
TREE .... Tree, Describe?
TREEC .... Coniferous Tree
TREECI .... Citrus Tree
TREECY .... Cypress Tree
TREED .... Deciduous Tree
TREEOA .... Oak Tree
TREEPA .... Palm Tree
TREEPC .... Palm Tree Cluster
TREEPI .... Pine Tree

WATER RELATED

FAU .... Faucet
FH .... Fire Hydrant
PMP .... Pump Well
SP .... Standpipe/Well
SPH .... Sprinkler Head
SPR .... Spring
TG .... Tide Gage
WLPT .... Wetland Point
WELL .... Well, size?

TELEPHONE

TB .... Telephone Booth
TELP .... Telephone Pole
TPD .... Telephone Pedestal

ELECTRICAL

ELEO .... Electric Outlet
FLD .... Flood Light
HML .... High Mast Light
LP .... Light Pole
PP .... Power Pole
PPT .... Power Pole with Transformer
PS .... Pedestrian Signal
RRS .... Railroad Switch
RRWS .... Railroad Warning Sign
SHP .... Shared Pole
SHPT .... Shared Pole (with transformer)
SIG .... Signal
SIGC .... Signal Controller
SIGP .... Signal Pedestal
SMA .... Signal Mast Arm
SRVC .... Service Cabinet
SSP .... Signal Span Pole
SWG .... Signal with Gate
TRNF .... Transformer
WPB .... Wiring Pull Box

POLES

ANT .... Antenna
CLMT .... Column Tower
FP .... Flag Pole
GYA .... Guy Anchor
GYP .... Guy Pole
PIL .... Piling, Pier
SSS .... Sign, Single Support

UTILITIES

CLNO .... Clean out
DMPS .... Dump Station/SS
FC .... Fill Cap
GA .... Gauges
M .... Meter, Unknown
ME .... Meter, Electric
MEU .... Meter, Electric (Underground)
MG .... Meter, Gas
MH .... Manhole, Unknown
MHD .... Manhole, Storm water
MHE .... Manhole, Electric
MHG .... Manhole, Gas
MHS .... Manhole, Sewer
MHT .... Manhole, Telephone
MHW .... Manhole Cover, Water
MW .... Meter, Water
PMPF .... Fuel Pump
PMPST .... Pump Station
RG .... Gas Regulator
UDBX .... Underdrain Box
VB .... Valve Box
VBG .... Valve Box Gas
VBNPW .... Valve Box (Non-Potable Water)

VBS .... Valve Box Sewer
VBW .... Valve Box Water
VC .... Valve Cover, Unknown
VCEF .... Valve Cover (Effluent)
VCG .... Valve Cover, Gas
VCNPW ...... Valve Cover (Non-Potable Water)
VCS .... Valve Cover, Sewer
VCRW .... Valve Cover (Raw Water)
VCW .... Valve Cover, Water
VLV .... Valve, ?
VLVG .... Valve Gas
VLVNPW .... Valve (Non-Potable Water)
VLVS .... Valve Sewer
VLVW .... Valve Water
VNT .... Vent, Unknown
VNTG .... Vent, Gas
VNTS .... Vent, Sewer
WIM .... Wind Mill

MISCELLANEOUS

BN .... Beacon
BNCH .... Bench, Bus Wait
BUOY .... Buoys
CGD .... Cattle Guard
CSH .... Core Sample/Test Boring
DF .... Dolphins and Fenders
CATVS .... Cable Television Service Box
CMPST .... Camp stove, Pit
DLP .... Delineator Post
DMP .... Dumpster, Bin
HNDC .... Handicap Pavement Marking
HOLE .... Hole
INCN .... Incinerator
MBX .... Mailbox(s)
MHCATV .... Manhole Cover (Cable TV)
MONW .... Monitoring Well
NAPLAN .... North Arrow (Plan)
NAR1 .... North Arrow 1
NAR2 .... North Arrow (Corps)
NAR3 .... North Arrow 3
NAR4 .... North Arrow 4
PKGM .... Parking Meter
PLEQ .... Playground Equipment
QTREW .... 1/4 Section Corner E or W
QTRNS .... 1/4 Section Corner N or S
SATD .... Satellite Dish Antenna
SECT .... Section Corner
SILO .... Silo
STAROW .... Straight Direction Arrow
STATRN .... Straight and Turn Arrow
STTK .... Storage Tank
TA .... Turn Arrow

