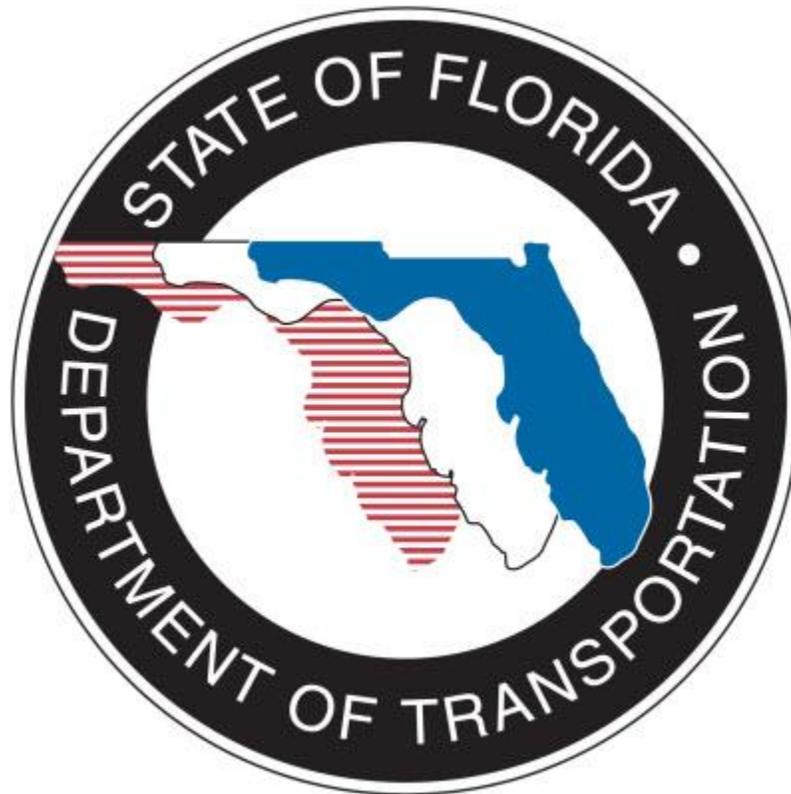


STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION



EFB Mobile User's Handbook

SURVEYING AND MAPPING OFFICE
TALLAHASSEE, FLORIDA

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Introduction

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

The Electronic Field Book is a system comprised of:

- Surveying Instrument(s) (usually Total Stations)
- Software
- Computer Platform(s)
 - ü The computer platform for field operations is a rugged, hand-held Personal Computer (PC) operating under Windows Mobile or Windows CE.

 - ü The computer platform for office operations is a desk top PC, operating under Windows XP or Windows 7.

The software is designed to be simple and consistent with current field practice with the classical EFB collection system in production since the late 1980's which ran DOS. The software-hardware combinations are also device (field computer, total station) independent, however only a limited number of total station devices are currently supported. 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 processed electronically and used later in the highway design process. The software also uses state-of-the-art 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 EFB 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.

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 the 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 task 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.

Point Naming

("N:" field of Setup, HVD Obs and SOR Obs screens, and Chain screens)

Point names used by the Department will adhere to the abbreviations found in APPENDIX A - Standard Abbreviations located in this document. The user still has flexibility in naming, albeit within the limitations of the naming system described below.

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

1. Alphanumeric prefix designated by the surveyor
2. Numeric suffix assigned by the system.

Users select an alphanumeric prefix consisting of up to seven characters in length while the numeric suffix is an integer, and is assigned by the system. The numeric suffix can also be from one to seven digits, depending on the length of prefix chosen by the user. The length of the combined prefix and suffix will not exceed 8 (eight) characters. Many thousands of points of the same alphanumeric prefix name, each differentiated by a unique numeric suffix can be created 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, and can often be cumbersome to type on a limited field keyboard.

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

A1	A9999999
AA1	AA999999
AAA1	AAA99999
AAAA1	AAAA9999
AAAAA1	AAAAA999

AAAAAA1 AAAAAA99
AAAAAAA1 AAAAAA9

'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 prefix that will be easily remembered and will intuitively suggest the objects observed in the field.

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 itself. The EFB has the capability to capture these designations, but they are used as *reference* to the EFB point name described previously.

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, including past or future surveys. The reference name is also the means by which CAiCE's segment manager knows that points potentially contain control information; coordinates or azimuths. When the processed data is read into CAiCE, it will interrogate the incoming data, looking for reference names. If a reference name is found, CAiCE 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 CAiCE 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 must also assign a point name for use by the EFB for the NGS station. So the point might have an EFB point name like "C13", but also have a reference name like "LEO STATION 1955".

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 (i.e. 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. For CAiCE, if it is a point to be used to establish new Control in the CAiCE control database it will be preceded with a period (.). If it is existing known Control already entered into the data base from a previous segment, enter the Reference Name only without the period.

Reference Names are typically keyed in exactly as they are stamped and may contain special characters such as dashes (-), spaces should be keyed as an under bar), and periods (.). However, they are limited to 16 alphanumeric characters. In some instances, a reference name may exceed 18 characters as stamped on the monument, but the user must abbreviate in some way.

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

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

.60-92-A05: 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 *CAiCE* control files for the project during processing will be lost, and he may not be able to even perform important processing steps!

Planimetric Information

("G:" field of Setup, HVD Obs and SOR Obs screens)

Geometry

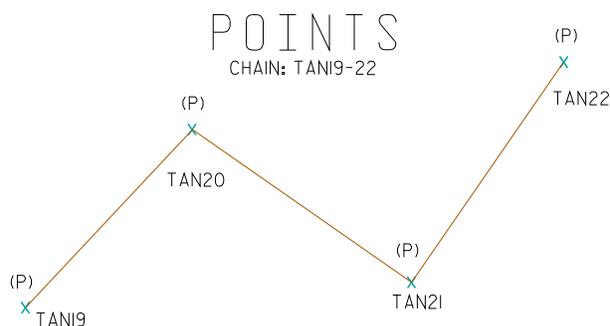
The *Geometry* is the geometric use of a point, when that point is part of a multi-point chain object. Many objects may be designated with a single point, such as a telephone pole, or a valve cover. When larger objects are to be designated, such as the edge of pavement along a length of highway, *many 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 in the previous paragraph. 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, and the intersection point of straight lines (tangents) in a line string. This will become clearer in the examples shown later.

Curve (C) - a point on a *circular arc*, or a point on a *smooth curve* (spline) passing through a series of non-linear points. Again, this will become clearer in the examples shown later.



Point geometry, **P**, indicates that the "point" in question will never be used in a curve for line work passing through that point. 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 pole locations are given a **P** geometry, since they all lie as points-of-intersection (PI's) of the wire span. See the illustration above, where the

geometry is set to P for the EFB points TAN19, TAN20, TAN21, and TAN22. Also note that points TAN10 through TAN19 must not exist, or the line work would pass through them as well.

A *Curve* geometry, C, indicates that the point in question is part of a curve. The C geometry would be used to indicate any 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 chain elements as we will see later.

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 spline 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 *circular arc* (PC, POC, PT) their sequence in the chain might look like ...PPPCCCPPP. Note that this circular arc may, or may not be tangent to the back and ahead lines connecting this "CCC" arc.
- 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, such as ...PPCPP, where the "P" points define the back and ahead tangents. A tangent circular curve passing through the "C" point is defined.
- A smooth curve is defined by four or more curve points in a sequence. ...PPCCCCCCCCPP...

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

1. The observed point is a P-Point location (i.e. a tree, fire hydrant, PI of two intersecting lines, etc.)
2. The observed point, C-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.

Chains

Chains named (chain name) series of points that have been previously located and their geometry (P -or- C) 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) exactly describes objects containing multiple points. 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 defines 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. 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 ("S:" field of Chain Screens) 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 *first point* in the chain listing, and as progression is made down the chain list, the stationing *increases*. The station value is not input for any other point in the chain list, but may be computed in the office by the coordinate geometry package(s) available for the EFB. A chain can represent a three-dimensional object, and is controlled by the XYZ 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 (2D) only. If the surveyor includes a point in the chain listing where only an elevation or Z ordinate value may be computed, the chain is ignored altogether. A two-dimensional (2D) chain is 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. Note that EFB can only describe lines, circular arcs, and splines (not spirals, but can be approximated with splines).

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 (Point location or Curve 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.).

Rules for chain lists

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 (due to the lesser point numerical suffix), 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.

When hand entering chain lists, 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 by that prefix and observed up to that point in timer in the chain. The order runs from the lowest numbered suffix to the highest numbered suffix.

EXAMPLE: XSECT If seven (7) XSECT points existed, EFB would determine this, and long-hand the global listing to connect XSECT1 to XSECT2, XSECT2 to XSECT3, and so on until XSECT7 is reached. The following would be created:

Shorthand list: XSECT1-7

Expanded list: SEC1,XSEC2,XSECT3,XSECT4,XSECT5,XSECT6,XSECT7

You can immediately see the convenience of the Shorthand list.

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 indicates the reversed list of the previous example.

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 be connected.

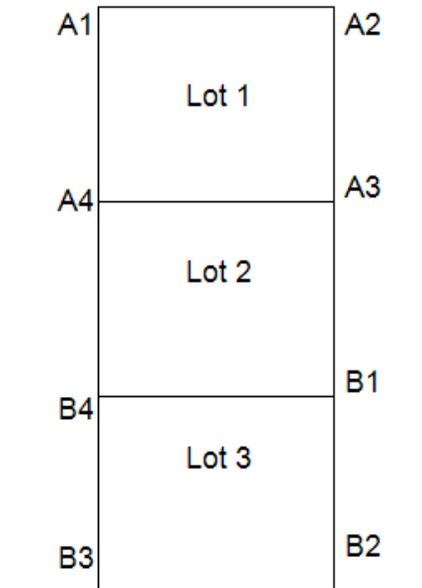
A chain list does not have to be *singular*, which means any number of points with differing point name prefixes may be used in the list.

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.

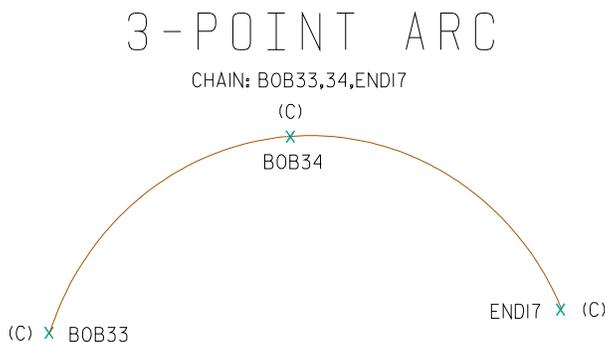
LOT1 and LOT3 could be listed as:
 A1-4,1,,B1-4,1 -or-
 A4-1,4,,B4-1,4 -or-
 A,1,,B,1 -or-
 -B,4,,A,1 etc.

The previous examples demonstrate a variety of ways a *similar* chain can be defined. You can see there are many ways to list a chain and achieve the same results. Now that we have demonstrated how the chain list is assembled, we will look at how the geometry of points in the chain list affects the graphical representation of the chain. Remember that it is the *P* and *C* geometry classification of points that influence the way arcs, smooth curves, and line strings are generated in the EFB chain lists.

The geometrics of the chain are 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:

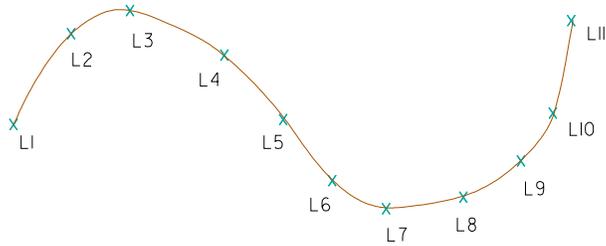
1. If three (3) points with geometry type *C* are encountered sequentially, then a circular arc is generated, where the first point is the *PC*, the second a *POC* and the third the *PT*.



2. 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.

SMOOTH CURVE

CHAIN: LI-II

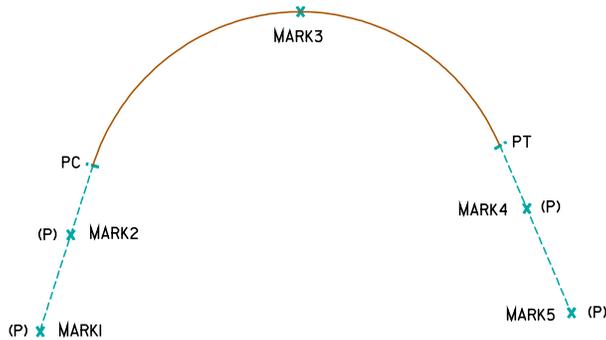


3. If a pair (2) of points with the geometry type *P* precede a single point with the geometry type *C*, then are followed by another pair of points with the geometry type *P*, the first pair define the *back tangent* of the curve, and the second pair define the *ahead tangent* of the curve, and the point with the *C* geometry type defines the POC. In this case the PC and PT are computed internally by CADD software interpreting the EFB chain data, such as the SDMS processor, CAiCE, GEOPAK, and Civil3D.

1-POINT ARC

CHAIN: MARK1-5

(C)



If two type *C* points are encountered in sequence and bounded by *P* points, they are treated as *P* points, and will be connected by line segments.