TEXT

BL .... Baseline Field Survey Symbol
CL .... Centerline Symbol
MAR .... Marsh Symbol
MISC .... Text (Miscellaneous)
NOTE .... Text (Miscellaneous)

FEATURE CODES FOR CHAINS -always to be assigned

ELECTRICAL

BCATV .... Buried Cable Television
BPWR .... Buried Power, Size Unknown
CATV .... Cable Television Line
CATVC .... Cable TV Line Conduit System
ELECS .... Electric Service Box (Large)
HVL .... High Voltage Line
PWR .... Power Line

DESIGN - ROADWAY

AC .... Asphalt Pavement Crown
AP .... Asphalt Pavement
APRS .... Approach Slab
ARST .... Archeological Site
ATTN .... Attenuator
BARW .... Barrier Wall
BNK .... Bank - Top/Bottom
BRDG .... Bridge Element
CCR .... Curb Cut Ramp
CG .... Curb and Gutter
CGB .... Curb and Gutter (Back)
CGF .... Face of Curb and Gutter
CL .... Center Line
CPV .... Concrete Pavement
CPVC .... Concrete Pavement (Crown)
CPVJ .... Concrete Pavement (Joints)
DEP .... W.M.D & D.E.P Wetlands
DTCH .... Ditch - Top, CL, Bottom
DUCT .... Conduit & Encasements
DWY .... Driveway
GRDBL .... Guard Rail Double Faced
GRL .... Guard Rail Left
GRR .... Guard Rail Right
GS .... Glare Screen
GYS .... Span Guys
HNDRL .... Handrail, Walls
LL .... Lane Line
MP .... Miscellaneous Pavement
MS .... Multi-Sign
RD .... Road - CL, Edge
RR .... Railroad (Rail, Bed)
RRCL .... Railroad Centerline
RRX .... Railroad Crossing
SGNT .... Sign Truss
SHLDR .... Shoulder
SLP .... Slope - Top/Bottom
SWK .... Sidewalk Edge
SWKB .... Sidewalk Edge
TFD .... Traffic Detector Loop
TFSP .... Traffic Separator
TMPW .... Temporary Wall
TRD .... Treadle
TX .... Tractor Crossing
UNPS .... Unpaved Shoulder
XO .... Cross Over

TOPOGRAPHY

BAS .... Basin, Pond
BL .... Baseline, Centerline Survey
BLC .... Baseline Control
BLDG .... Building
CAN .... Canal, Lock
COE .... CORPS Wetlands (Marsh or Swamp)
CSL .... Concrete Slab
DECK .... Deck / Porch
DOCK .... Docks and Wharfs
DUMB .... Dummy Chains
EM .... Edge of Mangrove
EXIST .... Existing Ground Surface
FNC .... Fence, Type?
GRV .... Grove, Orchard
GT .... Gate, Gap
HED .... Hedges, Shrubbery
LV .... Levee, Dike, Dam
MAR .... Marsh, Swamp
MISC .... Miscellaneous Topo
PMPIS .... Pump Island
RIP .... Rip Rap, Rubble (Describe)
SCT .... Scattered Trees
SE .... Sanitary Effluent (Open Channel)
SEAW .... Seawall
STP .... Steps, Planters
STRM .... Stream Edge
STRMC .... Stream Center
WALLS .... Walls
WDL .... Woods Line
WEDG .... Water's Edge

DESIGN - DRAINAGE

AGV .... Vaults, Above Ground
BXC .... Box Culvert
CB .... Catch Basin
CINL .... Curb Inlet
DRNB .... Drainage Bottom
DRNP .... Drainage Pipe
DTCHI .... Ditch Inlet
DTCHP .... Ditch Pavement
FES .... Flared End Section
GI .... Gutter Inlet
JB .... Drainage Junction Box
MEDI .... Median Inlet
MES .... Mitered End Section
PCULV .... Pipe Culvert
PIPEN .... Pipe Encasement
SEW .... Straight End wall
SPD .... Special Drainage
SPEW .... Special End wall
SPL .... Spillway, Flume
STS .... Storm Sewer (Size?)
UD .... Under Drains / Cross Drains
UEW .... U-Type End wall
WEW .... Winged End wall
YD .... Yard Drain

UTILITIES

BT .... Buried Telephone, Size Unknown
BTD .... Buried Telephone Duct
BTT .... Buried Telephone Toll
FM .... Force Main, (Size?)
FO .... Fiber Optics Telephone (Size?)
FOC .... Fiber Optics Cable (Size?)
FOCU ..... Fiber Optics Cable (Underground)
FOP .... Fiber Optics Power (Size?)
FOPU ..... Fiber Optics Power (Underground)
FOU .. Fiber Optics Telephone (Underground)
GAS .... Gas Line, Size Unknown
PETRO .... Oil Line (All sizes)
SS .... Sanitary Sewer, (Size?)
TEL .... Overhead Telephone Line
TELS .... Telephone Service Box (Large)
WL .... Water Line, (Size?)

APPENDIX E – Glossary

Most of these definitions, as well as others, can be found in the Vocabulary for Data Processing, Telecommunications, and Office Systems, 7th Edition, July 81, published by IBM.

adapter:
a peripheral device used to extend the capabilities of the computer.

address:
the identification of a specific location in memory or a specific device. Also, to access such a memory location or device.

ANSI.SYS:
an installable device driver that permits extended control of the PC screen and keyboard.

application program:
Computer software designed to perform a specific task, for example, word processing.

ASCII:
(American Standard Code for Information Interchange) a recognized standard for the numerical representation of information in data processing systems.

assembly language:
a low level computer language in which each command issued corresponds to a single computer instruction. In contrast, a command issued in a higher level language, such as BASIC, can result in multiple computer instructions.

asynchronous:
data transmission consisting of individually communicated characters (Contrast with synchronous).

attenuation:
a reduction in strength of the transmitted signal. Signal attenuation caused by resistance in the communications line can result in data losses.

AUTOEXEC.BAT:
a batch file that, if present, contains a series of commands for the PC to perform automatically on a power-up.

back-up:
a duplicate copy of programs or data that ensures availability should loss or damage occur to the original.

batch file:
a file containing a command or series of commands that the PC

performs with no user intervention.

baud:
during synchronous communications, the rate of data modulation per second. Also loosely the number of bits per second transferred; however, several sophisticated data encoding schemes, such as phase shift keying (PSK), allow more than one bit to be transferred per baud. (See also bps.)

BIOS:
Basic Input/Output System. The BIOS is a set of primitive routines stored permanently in ROM. These routines control the operation of major PC peripheral devices, such as the screen, disk drives, and keyboard.

bit:
a contraction of the term binary digit. The binary numbering system contains only two members, 0 and l; therefore, a bit can be either a 0 or a l.

boot:
casual term for the process involved in starting a computer.

bps:
bits per second. The number of bits transmitted by a communications device in one second. (See also baud)

break:
a signal consisting of a string of data zeroes longer than a transmitted character. The break signal interrupts normal operation to allow manual or program intervention.

buffer:
a temporary data storage area reserved for use during input (read) or output (write) operations.

byte:
a binary character operated upon as a unit, usually shorter than a computer word, that constitutes the smallest addressable unit in a computer system.

carrier:
a continuous signal altered by a modem or serial port to indicate transmitted data.

CCITT:
(*Comite Consultatif Internationale de Telegraphie et Telephonie* (International Telegraph and Telephone Consultative Committee)) The CITT standard for 300 bps transmissions is V21; the standard for l200bps transmissions is V22. These standards are defined in the CCITT Sixth Plenary Assembly Orange Book, published by International Telecommunications Union, Geneva, Switzerland, 1978.

CD:
(Carrier Detect) the RS-232 interface signal that indicates whether or not the serial port is receiving data.

character:
a distinct member of a finite set of numbers, letters, and symbols used to represent data.

character format:
the predetermined composition of information allowing the accurate decoding of transmitted data. Character format depends on such variables as character length, number of start and stop bits, and parity bits.