EXAMPLES 1), 2), and 3) reading from top to bottom:

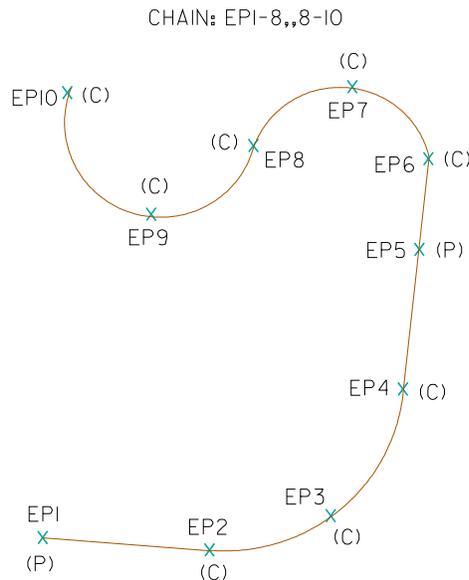
1)	2)	3)
P	P	P (BACK TANGENT)
P	P	P (BACK TANGENT)
C (PC)	C (BEGIN SMOOTH CURVE)	C (POC)
C (POC)	C	P (AHEAD/BACK TANGENT)
C (PT)	C	P (AHEAD/BACK TANGENT)
P	C	C (POC)
C (PC)	CP	P (AHEAD TANGENT)
C (POC)	C (END SMOOTH CURVE)	P (AHEAD TANGENT)
C (PT)	P	
P	P	

Example 3) would have the *PC* and *PT* points computed automatically by the CADD Systems when the chain is graphically presented. The following expanded example helps explain the concept better for EXAMPLE 3) above:

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

You can then see that merely coding the points with a P or C Geometry at the time of collection (the field surveyor can see if any curvature passes through any given point easily in the field) and creating a chain through that point, tangents, circular arcs, and smooth curves are easily created. More complex geometry, like compound and reverse curves can also be created by inventive use of the GAP (,,) which causes interpretation of the chain list geometry to re-start at the point following the GAP (,,).

The following figure illustrates how the GAP (a double comma, or ",,") is used in Chain lists. Notice at point EP8, a gap causes the processing to re-start beginning with Point EP8 processing forward to EP9, and EP10, which is interpreted as a 3-point arc. In this case since EP6-8 was also an arc, we end up with a reverse curve (EP6-8,,8-10):



The GAP (,,) may also be used to "pick the pen up" and have the same chain resume drawing in a completely different location than the last point preceding the GAP. This is common where an object represents a single entity, but the line work may not be continuous. Such is the case of a single edge of pavement broken by driveways, or other complex objects. A word of caution however, the GAP should not be used to continue drawing similar objects that are not the same entity. For example it would not be proper to describe two separate objects in the field (i.e. two

different inlet tops with the same chain), because it was convenient just to use a GAP to separate them. That is both lazy and creates difficulties for the Office staff processing and cleaning up the Chain data.

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 significantly weaker because there would be no data *along* breaks in the terrain between the cross section station, 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.

Attribute

An *Attribute* is 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 relates to a particular surface.

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

G - Ground Point - A point whose computed elevation is on a given surface that may occur individually (spot shots), or are often connected together in a chain to describe a terrain discontinuity (break line) or the three dimensional geometry of an object along the surface. This constrains the TIN model to the elevations of the break line.

F - Feature Point - A point that indicates a *planimetric* object only, whose elevation is NOT 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. This elevation classification is similar to the Feature attribute, however EFB allows a distinction so data may be culled or queried in the downstream CADD systems based upon the attribute classification.

Zone

A *Zone* is a tag to differentiate attributes between differing surfaces for terrain modeling. Sometimes the Zone is used to also distinguish other characteristics about the objects being observed or 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 its zone number. The zone number is an integer digit from one (1) through nine (9). The user may easily define up to nine different zones for each attribute. The zone number has also been used to define other classifications of data. For example the surveyor might wish to use a particular zone number to represent something other than a surface. For example, he/she may wish to reserve zone numbers to group real property information, and another to represent utility information, and yet another to group survey control information, and so on. Because there are 9 zones allowed in field operations with EFB, there are enough zone numbers to cover the distinguishing of different surfaces, and defining these groupings of data, should the surveyor choose to do so.

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.

Feature Code

A *Feature Code* is a series of a maximum eight alphanumeric characters that identifies a point or chain as a particular object. The feature code ties the named object as an index to a definition of what that object really represents. 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 WILL 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 appropriate 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 ARE graphically significant, as well as the chain representing the power line.

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.

Feature code organization

APPENDIX B of this documentation lists the feature codes used by FDOT. It also contains a brief description of the object(s).

Feature code options: Adding Text

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 – this text is called a description.

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 short 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 more fully, the description could be used, as shown below:

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 EFB_Settings.XML 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 .

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

Available feature codes

In *APPENDIX B* a list of the FDOT feature codes that have been defined for the EFB can be found. The user may modify the default feature table, and create any feature codes desired.

CEFB - Feature Code Input Mode

Entering Points is optimized by entering a Feature Code first. Point names may be created from the Feature Code or from the pre-assigned point name associated with the Feature Code.

When a Feature Code is entered into the applicable screen, it is searched in the Defaults table (maintained internally by EFB) for a match. This table is generated on-the-fly by EFB and associates Point names to the feature code used previously. When there is no match in the defaults table, the program will go to the EFB_Settings.xml for the point prefix and parameters associated with the Feature Code entered.

The Feature Code defaults table is beneficial for reusing specific combinations for a given project. When a Feature Code is entered with a new Point Prefix or changes to a parameter is made, the new data set will be updated to the Feature Code Defaults table. The program will only use the default (what is specified in the EFB_Settings.xml) settings when a new (to the project) Feature

Code is used. All other uses of the Feature Code will be pulled from the Feature Code defaults table.

For added flexibility, users will be prompted with the Attribute Update Prompt for which set of data to use...“as entered”, from the Defaults table or some combination of the two. Attribute Update Prompt will be explained in further detail in the EFB Operations section.

This function in EFB provides the functionality where if a given feature is selected, the other properties can become a default, such as the Attribute, Zone, and even the Point Name prefix. Likewise, if a Point Name Prefix is selected, then the Feature Code, Attribute, and Zone may automatically be selected as a default. This functionality improves consistency of the identifying data observed for objects in the field, helps eliminate misclassification mistakes, and reduces the amount of key entry the field surveyor has to make.

The installation of EFB field software

1. *EFB* is initially loaded onto the Mobile unit by utilizing the USB cable that is provided by the manufacturer with the unit Windows ActiveSync and basic Windows file management commands.
2. Connect the cable that comes with the Mobile unit to the Mobile unit and then plug the other end into the host computer that has the source program files.
3. In the Mobile unit, use the Windows File Explorer commands to create a folder under the Program Files folder named:
 - EFB.Mobile.CE50 for Windows CE operating system
 - <OR>
 - EFB.Mobile.PPC50 for Windows Mobile operating system
4. Copy the applicable two files from the same folder structure of the host PC.
 - EFB.Mobile.PPC50.exe & EFB_Settings.xml
 - <OR>
 - EFB.Mobile.CE50.exe & EFB_Settings.xml

The following is required to be up to date on your mobile platform:

SQL CE 3.5

<http://www.microsoft.com/sqlserver/2005/en/us/compact.aspx>

.NET Compact Framework 3.5

<http://www.microsoft.com/download/en/details.aspx?displaylang=en&id=65>

<http://msdn.microsoft.com/en-us/netframework/aa497273>

The links provided give the Web locations of where the utilities may be downloaded, in case your data collector has not been updated in some time.

In addition, EFB mobile can also be run on the Windows desktop in an emulator mode. The following instructions are provided in order to set up emulation mode:

Installing Windows Mobile Emulator for Testing EFB on a PC

Overview

The following steps will enable the use of an Emulator version of the EFB Mobile unit.

Files Required

1. Program files for EFB Mobile or EFB Mobile .CE
2. Windows Mobile 6.1.4 Professional Images (380.8MB)
(<http://www.microsoft.com/downloads/en/details.aspx?FamilyID=1a7a6b52-f89e-4354-84ce-5d19c204498a#Instructions>)
3. .Net Compact 3.5 Framework (EX: NETCTv35.cm.armv4i.cab)
(<http://www.microsoft.com/downloads/en/details.aspx?FamilyID=e3821449-3c6b-42f1-9fd9-0041345b3385&displaylang=en>)
4. SQLCE3.5 for Windows Mobile (EX: sqlce.wce5.armv4i.cab)
(<http://www.microsoft.com/downloads/en/details.aspx?displaylang=en&FamilyID=5544c638-c532-48e3-871c-58b49c5d855c>)

Installation Steps

1. Download and Install Windows Mobile 6.1.4 Professional Images.
2. Download .Net Compact 3.5 Framework (NETCTv35.cm.armv4i.cab) and SQLCE3.5 for Windows Mobile (sqlce.wce5.armv4i.cab)
3. Create a folder on the C:\ drive as a "share" for the emulator to retrieve files. Example path: C:\Users\Username\My Documents\EFB Share.
4. Place the NETCTv35.cm.armv4i.cab file, the sqlce.wce5.armv4i.cab file and the EFB.Mobile folder into the newly created *Share* folder.

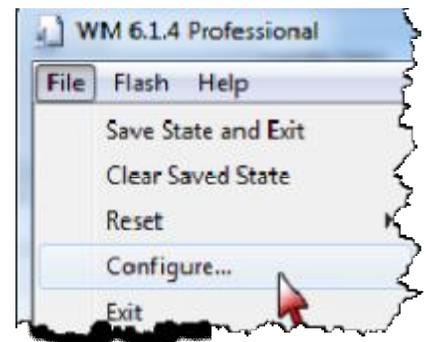
The EFB.Mobile folder should be located in the Program Files\FDOT.EFB 3.1\Program folder. These may not be the exact file names as they differ from Mobile to Mobile.CE and there may be later versions on the Microsoft website.

5. Launch Windows Mobile 6.1.4 Professional by navigating to All Programs from the Windows

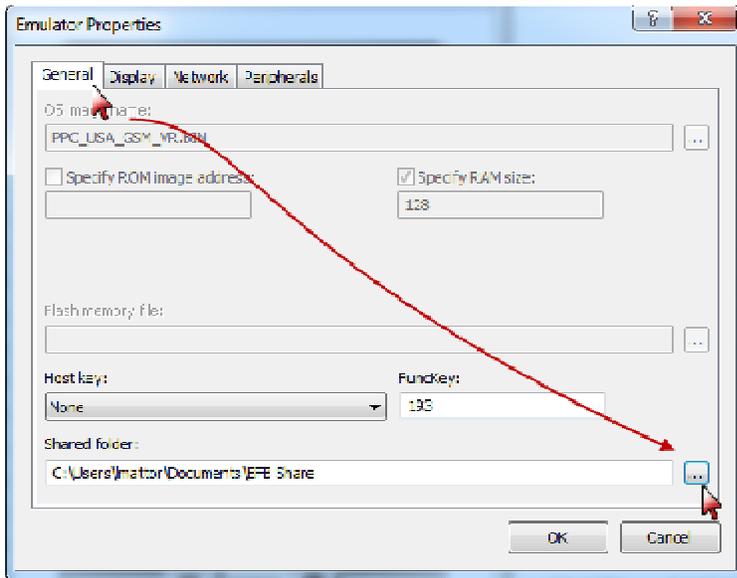


icon and selecting Windows Mobile 6 SDK > Standalone Emulator Images > US English > WM 6.1.4 Professional.

6. Select the File menu and click Configure. This step is necessary to identify (configure) the location of the Share folder, where files are stored for access from the Emulator.



7. Select the General tab, then click the  button adjacent to the *Shared folder:* box

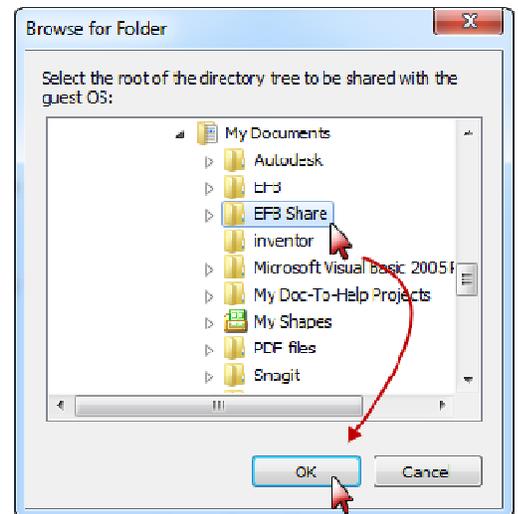


Navigate to the folder that was created in step 3 above.

Example path: C:\Users\Username\My Documents\EFB Share.

Select the applicable folder, and then click the OK button to save and exit.

This "share" folder will be referred to as the **Storage Card** in the Emulator.



Optionally, you can setup a COM port for connection to a Total Station.

To map a serial port:

Select the **COM port** on the desktop to access via the emulator.

Select the **Peripherals** tab.

Select the **COM#** from the *Serial port 0:* text box.

Click the **OK** button to save and exit.

NAVIGATION HINTS:

Folder Path Selector (A): This is a dropdown list that allows the user to browse and select a folder or to switch between the Device and the Storage Card.

UP button (B): Moves the folder structure up one level to the current folder's parent folder.

Virtual Keyboard toggle (C): Opens and closes the On Screen virtual keyboard.

Menu button (D): Open the File Explorer menu.



8. Select the down arrow of the *Folder Path Selector*, and then select **Storage Card**.

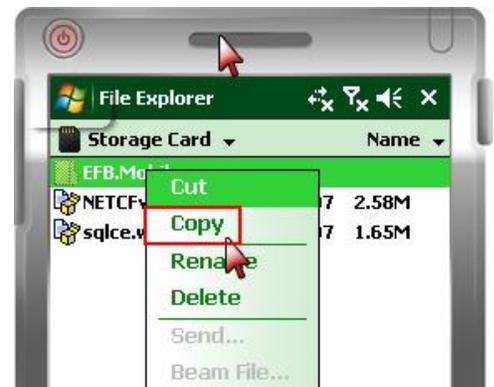
Select the **NETCTv35.cm.armv4i.cab** file in the list. This will start the Install process.

When completed, close the install dialog box.



9. Select the **sqlce.wce5.armv4i.cab** file in the list. This will start the Install process. When completed, close the install dialog box.

10. Using the program executable to the device, select the **EFB.Mobile** folder in the *Storage Card* folder and hold the left mouse button down until the command list appears, slide the mouse to **Copy** and select.