CMOS:
complementary metal oxide semiconductor. CMOS is a technology that produces integrated circuits that operate on extremely low power from a wide range of power supply voltages.

command:
an instruction or series of instructions that cause the computer to perform a specific task.

command processor:
the file, COMMAND.COM that accepts and interprets MS-DOS commands.

communications:
the interfacing of two or more data terminal devices for the purposes of transferring data.

CONFIG.SYS:
a file that, if present, the PC automatically reads during a "cold" power-up that installs device drivers or otherwise produces a specific computer configuration.

configuration:
the combination of installed hardware and software that allows the PC to perform specific tasks.

cps:
characters per second. A standard unit of measure of printer speed.

CPU:
central processing unit. The CPU is the functional unit that accepts, interprets, and executes programmed machine instructions.

crossover cable:
a cable in which data signals cross internally within the cable rather than passing straight through. Crossover cables are used in instances in which similar devices are connected, for example DTE to DTE or DCE to DCE.

cursor:
The graphic device, either blinking underline or box, that moves on the screen to indicate the current input location.

CRC:
cyclic redundancy check. The CRC is a systematic test that ensures errors are not introduced into data during read and write operations.

CTS:
(Clear to send) the RS-232 interface signal that indicates whether or not the serial port is prepared to transmit data.

data:
the representation of meaningful information in some formally recognized system.

DCE:
(Data Communication Equipment) the device necessary to establish and maintain the communications link. A modem is an example of a DCE. (Compare with DTE.)

diagnostic:
a program or routine designed to exercise and test the capabilities of a system to detect possible errors or problem conditions.

disk:
loosely any magnetic disk medium used for mass storage, either are movable (floppy) diskette or a non-removable (hard) disk.

display:
the visual presentation of information on the screen.

DSR:
(Data Set Ready) the RS-232 interface signal that indicates that data is ready to be transmitted to the receiver.

DTE:
(Data Terminal Equipment) the device necessary to control and maintain the communications link. The PC is an example of a DTE.(Compare with DCE.)

DTR:
(Data Terminal Ready) the RS-232 interface signal that indicates whether the receiver is ready to accept data.

duplex:
communications in which transmissions are possible in both directions. In full duplex, transmissions are simultaneous; in half duplex, transmissions alternate. (Contrast with simplex)

echo:
the ability to display characters on the computer screen.

EIA:
(Electronic Industry Association) RS-232-C is an EIA recommended interface standard for data communications.

EOF:
end-of-file. The EOF code immediately follows the last record or data element in a file indicating the end of that file. The EOF marker in MS-DOS files is Ctrl-Z (1A hex).

Esc:
(Escape) code 1B hex or the key that produces this code. The Esc code typically indicates that the character or characters following should be interpreted according to a different set of conventions.

field:
in a record, a specified area used for a particular category of data, or the smallest unit of data that can be referred to.

file:
a collection of related data records or program code that is processed as a single entity.

flag:
an indicator, the presence or absence of which indicates the occurrence of a significant event during a process.

format:
the predictable arrangement of data on any storage medium such that the data can later be successfully retrieved.

full duplex:
simultaneous two-way communications in which no alternation between transmitter and receiver is necessary. (Compare with half duplex.)

half duplex:
two-way communications in which the transmitter must alternate with the receiver on the communications link. (compare with full duplex.)

handshake:
informal term referring to the procedures and protocols involved in initiating a formally codified process.

hardware:
the physical equipment and accessories manipulated by computer software during the processing of data.

hexadecimal:
a numbering system containing 16 members, the numbers 0 through 9 followed by the letters A through F.

interface:
a device or environment that converts signals or data from a hardware

or software source into a form suitable to different hardware or software.

interrupt:
the suspension of a computer process caused by an event external to the process and performed in such a manner that the original process can resume as if uninterrupted.

Kbyte:
kilobyte or 1024 bytes.