11. The EFB.Mobile folder needs to be located in the *Program Files* folder in the Emulator device. Navigate to this folder by:

1. Click the down arrow of the *Folder Path Selector*, and then select *My Device*

Select *Program Files* in the folder list.

Select the blank area under *Program Files* and hold the left mouse button down until the command list appears, slide the mouse to *Paste* and select.



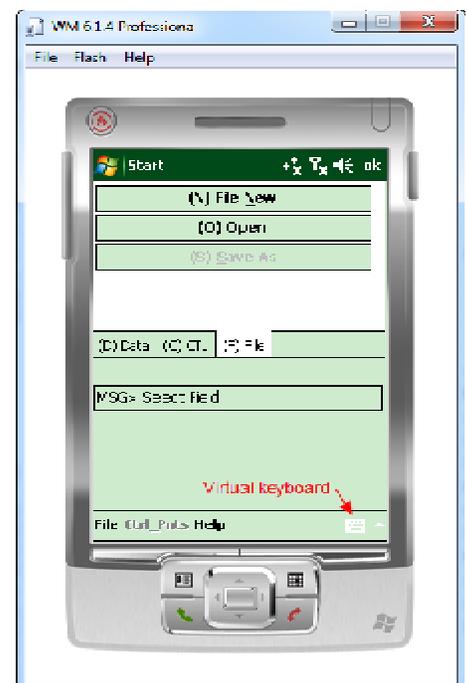
12. Open the EFB.Mobile folder by selecting from the list.



13. Select *EFB.Mobile.PPC50.exe* file from the list to load EFB.



14. The EFB program Start window will appear as shown below:

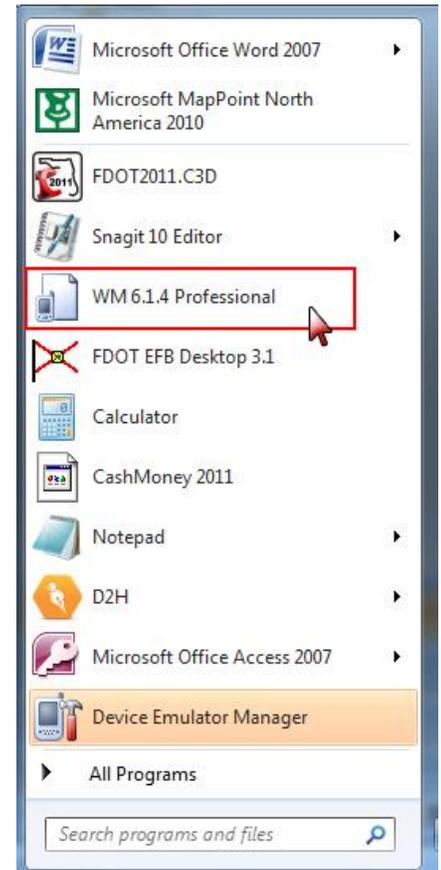


15. Select **File** menu, then **Save State and Exit** command. This will save the setup process that was just completed.

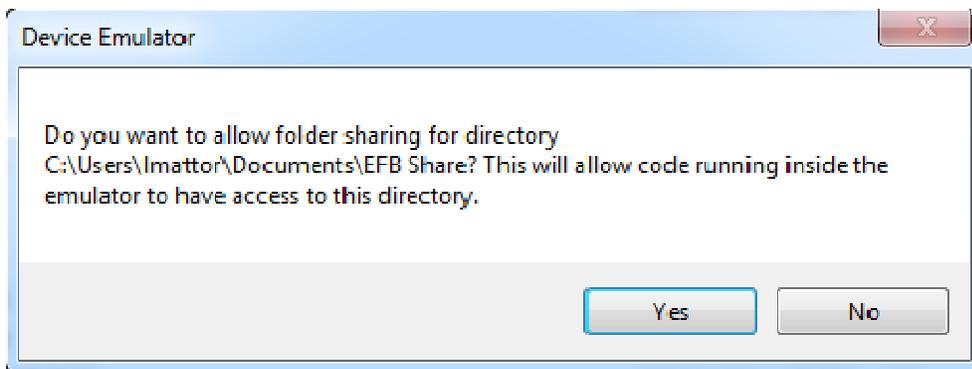


To reopen the EFB Mobile Emulator, repeat step 5

<OR> Select **WM 6.1.4 Professional** from the recent programs list in the Start Windows list.



16. Upon opening, click the **Yes** button in the Device Emulator dialog box.



The operation of EFB field software

EFB is the name used throughout the remainder of this documentation for the computer program operating on the mobile unit used to gather field data. EFB is a single program. The Windows name for the program may be EFB.Mobile.PPC50.exe or EFB.Mobile.CE50.exe, depending on the operating system of the mobile unit.

EFB was designed to help 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 minimal error. The user is appropriately warned of a variety of potential problem situations.

Controlling the System – Switchboard

Operation of EFB is based on a *Switchboard* screen. A menu item is selected by pressing the appropriate *digit* on the keypad corresponding to the task the surveyor wishes to accomplish. The Switchboard may also be navigated with the use of the stylus that is provided with the mobile unit.

Controlling the System - Data Prompts

Data is entered into a data field by pressing the letter key (*prompt letter*) corresponding to the data field that is 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  returns the cursor to *standby status* in the message field at the bottom of the data screen. The next function may then be evoked by the user.

The use of the  key will move the cursor from one field to the next, allowing the entry of all necessary fields without having to key in the prompt letter or going back to the message field standby status each time.

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  is NOT required to terminate entry -instead it will close the screen, returning the system to the switchboard.

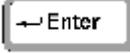
When the focus (cursor) is in the data field with a specific set of data as in a dropdown, selection may be made by typing the character or the first character of a full-word option <OR> by using the



(up) and



(down) arrows to toggle through the set. To accept the selection and return

to the message field, press . Press  to move to the next data field.

Data will remain in a data screen until the user is ready to record the information (selecting the



key) in order to verify that all data fields are correct. A "Saved" message is displayed indicating that 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.

Starting EFB

To start up EFB select the **Start** button on the Mobile unit.



Then EFB can be accessed from: **File Explorer > My Device > Program Files** and then selecting the program file.

Windows CE operating system filename: **EFB.Mobile.CE50.exe**

<OR>

Windows Mobile operating system filename: **EFB.Mobile.PPC50.exe**

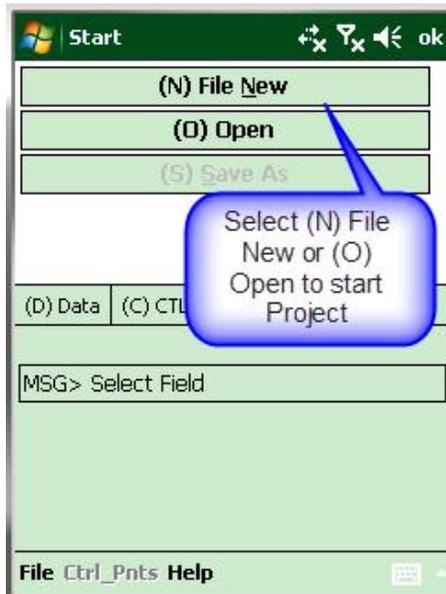
Upon startup of the EFB Mobile program a **Startup Log** is created. The log will provide system information about the *Name and Location of the EFB Mobile executable, Port names and the Operating System Parameters* of the mobile device that is being used.

The Windows.Mobile default location for the **Startup_Log.xml** file would be found in the EFB folder in *My Device\My Documents*.

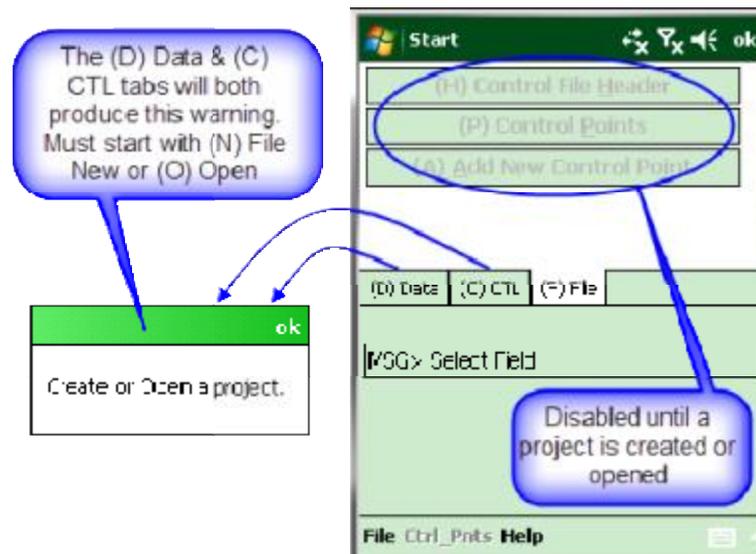
EXAMPLE: `My Device\My Documents\EFB\Startup_Log.xml`.

An environment variable (*Environment.SpecialFolder.Personal*) is used to locate the folder. This file may be viewed using a text editor program such as NotePad.

EFB Mobile program opens with the dialog box shown below. Upon execution of the program the user has two choices; open an existing project or create a new one. A project file is stored in a database format with an .SDF file extension.



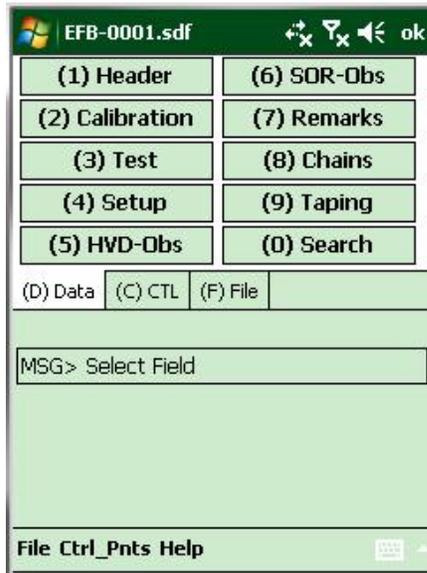
The dialog box has three tabs. The (D) Data and (C) CTL tabs functionality will be disabled until an action has been taken in the (F) File tab. Selecting the (D) Data and (C) CTL tabs will open a dialog message guiding the user back to the (F) File tab selections.



The (F) File tab has three options: (N) File New, (O) Open or (S) Save As, as illustrated above.

The (C) CTL tab also has three options (H) Control File Header, (P) Control Points or (A) Add New Control Point, which are shown disabled above.

The (D) Data tab displays the Switchboard. A view of the switchboard is below:



Files and Data Management

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

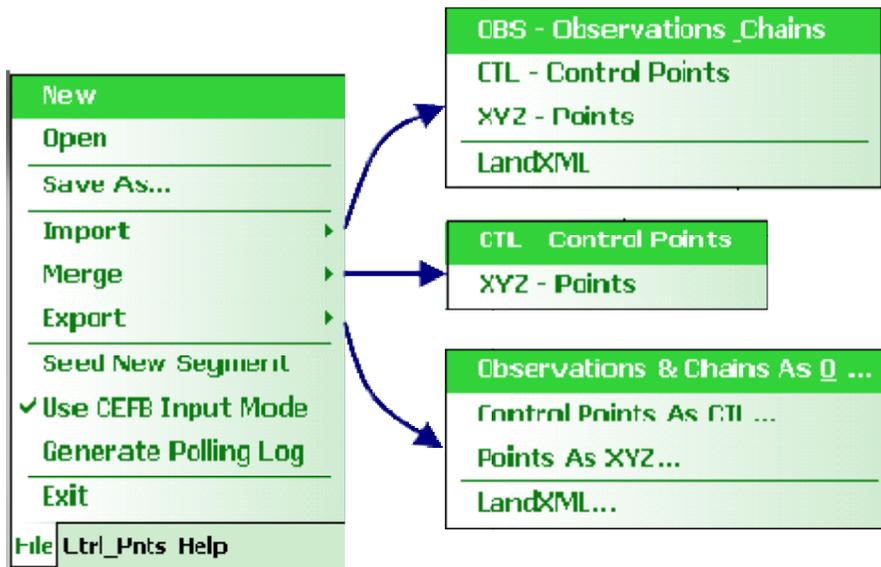
Files are stored in a Windows folder, determined by the surveyor. Files on the field computer are one of five types:

- .SDF = Native file format and contains all Observations, Chains and Control Points.
- .OBS = Observations and Chains
- .CTL = Control Points (known defined points)
- .XYZ = Control Points (coordinate values of points)
- .XML = LandXML

The first file type "SDF" contains all types of collected data and is the native file format of EFB. The remaining four types (OBS, CTL, XYZ, & XML) provide backward compatibility as well as a way to transfer data between applications.

File Menu

To access a file select the **File Menu** at the bottom of the screen. The following commands are available and are explained below:



Detailed explanation of each of the File commands:

New: Opens the Save As dialog box, prompting the user to create a new project name, folder, type and location.



Open: Allows the user to open an existing SDF project file.



Save As: Opens the **Save As** screen prompting the user to create a new project name, folder, type (will default to SDF) and location. It is used to create the filename and storage location for the segment being surveyed. This provides a permanent file on the mobile unit physical drive.

Import: Allows the user to import existing segment data (OBS & LandXML), Control Points (CTL or XYZ) to be used with the segment being surveyed. The segment file may be imported as either:

- .OBS file which would contain Observations and Chains.
- .CTL file which would contain established Control Points.
- .XYZ file which would contain coordinate values of Control Points.
- .XML file (LandXML) which would contain all information (observations, chains and/or control points) that makes up a segment. These LandXML files provide portability to other applications.

Merge: Allows the user to merge existing Control Points (CTL) or Control Points (XYZ) to be used with the segment being surveyed. This differs from import; instead of creating an entire new file, only the new information is brought into the current file. The routine compares the existing data with the merged data and for any new point it will merge all of the information associated with that point. For points that are the same name, the only data that will be merged is for blank fields in the existing data in the current .SDF. The existing information takes precedence.

Export: Allows the user to export the current data to OBS, LandXML Control Points (CTL or XYZ) files. The segment file may be exported as either:

- Observations and Chains** as .OBS file extension. It contains established Observations and Chains.
- Control Points** as .CTL file extension. It contains established Control Points.
- Points As XYZ** as .XYZ file extension. It contains coordinate values of Control Points.
- LandXML** with .XML file extension. It contains all information (observations, chains and/or control points) that makes up a segment. These LandXML files provide portability to other applications.

Seed New Segment: Allows the user to seed a new segment with the projects existing points and chain information, so the new segment of data can call up the relationships of point names to Feature, Attribute, Zone, etc. data that was observed in the earlier segment.



Use CEFB Input Mode: When checked, the CEFB (C representing Cadastral) **Input Mode** feature makes the input mode to feature driven. This feature is “On” or checked by default. See Feature Code section for more information.

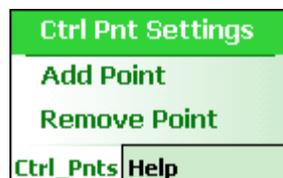
Generate Polling Log: When checked, the **Generate Polling Log** feature creates a log to capture the sequence of events while polling information from an instrument. This information is used by the programmers if debugging is necessary to sort out the communications issues between the EFB and the instrument. This feature is “Off” or NOT checked by default. The log is useful for troubleshooting polling errors. Unlike the Startup_Log which writes to an XML file, the Polling Log writes to the internal .SDF database only, and this SDF file would need to be transmitted to support for technical assistance with polling issues.

Exit: Closes the program. In the event that the file has not been saved, the following prompt for a final save.



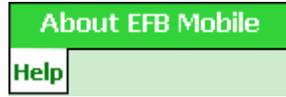
Ctrl_Pnts Menu

The Control Points menu provides a method to manage the setup of Control Points, by establishing the *Control Point Settings* for the project, *Adding* a point or *Removing* existing control points in an EFB file.



Help Menu

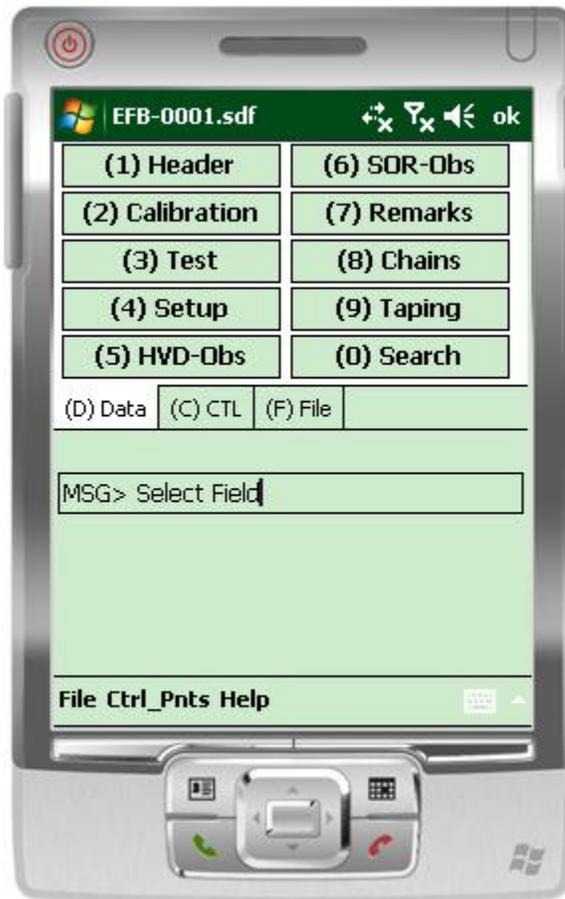
Help > About EFB Mobile displays the version information.



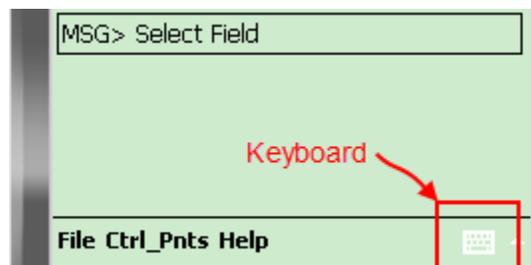
The Switchboard

Selecting the (D) Data tab the EFB Switchboard is displayed.

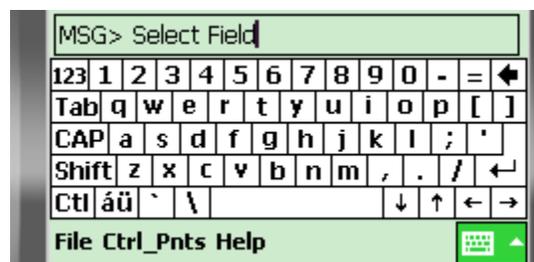
The Switchboard screen as shown below:



To activate the keyboard, select the keyboard image on the lower right hand section of the mobile unit.



Keyboard display:



If your Mobile unit does not have a physical keyboard on a screen, the virtual keyboard can be used with a stylus.

Once EFB is running, the opening menu is titled *EFB 3.1*. This menu contains the primary operations that are performed when surveying with EFB. This screen indicates the available surveying *tasks* supported by EFB. The options will be discussed one at a time and in greater detail, since they are the "meat" to using EFB as a data collection system.

Surveying operations are divided into general categories, or tasks. The tasks currently supported correspond to major field activities (like calibrating the instrument, performing an instrument Setup, taking, HVD or SOR observations, taking, creating Chains and so on). They are in EFB as follows:

HEADER: User information about the Segment.

CALIBRATION: User information about environment, crew and instrument, selection of instrument, and optional instrument testing.

TEST: A test screen for Axis and Level testing of instruments, which data is used during the processing of the data to help resolve systematic errors in the instruments being used.

SETUP: Data about the point the instrument occupies.

HVD-Obs: Data about the point the target occupies, and measurement data (horizontal direction, zenith angle (direction), and distance (slope and horizontal) combinations) of the target point relative to the current setup.

SOR-Obs: Data about the point the target occupies, and measurement data (station, offset, and rod reading combinations) of the target relative to a baseline.

REMARKS: General remarks during the data collection process.

CHAIN: Construction of Point lists (chains) that define curvilinear geometric objects.

TAPING: Remote taping operations independent of the traditional instrument setup.

SEARCH: Searches for a data record by setup, reference name, prefix, or point name.

A detailed description of each task will be included in the section about the data screen used to perform that task.

Data Transfer

EFB has NO internal ability to transfer programs and data to and from the host PC computer. The Mobile unit will need either a USB or serial cable which will allow the transfer of files to the host PC. This is usually provided by the manufacturer. Files can be transferred in either direction with the use of Microsoft ActiveSync and standard Windows file management commands.

Users should consult the manuals and documentation from the manufacturer of the particular survey equipment being used for their serial communications options for connecting to total stations.

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 record of the EFB database. Manipulation of data and data screens are performed also through the use of *functions*. The *function keys* are generally 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, NOT when editing a data field. All that is required to activate a function is to press the appropriate numerical key, and the function selected is performed.

Example of cursor in message field:

MSC> Select Field|

Cursor in standby status
within the message field

Pressing  to complete a function is not required, although some functions that potentially have detrimental effects on the data processing will 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. Many functions perform similar operations in all data screens as we will see later.

Feature Codes

Overview

Feature codes can be setup in advance for the default values of the point / chain attributes. The following attributes may be preset: Point Geometry, Units, Alias, Prompt, DTM Attribute, Zone & Point Prefix.

Feature code "builder" functionality will assist the user in the creation of the descriptor of the feature code by utilizing a *builder_template* command in the *EFB_Settings.xml* file. This functionality will provide a more efficient method of data entry and result in standardized naming and attribution conventions.

The Administrator of the EFB software will predefine the default values for the point attributes and nomenclature for any given feature code by editing the *EFB_Settings.xml* file.

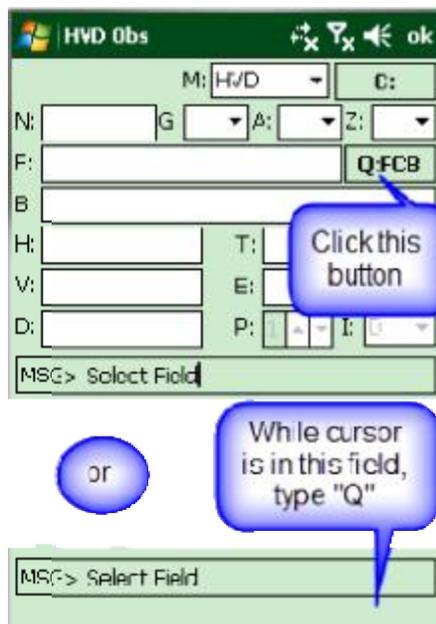
Using Feature Codes

Feature Code Builder is available in the following screens: *Setup*, *HVD-Obs*, *SOR-Obs*, *Chains*, and *Taping* along with being integrated into the *Control Point* menu.

Feature Code Builder initiation is as follows:

EFB Input Mode (*Data input type in the File Menu, where Use CEFB Input Mode is NOT checked*):

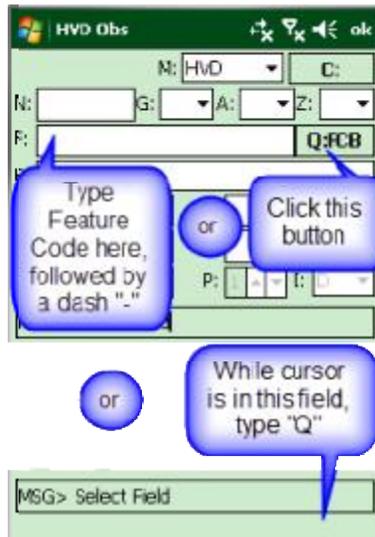
Typically in this scenario a Point or Chain prefix would be entered into the N: text box.



- Click the **Q:FCB** button to the right of the Feature Code field. This will display a list of applicable feature codes for the feature type (point or chain).
- <OR> with the cursor in the MSG> box, type the key Q to initiate the Feature Code Builder.

CEFB Input Mode (*The mode selected for data input type in the File Menu, where Use CEFB Input Mode IS checked*):

Typically in this scenario the Point or Chain Prefix is determined by the Feature Code being used, although it is not required as flexibility is built into the program.

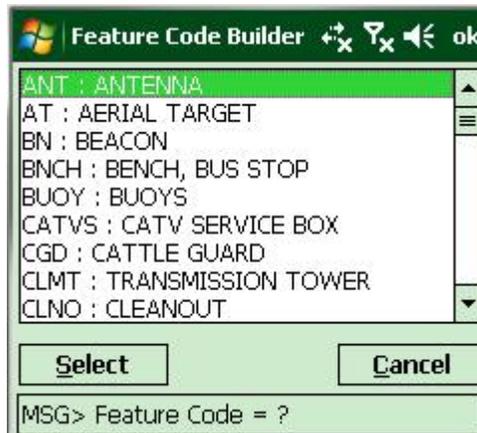


- In the *Feature Code (F:)* field, type a known feature code (EX: ANT) followed by a dash "-". Once the dash is keyed, the *Feature Code Builder* will initiate.
- <OR> Click the button to the right of the Feature Code field. This will display a list of applicable feature codes for the feature type (point or chain) desired.
- <OR> With the cursor in the *MSG>* box, type the key Q to initiate Feature Code Builder.

Based on your selection the builder will prompt for the proper settings of the particular feature selected.

EXAMPLE:

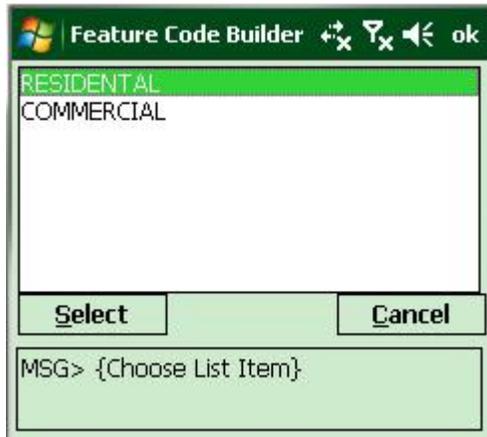
1. Select the applicable feature code from the Feature Code Builder list.



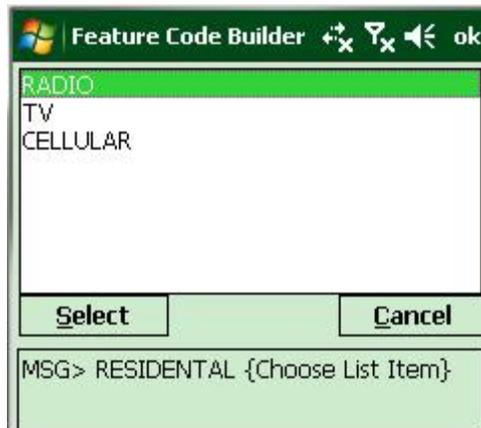
2. Use the up and down arrows or the stylus and cursor to highlight the required feature code, then click the button.

Only feature codes that pertain to the geometry type will be presented in this list.

3. Upon selecting the feature code for Antenna "ANT" the following dialog box will appear:

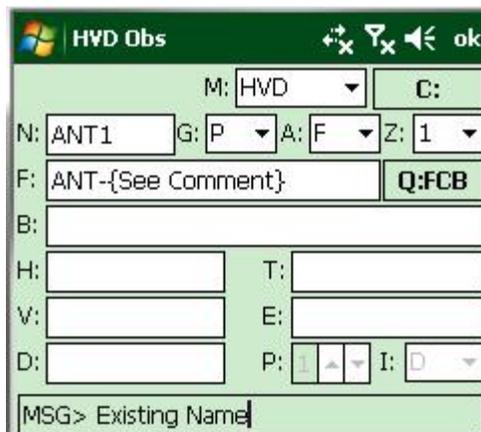


- Use the up and down arrows or the mouse and cursor to highlight the applicable item, then click the button to accept the selection and to open the next dialog box.