LCD:
liquid crystal display. A type of display producing high contrast with low power consumption.

loopback:
a diagnostic procedure in which signals are returned from one stage directly into another to produce a test loop. In an analog loopback, for example, the transmitted signal is connected to the receiver to verify local operation.

mass storage:
the permanent location from which programs and data are retrieved and loaded into system memory for use by a program. Typically, PC's use diskettes and hard disks for mass storage. (Contrast with system memory.)

Mbyte:
megabyte or 1,048,576 bytes.

microprocessor:
an integrated circuit that contains a complete CPU in a single package.

modem:
a contraction of modulator/demodulator. A modem transforms digital information into analog signals that can be transmitted over conventional telephone lines to a similar device at the receiving end that performs the reverse process.

MS-DOS:
Microsoft Disk Operating System. MS-DOS is the system software that manages files, programs, peripheral devices, and other system resources.

parallel:
processing method in which data transfers occur simultaneously as logical units rather than sequentially as physical units. For example, during parallel data communications to a printer, data is processed in groups of eight bits, or a byte (contrast with serial).

parity:

a method of error checking in which the serial port manipulates one bit such that the entire transmitted byte of data conforms to a simple predetermined rule. When parity is selected as odd, for example, the serial port sets the parity bit such that the total number of bits in the data byte is always odd. Parity can also beset as even, mark, space, or none.

peripheral:
any device connected to and controlled by the CPU for the purpose of performing or extending a computational process. For example, common peripherals include disk drives, printers, and the like.

port:
location through which information can be transferred between the computer and a specific device or between the CPU and memory.

program:
a series of computer instructions designed to perform some computational task or the process of constructing such a series of instructions.

prompt:
a symbol or statement indicating further input or action is required to continue the current process. The DOS prompt is d:\>, in which d: represents the current default drive.

protocol:
a set of rules and standards governing the interaction of electronic devices, particularly as regards communications.

RAM:
Random Access Memory. Information stored in RAM is temporary and can be changed.

read:
the retrieval of data from a storage device for comparison or manipulation.

record:
collection of related data, treated as a unit of information.

register:
a storage location.

ROM:
Read Only Memory. Information stored in ROM is permanent and cannot be changed.

RS-232:
an EIA interface standard controlling the communications interface between data terminal equipment and data communications equipment.

RTS:

(Request to Send) the RS-232 interface signal that indicates whether or not the serial port is in the transmit or receive mode.

screen:
the physical visual output device.

serial:
processing method in which data transfers occur sequentially indiscrete units rather than simultaneously as logical units. For example, during serial communications, data is processed bit-by-bit.(Contrast with parallel.)

simplex:
communications in which transmissions are possible in one direction only. (Contrast with duplex.)

software:
computer programs designed to manipulate hardware in the processing of data.

Super twist: a description of the technology used in increasing the contrast and legibility of LCD screens.

synchronous:
data transmission consisting of information communicated during a specific time frame. During synchronous transmission, the transmitting and receiving devices operate at the same fixed frequency and phase. (Contrast with synchronous.)

syntax:
the set of rules and parameters that govern the relationships between symbols or characters, independent of their meanings or the manner of their interpretation and use.

system memory:
the temporary location (Transient Program Memory) into which programs and data are loaded for use by a program. (Contrast with mass storage.)

symbol:
the conventional representation of an abstract concept.

telecommunications:
the external transmission of data through data communications equipment to remote data terminal equipment.

time-out:
an event enforced when a predetermined interval elapses.

typematic:
description of keyboard keys that repeat the character or function at

a set rate when pressed and held.

UART:
(Universal Synchronous Receiver/Transmitter) an integrated circuit that converts parallel data into serial format for transmission and converts the received serial data into parallel format.

video:
any function, either text or graphics, visually displayed on the computer screen.

virtual disk:
a term synonymous with RAM disk.

write:
the recording of data on a device for storage or display.

ELECTRONIC FIELD BOOK

EFB

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If the suggestion is for consideration of a new feature code, also provide recommendations for the following:

Bylevel Name ___________________________

Color __________ Line Style __________ Line Weight __________

Use additional sheets if necessary

Suggestions from: ____

Return form to:

Department of Transportation
Survey Section, Surveying & Mapping Office
605 Suwannee St., MS 5L
Tallahassee, FL 32399-0450