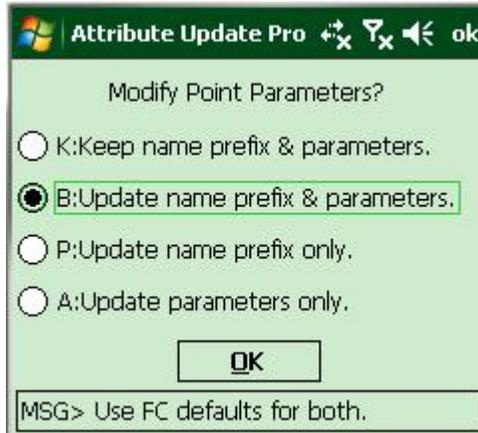


- Click the button to accept the selection and to open the next dialog box, in this example all the information required was entered and the builder goes back to the original screen. This will build a Feature-description string of "ANT-RESIDENTIAL RADIO ANTENNA". Note that this builder can also embed the literal terms like "ANTENNA" in the description strings it build. This function will help standardize descriptions of objects observed in the field.

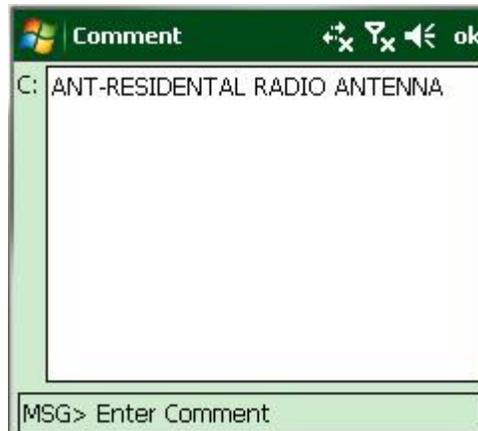
This example is in the **EFB Input Mode**



- When in the *CEFB Input Mode* and changes have been made to the Feature Code, point prefix or any of the parameters (Point Geometry, DTM Attribute, Zone, and Chain Name), the *Attribute Update Prompt* dialog box will display prior to returning to the original screen.



7. Select the applicable *action* to be performed and then click the **OK** button to return to the original screen. See the *Attribute Update Prompt* section below for further explanation of its functions.
8. When the feature code exceeds the 18 character space limitation, the feature code descriptor will be placed in the *Comments* screen. Click the **C:** button to call up the *Comments* screen:



Program Logic – Point and Feature Code entries

When a point is saved: (EFB or CEFB input mode)

- 1) The feature code field is checked to see if a value was entered.
- 2) If a value was entered the Feature Code to Prefix relationship is added to the internal FeatureDefaultsList table in the database along with a time stamp.
- 3) If no value was entered then it is ignored and the relationship to the other attributes is ignored as well.

When a point is entered: (EFB or CEFB input mode)

- 1) The Feature Defaults List is searched for the most recent use of the point prefix.
- 2) If not found the Setting XML feature codes are searched for a point prefix match.
- 3) Finally if not found the defaults P G 1 are used.

When a feature is entered: (CEFB input mode only)

- 1) The Feature Defaults List is searched for a feature match.
- 2) If not found the Setting XML feature codes are searched for an alias match.
- 3) If not found the Setting XML feature codes are searched for a feature match.
- 4) Finally if not found the defaults P G 1 are used.

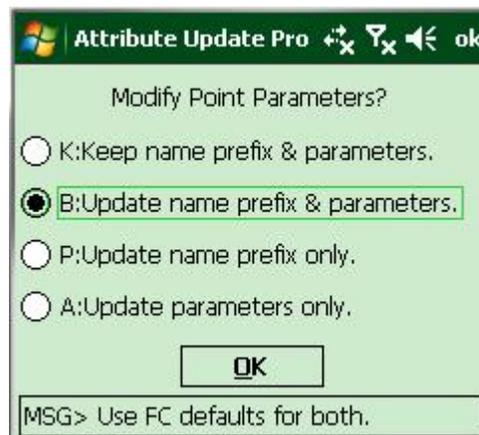
Attribute Update Prompt (CEFB Input Mode only):

When in the *CEFB Input mode*, the user has options available on how the feature code naming and data will be stored. The *Attribute Update Prompt* dialog box will appear when a different value is entered into any of the following fields: *Feature code*, *Point Geometry*, *DTM Attribute*, *Zone*, or *Chain Name*. The *Attribute Update Prompt* dialog box will prompt the user to choose whether to overwrite any, part of or *all* of the previously entered information.

Name refers to Point Prefix (N:) and parameters refer to *Point Geometry*, *DTM Attribute*, *Zone*, and *Chain Name*.

The first time a Feature code is used the program will use the Settings XML values for the Point prefix and the parameters for Point Geometry, Units, Alias, Prompt, DTM Attribute, Zone, and Chain Name.

A Feature Code default table is generated with each new SDF file (project file). As feature codes are entered and saved, the Point name and the parameters are stored in this table.



K: Keep name prefix & parameters

This selection maintains the values that were entered in the previous dialog box (Setup, HVD-Obs, SOR-Obs, Chains or Taping). The point prefix or any of the parameters listed above WILL NOT be overwritten. This is the default action.

B: Update name prefix & parameters

This selection changes the values that were entered in the previous dialog box (Setup, HVD-Obs, SOR-Obs, Chains or Taping). The point prefix or any of the parameters listed above WILL be overwritten by the new values entered. The program compares the values to the Feature Code defaults table. If the Feature code is found, it uses the Point prefix and parameter values in the table to overwrite the values entered in the previous dialog box.

If the Feature code is not yet in the table, the program uses the Feature code Point prefix and parameter values from the *EFB_Settings.xml* to overwrite the values entered in the previous dialog box. When the record (a new point) is saved to the EFB database, it will also write the new Feature code point prefix and parameters to the Feature code defaults table. The next time that same feature code is used, it uses the values from this table, if B: Update name prefix and parameters is selected. If different values are required, the changes will need to be made in the Observation (or chains or taping) dialog box.

P: Update name prefix only

This selection changes the Point prefix value that was entered in the previous dialog box (Setup, HVD-Obs, SOR-Obs, Chains or Taping). The point prefix WILL be overwritten. The program compares the value to the Feature Code defaults table. If the Feature code is found it uses the Point prefix value in the table to overwrite the value entered in the previous dialog box.

If the Feature code is not yet in the table, the program uses the Feature code Point prefix value from the *EFB_Settings.xml* to overwrite the value entered in the previous dialog box. When the record (a new point) is saved to the EFB database, it will also write the new Feature code point

prefix to the Feature code defaults table. The next time that same feature code is used, it will use the values from this table, if P: Update name prefix only is selected. If different values are required the changes will need to be made in the HVD-Obs, SOR-Obs, Chains or Taping dialog box.

A: Update parameters only

This selection changes the parameter values that were entered in the previous dialog box (Setup, HVD-Obs, SOR-Obs, Chains or Taping). The parameter values WILL be overwritten. The program compares the parameter values to the Feature Code defaults table. If the Feature code is found it uses the parameter values in the table to overwrite the values entered in the previous dialog box.

If the Feature code is not yet in the table, the program uses the Feature code parameter values from the *EFB_Settings.xml* to overwrite the values entered in the previous dialog box. When the record (a new point) is saved to the EFB database, it will also write the new Feature code parameter values to the Feature code defaults table. The next time that same feature code is used, it will use the values from this table, if A: Update parameters only is selected. If different values are required the changes will need to be made in the HVD-Obs, SOR-Obs, Chains or Taping dialog box.

	<i>Hint</i>	In a saved point record, if a new feature code is entered and <i>K: Keep name prefix & parameters</i> is selected, a point is <i>modified</i> and will need to <i>type 6</i> to modify & save. If <i>B: Update name prefix & parameters</i> is selected, then a new point is <i>created</i> and you will need to <i>type 0</i> to save.
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In all cases, if the Feature Code does not exist in the *EFB_Settings.xml* an error message will appear in the MSG> text box. EX: Bad Feature Code.

Header (Switchboard, Option - 1)

The *Header* contains the opening pieces of information that go in the EFB file. 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*, and space for a short paragraph of *remarks*. There is only one Header in an EFB segment. The only data required for the Header is a segment name and the units. The segment name in the Header allows a longer, more descriptive name than the *filename* given during the Windows Save As function.

The header data screen:



Screen title: **Header**

Units of linear measurements



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 one hundredth of a foot (.01).



Segment name field

The segment name may be up to 18 characters in length.

Example: I-75 COLUMBIA CO.

Remarks field about nature of the segment

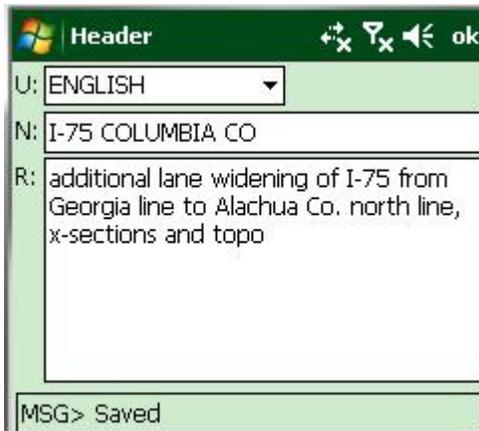
Remarks are used to input a brief description about the work to be performed. The surveyor has space to input up to 98 characters (including spaces) for the description.



Example: 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. The field will stop accepting input once it has reached the character limit.

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



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.

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

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 EFB database. This allows the user to correct mistakes prior to recording the data permanently to the EFB database.

Functions Available: Header



PAGE BACK

PAGE FWRD



RECORD

0 **RECORD** Records the current data screen to the segment file on the field computer. Data is written to the EFB database on the device drive.

1 **PAGE BACK** Displays each screen in reverse order of recording.

2 **PAGE FWRD** Displays each screen in order of recording.

Record

The *Record* function is used to record the contents of a data screen to the EFB database .SDF file. 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. When an attempt to record the data screen is successful, the message "Saved" is displayed in the message field, indicating the Record function was successful in its operation.

The Record function will ALWAYS be located on  key, for all data screens.

Page Backward/Page Forward

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 the next/previously recorded screen in sequence depending on whether the direction is forward or back.

The functions will also "revolve" past the end or beginning of the recorded data as the following illustration depicts:

β β β β β PAGE BACKWARD β β β β β
à à à à à à à à à à à à à à à à à

(beginning of file) (end of file)

à à à à à PAGE FORWARD à à à à à
β β β β β β β β β β β β β β β β

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.

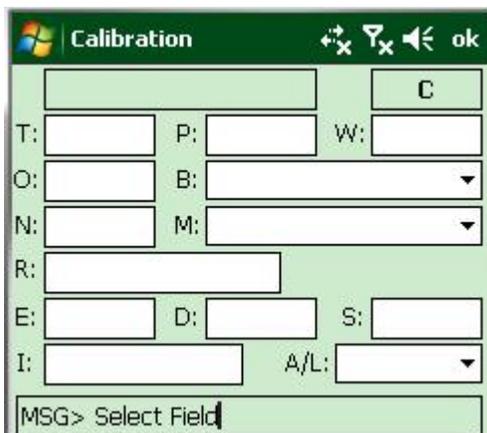
Calibration - (Switchboard, Option - 2)

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 instrument. 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, or 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.

The Calibration Screen:



Screen title: **Calibration**



Temperature, input in degrees Fahrenheit.



Atmospheric pressure, input in inches of mercury (Hg).



Weather code (see Weather Code Table).



Observers initials.



Note keeper's initials.



Rodman(s) initials (initial groups separated by a space example: R:HEC BMD CBM).



Brand of instrument (a *toggle between supported brands*).



Model of instrument (a *toggle between supported models of a brand*).



Identification (serial number) of instrument.



EDM absolute error value in millimeters (manufacturer's specifications).



Distance dependent error in parts per million (ppm - per manufacturer's specifications).



Stadia constant for instruments equipped with stadia hairs in their optics (manufacturer's specifications).



Axis testing (collimation, inclination and pointing) / Level testing (peg test) selector - branches to the type of test screen selected. See below and the Test section (Switchboard option -3).



Comments button branches to comments screen pertaining to the Calibration.

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/instrument point at a target? [a random error]
- What is the horizontal axis collimation error of the instrument? [a systematic error]
- What is the vertical axis collimation error of the instrument? [a systematic error]

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 program (EFBP.EXE) 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 on EFB and stored as a remarks record in the file

immediately following the calibration record, so the user can determine if the instrument is in sufficient adjustment for continued field use.

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.

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. EFB prompts the user for rod readings on two rods (A & B) from different setups (SET1 & SET2) of the level, and then instructs him to adjust the cross hairs, if necessary. From Setup 1 (SET1) centered between the two rod locations (A and B) make readings on rods at locations A and B. Then move the level to Setup 2 (SET2) near the rod location A. Again read and enter the two rod location readings from setup 2. The amount to adjust the level cross hair so that the reading at rod B is correct is computed.), and 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.

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  is not required (because the cursor is in standby status, remaining in the message field) after using a toggle.

When the focus (cursor) is in the data field, where there are a specific set of data as in a dropdown, selection may be made by either typing the highlighted character or the first character

of a full-word option <OR> by using the  and  arrows to toggle through the set of available selections. To accept the selection and return to the message field you must press

.

You may also press  to move to the next data field.

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  key will toggle through all the available supported Brands of electronic total station or levels.

When pressing the  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.

Weather

Weather information is placed into the Calibration screen by editing the fields designated.

The *Temperature* (T:) is input in degrees Fahrenheit.

The *Pressure* (P:) is input in inches of mercury.

The NGS *Weather Code* (W:) 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 NGS weather code, EFB enforces the appropriate digits allowed for input. The weather code table is used to determine the weather code digits required for NGS blue booking of data. Note the NGS weather code does not automatically update to correct values if the temperature (T:) is out of range.

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 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, and the second to the visibility, and so on.

An example weather code for a day where:

The weather is possibly affecting observations (2)

fair visibility (1)

very cold temperature (18 degrees F.) (2)

clear sky (0)

strong winds (2)

moderate humidity (1)

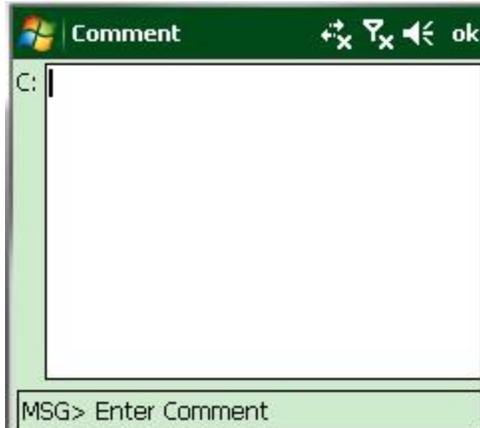
Would be input as: 212021

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  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.

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  prompt letter key. When the  prompt key is pressed, the comment field is displayed. 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 finished editing, press  to return to the Calibration screen. The user may return to any comments field previously edited, and resume editing by the same process.

Functions Available: Calibration



PAGE BACK

PAGE FWRD



RECORD



RECORD Records the current data screen to the segment file on the field computer. Data is written to the EFB database on the device drive.



PAGE BACK Displays each screen in reverse order of recording.



PAGE FWD Displays each screen in order of recording.

Record

The *Record* function is used to record the contents of a data screen to the EFB database .SDF file. 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. When an attempt to record the data screen is successful, the message "Saved" is displayed in the message field, indicating the Record function was successful in its operation.



The Record function will ALWAYS be located on , for all data screens.

Page Backward/Page Forward

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 the next/previously recorded screen in sequence depending on whether the direction is forward or back.

When a screen is recorded, the EFB will respond with the message "Saved" in the message field.

Test - (Switchboard, Option - 3)

When either the *Axis Test* or *Level Test* is selected in the Calibration menu (only one may be selected for each Calibration record) the Test option will display the applicable Test menu. Then one of the following screens will appear:

Example Axis Test:

The screenshot shows a screen titled "Axis Test" with a green header bar containing a Windows logo, the title "Axis Test", and navigation icons (back, forward, home, ok). The main area is light green and contains four input fields arranged in a 2x2 grid. The top-left field is labeled "H:" and contains the text "0 0 0.0". The top-right field is labeled "N:" and is empty. The bottom-left field is labeled "V:" and is empty. The bottom-right field is labeled "I:" and is empty. At the bottom of the screen, there is a status bar with the text "MSG> Select Field".

Screen Title: *Axis Test*

- H** Horizontal direction in DDD MM SS.S format
- V** Vertical direction in DD MM SS.S format
- N** Number (1,2,...) of *recorded* point for the current telescope orientation
- I** Current telescope orientation (Direct or Reversed)

Example Level Test:

The screenshot shows a screen titled "Level Test" with a green header bar containing a Windows logo, the title "Level Test", and navigation icons (back, forward, home, ok). The main area is light green and contains four input fields arranged in a 2x2 grid. The top-left field is labeled "A:" and is empty. The top-right field is labeled "B:" and is empty. The bottom-left field is labeled "C:" and is empty. The bottom-right field is labeled "D:" and is empty. At the bottom of the screen, there is a status bar with the text "MSG> Select Field".

Screen Title: *Level Test*



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).

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. Usually 3 to 4 observations in Direct, and an equivalent number in Reverse suffice.

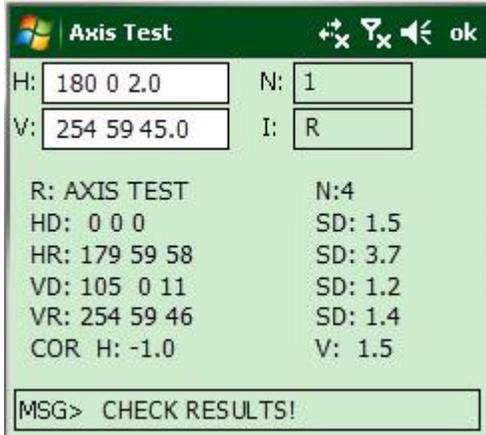
The following steps are taken to complete the Axis test:

1. Point the instrument at a *fixed target*, beginning in either *Direct* or *Reversed* telescope orientation.
2. 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.
3. Record the *test data* using the *Record* function, if you are satisfied with the values on the screen. 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 points made with the telescope in the first orientation is incremented (1,2,3,...) and displayed in the *N:* field.
4. 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.
5. Repeat steps 1 through 3 in the opposite telescope orientation. The number of recorded points will then decrement (...3,2,1) until an equal number of points has been made. When an equal number of points in the opposite telescope orientation has been made and recorded, EFB notifies the user that the test is complete.
6. 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

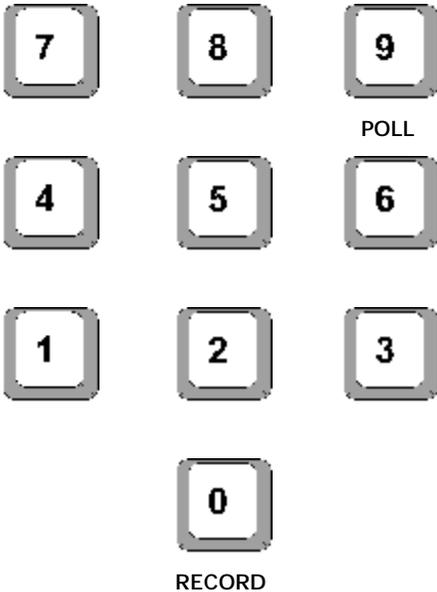
The Axis Test Results screen:



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. In any case, the field surveyor must decide if the instrument is in sufficient adjustment, and that the instrument man has a good enough eye (can point with accuracy and consistency) to continue operations.

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 Switchboard to complete the testing and the Calibration. A Calibration should also be repeated if the test results are unacceptable.

Functions Available: Axis Test



0 **RECORD** Records the current data screen to the segment file on the field computer. Data is written to the EFB database on the device drive.

9 **POLL** Initiates the measurement cycle on automatic total stations supported by EFB.

Record

The *Record* function is used to record the contents of a data screen to the EFB database .SDF file. 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. When an attempt to record the data screen is successful, the message "Saved" is displayed in the message field, indicating the Record function was successful in its operation. The Record function will ALWAYS be located on



, for all data screens.

Poll

If your total station is one of the Brand/Models supported by the EFB, press  to *poll* the total station to measure. 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 and placed on the display screen for review.

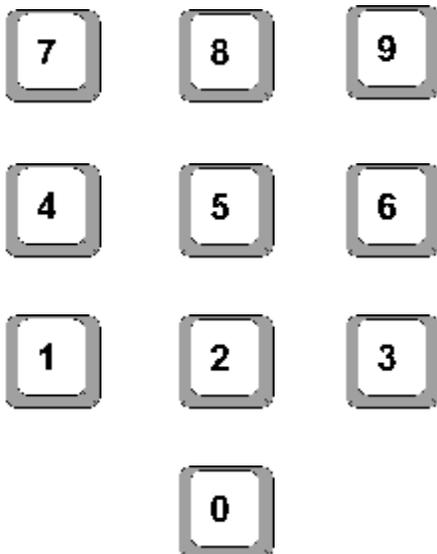
Some electronic total stations require that the instrument be placed in the correct operational mode to make a measurement. Once the instrument is placed in the correct mode (either manual

or automatically - consult your instrument documentation.), press  to request measurement data.

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 at locations *A* and *B*. The first two readings are made from a setup (*SET1*) on line and midway between the rods *A* and *B*. After the rod readings on *A* and *B* are keyed into their appropriate fields *A:* and *B:*, respectively, the level is moved to a new setup (*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*.

Functions Available: Level Test



RECORD



RECORD Records the current data screen to the segment file on the field computer. Data is written to the EFB database on the device drive.

Record

The *Record* function is used to record the contents of a data screen to the EFB database .SDF file. 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. When an attempt to record the data screen is successful, the message "Saved" is displayed in the message field, indicating the Record function was successful in its operation.



The Record function will ALWAYS be located on , for all data screens.

Setup - (Switchboard, Option - 4)

The *Setup* is a record used to store the location of the instrument setup. The Setup is used for both *theodolite*/Total Station (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 being occupied. 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.

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

The Setup screen:

The screenshot shows a green-themed 'Setup' screen. At the top, it says 'ENGLISH' and has navigation icons. Below that, there are several input fields: 'N: SETUP1' with a 'C' button; 'G: P', 'A: G', and 'Z: 1' as dropdown menus; 'F:' with a 'Q:FCB' button; 'B:' and 'I:' as empty text boxes. At the bottom, there is a prompt 'MSG> Select Field'.

Screen title: Setup

- N** User assigned point name (point naming previously discussed)
- G** Geometry (P – point, C - curve, as discussed previously, This is a toggle!)
DEFAULT: P
- A** Attribute (G - ground point, F – feature point, U - user defined, as discussed previously. This is a toggle!)
DEFAULT: G
- Z** Zone (1 through 9, as discussed previously)
DEFAULT: 1
- C** Comments button branches to comments screen pertaining to the Setup.
- F** Feature code (discussed previously)
- Q** Feature Code Builder
- B** 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 program (EFBP.EXE), and is 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 (whether setup over or sighted)
- 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 control *network* and are used to solve the coordinates of the unknown 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 for the least-squares adjustment of the control network is, the stronger the statistical profile of the solution. A distinction should also be made about the term *repetition*, which is making the same observation more than once. Repletion (repeating a measurement) helps identify errors (*blunders*), and allows for the averaging of measurements to get a mean closer to the "truth." Statistically, the mean values are used for distance and angle calculations, and the standard deviations from repletion can be used to model and weight the observations in a least squares adjustment of the data.

The surveyor must use good field judgment 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.

EFB will calculate and communicate to the field operator the results of repetition if a point is observed more than once from any given setup.

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.

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



RE-USE



INCREMENT



PAGE BACK



PAGE FWRD



RECORD



RECORD Records the current data screen to the segment file on the field computer. Data is written to the EFB database on the device drive.



PAGE BACK Displays each screen in reverse order of recording.



PAGE FWD Displays each screen in order of recording.



RE-USE Allows the use of the current point information for additional Setups on that point.



INCREMENT Increments point name suffix of the current point name to the next available point name.

Record

The *Record* function is used to record the contents of a data screen to the EFB database .SDF file. 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. When an attempt to record the data screen is successful, the message "Saved" is displayed in the message field, indicating the Record function was successful in its operation.



The Record function will ALWAYS be located on , for all data screens.

Page Backward/Page Forward

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 the next/previously recorded screen in sequence depending on whether the direction is forward or back.

Re-use

Re-use allows the surveyor to re-observe a point currently on the screen. This function may be used in combination with the page functions to retrieve previously observed points or setups. 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 .

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 .

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

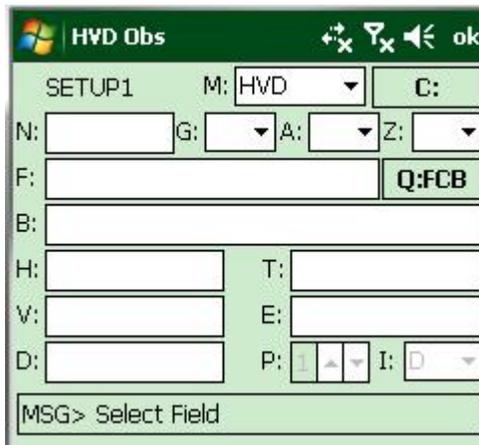
H

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 Switchboard as HVD-Obs and SOR-Obs.

HVD Observations - (Switchboard, Option - 5)

Example of HVD Obs screen:



Screen title: **HVD Obs**

- N** User assigned point name (point naming was previously discussed)
- G** Geometry (P - point, C - curve, as discussed previously) toggle.
- A** Attribute (G - ground point, F - feature point, U- User Defined, as discussed previously) toggle.
- M** Mode of measurement (HVD, HD, HV, VD, H, D) toggle.
- Z** Zone (1 through 9, as discussed previously)

- C** Comments button branches to comments screen pertaining to the HVD Observations.
- F** Feature code (discussed previously)
- Q** Feature Code Builder
- B** Reference name (discussed previously)
- H** Horizontal direction in Degrees, Minutes, and Seconds
- V** Zenith direction in Degrees, Minutes, and Seconds
- D** Distance in US Survey feet (with suffix of S-slope distances, H- for horizontal distances measured)
Note: defaults to slope distance
- P** Position set number (This is the position index of the horizontal reading circle of the instrument. The Position begins at 1, and is manually advanced by the user [2,3,4...etc.] each time the reading circle is advanced or changed during angle measuring operations)
- I** Telescope orientation (D – Direct (Face 1), R – Reversed (Face 2))
- T** Target height in feet (a negative [-] target height indicates the target is *below* the object being located by the amount entered, a positive value indicates the height of the target above the object being observed).
- E** Eccentricity of target to the object (Left, Right, Front, or Back) being observed.

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.

At the bottom of the screen is the message field (*MSG>*) 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 re-measuring 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 field. 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 five (5) feet.

Reading 1:

HVD Obs			
SETUP1	M: HVD	C:	
N: POINT1	G: P	A: G	Z: 1
F:	Q:FCB		
B:			
H: 70 45 37	T: 3.43		
V: 89 31 24	E:		
D: 1677.20 S	P: 1	I: D	
MSG> Saved			

Reading 2:

HVD Obs			
SETUP1	M: HVD	C:	
N: POINT1	G: P	A: G	Z: 1
F:	Q:FCB		
B:			
H: 250 45 25	T: 3.43		
V: 270 28 47	E:		
D: 1677.26 S	P: 1	I: R	
MSG> H012 D0.06 Z0.09			

Reading 3:

HVD Obs			
SETUP1	M: HVD	C:	
N: POINT1	G: P	A: G	Z: 1
F:	Q:FCB		
B:			
H: 70 45 34	T: 3.43		
V: 89 31 23	E:		
D: 1677.33 S	P: 1	I: D	
MSG> H003 D0.10 Z0.04			

If the fourth repetition to POINT1 looked like the following screen then the message field would display:

Reading 4:

HVD Obs

SETUP1 M: HVD C:

N: POINT1 G: P A: G Z: 1

F: Q:FCB

B:

H: 250 45 22 T: 3.43

V: 270 28 49 E:

D: 1677.26 S P: 1 I: R

MSG> H010 D0.00 Z0.07

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 re-measured if necessary. Reading 4 indicates a standard deviation from the mean of the previously recorded observations to POINT1 of 10 seconds in the Horizontal Direction, 0.0 feet in Horizontal Distance, and 0.07 feet in mark-to-mark elevation change (delta Z).

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: 1677.210 feet
- mean mark-to-mark elevation change: 15.577 feet

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

HVD Obs

SETUP1 M: HVD C:

N: POINT1 G: P A: G Z: 1

F: Q:FCB

B:

H: 359 49 31 T: 3.43

V: 90 32 39 E:

D: 1677.33 S P: 1 I: D

MSG> H999 D0.05 Z9.99

In the above screen, the Z value is fairly high and indicates a possible error measuring the height of target or height of instrument. Note the Distance checks in fairly well. The value for Horizontal direction can be disregarded. In such a case, the cause of this "Traverse check" should be investigated while in the field and a new observation made.

Other Components of the HVD observation

Eccentricity

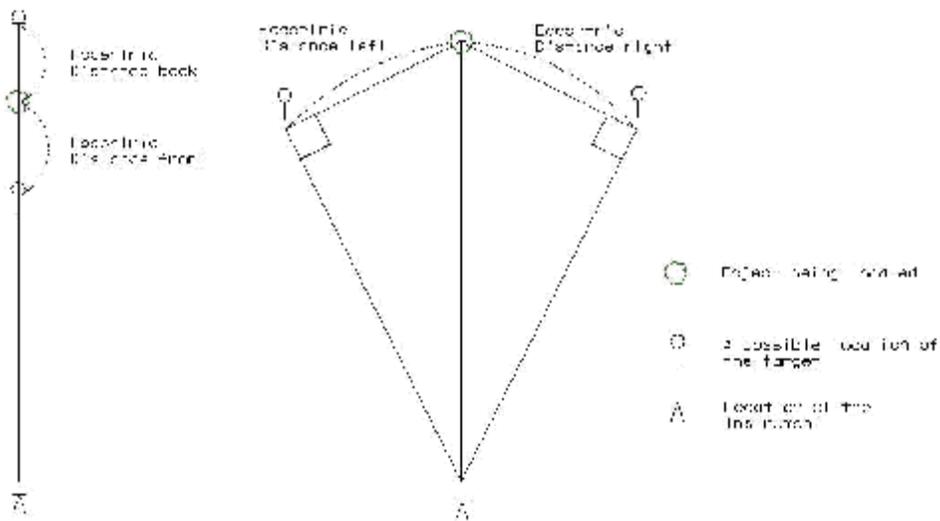
In some cases when making field measurements, it becomes impossible for the Rodman to physically occupy the center of an object that will be located. For this reason, *eccentricity* (rod target is eccentric to the object) is employed as an option for some HVD observation types (namely: HVD, HD).

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 *Front*, and *Back* 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 *Left*, and *Right* 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.

The software traps on input for values greater than 30.00 feet or 9.999 meters, which was estimated as the greatest distance the Rodman could measure eccentricity with ordinary equipment while maintaining a reasonable 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 <OR>
30.00F for a target of 30 feet in front of the object
- 6.61L for a target 6.61 meters to the left of the object <OR>
21.69L for a target of 21.69 feet to the left of the object
- 5R for a target 5.00 meters to the right of the object <OR>
16R for a target of 16 feet 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 the numerals and

Directions

The direction fields are filled by the user in the same manner as 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 checks 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 (Direct V = 0° through 179° 59' 59.9", Reverse V = 180° 0' 0" through 359° 59' 59.9"). If the telescope orientation is incorrect for the zenith angle entered, the orientation is toggled automatically.

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
- 411.29H A Horizontal distance of 411.29 feet
- 266.28 A Slope distance of 266.280 meters
- 873.6 A Slope distance of 873.60 feet
- 987S A Slope distance of 987.000 meters
- 3238S A Slope distance of 3238.00 feet

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

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.

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

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*; therefore EFB only allows the position set number to advance.

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



The position set number is on a toggle key, , corresponding to the prompt letter on the HVD Observation screen. The position set number begins with 1, and toggles 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

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 (or if supported *Bluetooth*).

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.

Functions Available: HVD Observation



RE-USE



INCREMENT



POLL



ROLL BACK



ROLL FWRD



MODIFY



PAGE BACK



PAGE FWRD



DELETE



RECORD



RECORD Records the current data screen to the segment file on the field computer. Data is written to the EFB database on the device drive.



PAGE BACK Displays each screen in reverse order of recording.



PAGE FWD 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.



RE-USE Allows the use of the current point information for additional Setups on that point.



INCREMENT Increments 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.

Record

The *Record* function is used to record the contents of a data screen to the EFB database file. 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. When an attempt to record the data screen is successful, the message "Saved" is displayed in the message field, indicating the Record function was successful in its operation.

The Record function will ALWAYS be located on , for all data screens.

Page Backward/Page Forward

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 the next/previously recorded screen in sequence depending on whether the direction is forward or back.

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 file as part of the permanent record of the survey.

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  on the numeric keypad. EFB will then require a confirmation by responding to a Yes/No Message box prompt before the record is deleted.

This function will always be located on  for the data screens that support the Delete function.

Roll

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.

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  or Roll Backward  reach all of the available names.

The Re-Use  or Increment  function will be used to get the same name or next available name respectively once a name prefix is located.

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)

6

The modify function is selected by pressing **6** once the data fields have been corrected manually. 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.

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.

7

Re-use is assigned to **7**.

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.

8

Increment is assigned to **8**.

Poll

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.

9

Press **9** to request measurement data once the instrument is placed in the correct mode (either manual or automatically consult your instrument documentation).

9

The *poll* function is assigned to the **9** key.

SOR Observations - (Switchboard, Option - 6)

Example of SOR Obs screen:

The screenshot shows a mobile application interface titled "SOR Obs". At the top, there is a green header bar with the title and several icons (a plus sign, a minus sign, a speaker, and an "ok" button). Below the header, the screen is divided into several sections. The top section contains a label "SETNAME1" followed by a dropdown menu set to "SOR" and a button labeled "C:". Below this, there are four rows of input fields: "N:" followed by a text box; "G:" followed by a dropdown menu; "A:" followed by a dropdown menu; and "Z:" followed by a dropdown menu. The next row is "F:" followed by a text box and a button labeled "Q:FCB". Below that is a row for "B:" followed by a text box. The following two rows each have two input fields: "S:" and "U:"; "O:" and "X:"; and "R:" and "L:". At the bottom of the screen, there is a green bar with the text "MSG> Select Field".

Screen title: **SOR Obs**

- N** User assigned point name (point naming was previously discussed).
- G** Geometry (P - point, C - curve, as discussed previously).
- A** Attribute G - ground point, F - feature point
 U - User defined
- Z** Zone (1 through 9, as discussed previously)
- M** Mode (SOR, SO, R) of measurement toggle.
- C** Comments button branches to comments screen pertaining to the SOR Observations.
- F** Feature code (discussed previously)
- Q** Feature Code Builder
- B** Reference name (discussed previously).
- S** Station of point with reference to the Route (alignment).
- O** Offset ([-] left of Route) of point with reference to the Route.
- R** The name designation of the Route, a stationed chain.
- U** 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 *EFB* database. 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).

Components of the *SOR* Observation

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.

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 (125+26.321) in the screen.

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:

- 405.42 - 405.42 feet right of Station
- 405.42L - 405.42 feet left of station
- 1100.40R - 1100.40 feet right of station
- -405.42 - 405.42 feet left of station

Rod Readings

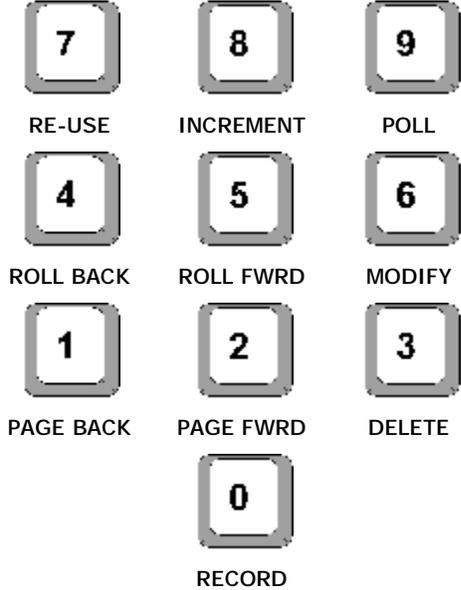
The *SOR* screen has the ability to accept three-wire rod readings made on a level rod using a level. All *solvable* combinations of Upper wire, Cross hair, and Lower wire are acceptable (*UXL*, *UL*, *UX*, *XL*, *X*). *EFB* also checks *UXL* values to help prevent a rod misreading. If the stadia interval 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  for electronic levels supported by EFB.

Functions Available: SOR Observation



-  **RECORD** Records the current data screen to the internal record on the EFB. Data is written to the EFB database on the device drive.
-  **PAGE BACK** Displays each screen in reverse order of recording.
-  **PAGE FWRD** 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 FWRD** Rolls the point name / data list in forward chronological order.
-  **MODIFY** Modifies the current data screen with the edits that were made.
-  **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.

Record

The *Record* function is used to record the contents of a data screen to the EFB database .SDF file. 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. When an attempt to record the data screen is successful, the message "Saved" is displayed in the message field, indicating the Record function was successful in its operation.



The Record function will ALWAYS be located on , for all data screens.

Page Backward/Page Forward

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 the next/previously recorded screen in sequence depending on whether the direction is forward or back.

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 file as part of the permanent record of the survey.

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  on the numeric keypad. EFB will then require a confirmation by responding to a Yes/No Message box prompt before the record is deleted.



This function will always be located on  for the data screens that support the Delete function.

Roll

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, etc.) is saved off in a temporary memory area when EFB is running.

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  or Roll Backward  will reach all available names.

The Re-Use  or Increment  function will be used to get the same name or next available name respectively once a name prefix is located.

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

The modify function is selected by pressing  once the data fields have been manually corrected. The previous version of the SOR screen is removed from the display list (just like the delete function). *Modify* retains the previous version of the Setup data internally, and is flagged as modified in the file.

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 .

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 .

Poll

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.

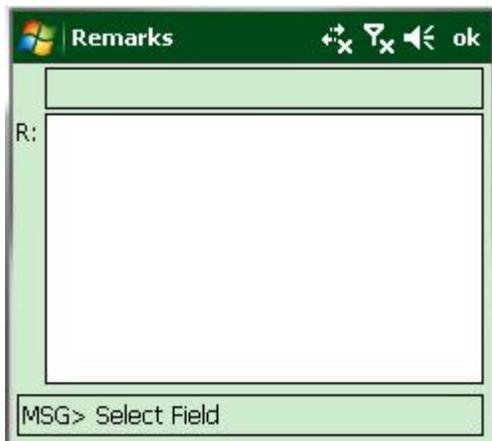
Press  to request measurement data once the instrument is placed in the correct mode (either manual or automatically consult your instrument documentation).

The *poll* function is assigned to the  key.

Remarks - (Switchboard, 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



PAGE BACK

PAGE FWRD



RECORD



RECORD Records the current data screen to the internal record on the EFB. Data is written to the EFB database on the device drive.



PAGE BACK Displays each screen in reverse order of recording.



PAGE FWRD Displays each screen in order of recording.

Record

The *Record* function is used to record the contents of a data screen to the EFB database file. 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. When an attempt to record the data screen is successful, the message "Saved" is displayed in the message field, indicating the Record function was successful in its operation.

The Record function will ALWAYS be located on , for all data screens.

Page Backward/Page Forward

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 the next/previously recorded screen in sequence depending on whether the direction is forward or back.

Chains - (Switchboard, 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:

The screenshot shows the 'Chain' screen with the following fields and controls:

- P:** Input field for point prefix.
- C:** Button for comments.
- N:** Input field for chain name.
- A:** Dropdown menu for attribute.
- Z:** Dropdown menu for zone.
- F:** Input field for feature code.
- Q:FCB** Button for Feature Code Builder.
- S:** Input field for station.
- L:** Large text area for the chain list.
- MSG> Select Field** Status bar at the bottom.

- 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 point (break line),
 F - feature point, U - User defined
- Z** Zone (1 through 9, as discussed previously)
- C** Comments button branches to comments screen pertaining to Chains.
- F** Feature code (discussed previously)
- Q** Feature Code Builder
- S** Station of the first point in the chain list.
- L** List of points comprising the chain list.

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. 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 are flagged "active edit mode" in the EFB database on the field computer. A chain that has just been keyed in is automatically placed in active edit. The chain remains in active edit until saved or deleted at which time it is removed 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. To remove the Active Edit flag from the Chain record in the EFB database, select 0 (zero) Record function.

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. If the surveyor elects to delete the chain, it is removed from active edit and deleted from the project 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 data file using the record function by pressing the  key.
- The chain in the chain screen is deleted using the delete function by pressing the  key.

As previously stated, each chain is automatically entered into active edit when it is created. The surveyor must then return to the chain screen and resolve the chains in active edit by either recording them or deleting them.

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.

Required Chain Data

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

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.
- Delete the chain from active edit using the Delete function.

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 foot 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).

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 Setup, HVD, or SOR 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.

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. The user then enters the Chain List "XYZ1-12" manually. If a Point XYZ13 is later recorded in either the Setup, HVD Observation, or SOR Observation Screen(s) the Chain List becomes L:XYZ1-13.

The change indicated 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. To place a comma, enter the Chain List field by pressing the key when in the chain screen, select the comma key, along with the next point in the chain.

An example of this follows:

P:		C:
N:	BLD1	A: G Z: 1
F:	BLDG	Q:FCB
S:		
L:	LAF1-12,SW1	

MSG> Select Field

To place a GAP in your point sequence, select the comma key twice, along with the next point in the chain.

Example of GAP separation:

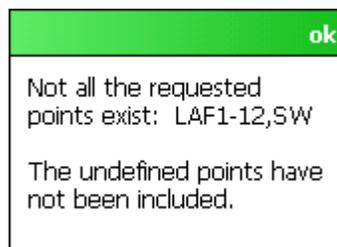
P:		C:
N:	BLD1	A: G Z: 1
F:	BLDG	Q:FCB
S:		
L:	LAF1-4,,6-12	

MSG> Select Field

Press the  key to indicate that editing is complete.

Chain Error:

The system will not allow the use of points that are not available within the project. The following error message will appear:



The system will warn when the syntax is wrong for the Chain being entered:



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 both the [F1] function key and the [J] 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] or [J].

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 are 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] or [J] a second time returns the user to the screen he was in when he originally pressed the *Chain Toggle* function.

The [J] function key was added to accommodate virtual keyboards as they do not support function keys [F1].

Functions Available: Chains



DIRECTORY



INCREMENT



ROLL BACK



ROLL FWRD



DELETE



RECORD



RECORD Records the current chain data screen to the chain data file on the field computer. Data is written to the EFB database on the device drive.



DELETE Marks the current chain in the screen from the active edit list and from the chain data file.



ROLL BACK Rolls the active edit chain list in backward chronological order.



ROLL FWRD Rolls the active edit chain list in forward chronological order.



DIRECTORY Displays a listing of the recorded chain name 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.

Record

The *Record* function is used to record the contents of a data screen to EFB database file. 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 will ALWAYS be located on , for all data screens.

Delete

The *Delete* function 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 file. 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.

Roll

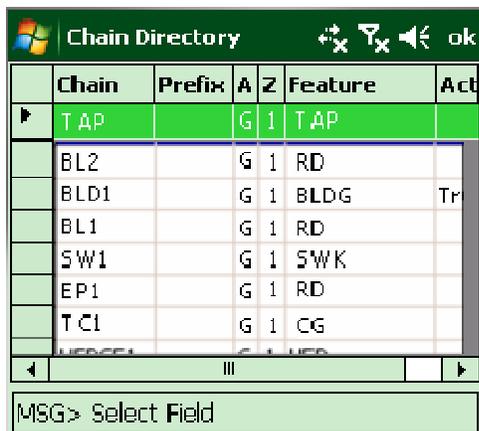
The *Roll* function allows the recall and use of chains in the active edit memory buffer since the name/information data is added chronologically to the Roll list as each prefix is used, a Roll Forward and Roll Backward function is implemented to move you through the available chains and their data.

The Roll buffer is a circular list, like a "Rolodex" so either Roll Forward  or Roll Backward  will reach all of the available chains.

Directory

The *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:



Chain	Prefix	A	Z	Feature	Act
TAP		G	1	TAP	
BL2		G	1	RD	
BLD1		G	1	BLDG	Tr
BL1		G	1	RD	
SW1		G	1	SWK	
EP1		G	1	RD	
T C1		G	1	CG	
USER01		G	1	USER	

MSG> Select Field

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

Deleted chains are not reflected in the chain directory function. If the chain *BLD1* from the previous example was deleted, attempting to retrieve it into active edit returns 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 .

Increment

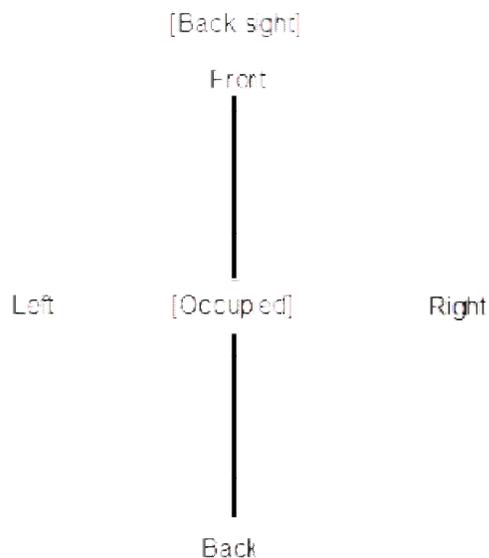
The *Increment* function works in a manner similar to the increment function for point names, except that the current chain in the chain screen is stored and removed from active edit before the chain name is incremented. In this way, the same information may be used to create a second chain with the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

Taping (Switchboard, 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 Left, Right, Front, and Back 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 Front, Back, Left, or Right of the occupied point with respect to the back sight.

The Taping data screen:

ENGLISH C

N: G: A: Z:

O:

B:

F: Q:FCB

H: D:

MSG> Select Field

N Point name for new points being established.

- O** Occupied point name for horizontal angle reference, and distance measurement starting location.
- B** Back sight point name from horizontal angle reference.
- Geometry for newly established point:
- G** P – Point
C - Curve
- A** Attribute F – feature point is the only option.
- Z** Zone (1, 2, 3...9)
- C** Comments (Y – Yes, N – No, branches to a comments screen)
- F** Feature code.
- H** Orthogonal angle from the Back sight point (L – left, R – right, F- front, B – back).
- D** Distance taped from Occupied point to newly established point.

Taping Operation

Because taping is a manual operation, all data input will be keyed in at the keyboard of the filed computer. To begin, the explicit point names (prefix + suffix) of the back sight and occupied points must be input. EFB checks the existence of these points, 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 Front, Back, Left, and Right. The taped distance is then input editing the DA: 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 that 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.

Functions Available: Taping



SHIFT



INCRMNT



SHFT/INCR



MODIFY



PAGE BACK



PAGE FWRD



RECORD



RECORD Records the current taping data screen to the taping data file on the field computer. Data is written to the EFB database on the device drive.



PAGE BACKWARD Displays each screen in reverse order of recording.



PAGE FORWARD Displays each screen in order of recording.



MODIFY Modifies the current data screen with the edits that were made.



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.

Record

The *Record* function is used to record the contents of a tape data screen to the EFB database .SDF file. 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 an attempt to record the data screen is successful, "Saved" is displayed in the MSG field, indicating that the Record function was successful in its operation.



The Record function will ALWAYS be located on , for all data screens.

Paging

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 Backward* or the *Page Forward* function.

The *Page Backward* function is assigned to 1, and the *Page Forward* function is assigned to 2

Shift

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, *and* 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:

The screenshot shows the 'Taping' screen with the following fields: ENGLISH (language), C (unit), N: BLDG1, G: P, A: (empty), Z: 1, O: OCCUPID1, B: BK5IGHT1, F: (empty), Q:FCB, H: (empty), D: (empty). The bottom status bar shows 'MSG> Select Field'.

After the shift:

The screenshot shows the 'Taping' screen after a shift operation. The fields are: ENGLISH (language), C (unit), N: BLDG1, G: (empty), A: (empty), Z: (empty), O: OCCUPID1, B: (empty), F: (empty), Q:FCB, H: L, D: (empty). The bottom status bar shows 'MSG> Select Field'.

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

Increment

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:

The screenshot shows the 'Taping' screen with the following fields: ENGLISH (C), N: (empty), G: (dropdown), A: (dropdown), Z: (dropdown), O: BLDG1, B: OCCUPID1, F: (empty) with a Q:FCB button, and H: L (dropdown) and D: (empty). The bottom bar contains 'MSG> Select Field'.

After the increment:

The screenshot shows the 'Taping' screen after an increment. The fields are: ENGLISH (C), N: BLDG2, G: P (dropdown), A: (dropdown), Z: 1 (dropdown), O: BLDG1, B: OCCUPID1, F: (empty) with a Q:FCB button, and H: L (dropdown) and D: (empty). The bottom bar contains 'MSG> Select Field'.

Shift/Increment

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

Before the shift/increment:

The screenshot shows the 'Taping' screen with the following fields: ENGLISH (C), N: BLDG1, G: P (dropdown), A: (dropdown), Z: 1 (dropdown), O: OCCUPID1, B: BKSIGHT 1, F: (empty) with a Q:FCB button, and H: L (dropdown) and D: (empty). The bottom bar contains 'MSG> Select Field'.

After the shift/increment:

Taping

ENGLISH C

N: BLDG2 G: P A: Z: 1

O: BLDG1

B: OCCUPID1

F: Q:FCB

H: L D:

MSG> Select Field

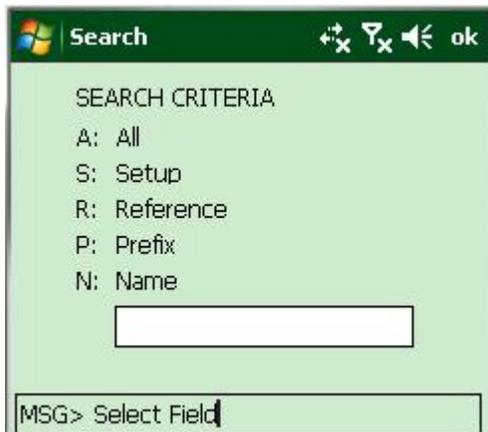
Modify

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 the  digit key. EBF will require the user to confirm this action with a Yes/No response.

Search - (Switchboard, Option - 0)

Survey Menu Option 0, Search Criteria, will display the Search Criteria screen:



The search criteria screen allows the EFB system operator to control which screens are displayed during any paging operation. The search criteria screen acts as a filter which allows only certain operator designated screens to be displayed.

The selected search criteria only effects the display of data screens during any paging function. If the All search criteria is used during paging the EFB system the operator will be able to page through each Header, Calibration, Setup, and Observation screen. If the Setup search criteria is used during paging, the operator will only see setup data screens. If the reference search criteria is used during paging, the operator will only see data screens which contain reference name during paging.

The Prefix and Name search criteria can be used to limit paging to data screens which contain a specific point name or data screens which contain point names which begin with a specific prefix. For example, if the Prefix search criteria is being used and the operator enters the prefix of TOB, only data screens which contain point names which begin with TOB will display during paging. If the Name search criteria is being used and the operator enters the prefix TOB7, only data screens which contain the point name TOB7 will display during paging.

Restricting which data screens are displayed during paging will cut down the number of data screens which must be paged through, and can be used to find data screens which contain a specific observation, or setup to a specific point name.

Search Criteria Screen Options

The following data entries are available in the Search Criteria screen:

- A** Allows the display of All data during paging.
- S** Allows the display of only Setup data during paging.
- R** Allows the display of only data with reference names during paging.
- P** Allows the display of only data where point names begin with an operator specified prefix during paging.
- N** Allows the display of only data which contain an operator specified point name during paging.

Components of the Search Screen

All

The *All* option allows for the display of each data screen during paging.

To select the All option press the  key. In the MSG> display area the EFB system will display the prompt "Match All" to indicate that the operator has elected to display all data screens.

Setup

The Setup option allows for the display of only Setup data screens during paging.

To select the Setup option, press the  key. In the MSG> display area the EFB system will display the prompt "Match Setup" to indicate that the operator has elected to display only Setup data screens.

Reference

The Reference option allows for the display of only screens which contain a reference name during paging.

To select the Reference option, press the  key. In the MSG> display area the EFB system will display the prompt "Match Ref." to indicate that the operator has elected to display only data screens which contain a reference name.

Prefix

The Prefix option allows for the display of data screens which contain a certain prefix during paging.

To select the Prefix option, press the  key. The operator will then be prompted to enter a prefix.

Enter the desired prefix and press the  key. In the MSG> display area the EFB system will display the prompt "Match Prefix" to indicate that the operator has elected to display only data screens which contain point names which begin with the indicated prefix.

Name

The Name option allows for the display of data screens which contain a certain point name during paging.

To select the Name option press the  key. The operator will then be prompted to enter a point name.

Enter the desired point name and press the  key. In the MSG> display area the EFB system will display the prompt "Match Point" to indicate that the operator has elected to display only data screens which contain a specific point name.

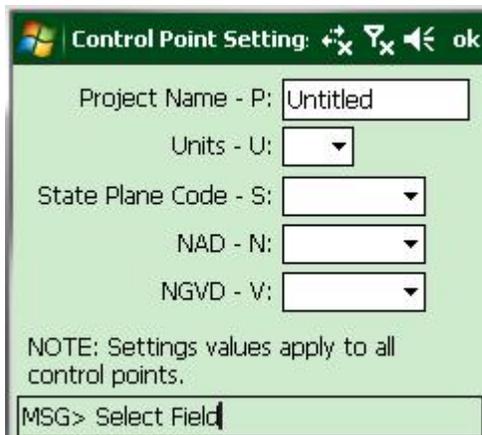
Control Points

A project with no Control Points established will display an empty file with a project name of "Untitled". Startup of a Control Point setup can be accomplished by selecting the Control Points Settings command in the *Ctrl_Pnts* Menu drop down. The initial setup of the Control Point file will require naming of (or referring to) the EFB project and setting the *Units*, *State Plane Code*, *NAD* and *NGVD*. These settings will apply to all Control Points added to a project.

A Control Point file may be imported into the file by selecting *File > Import* from the *Main Menu* or new points added individually by selecting the "Add Point" command in the Control Points drop down menu. At any time after points have been added, the user also has the option of Merging in control points from a control point file. (See the *File Menu* section of this document for further explanation of the differences between importing and merging).

Control Point Settings

Master Control Point settings are established by selecting from the Main Menu: *Ctrl_Pnts > Control Point Settings*. The following screen will appear:

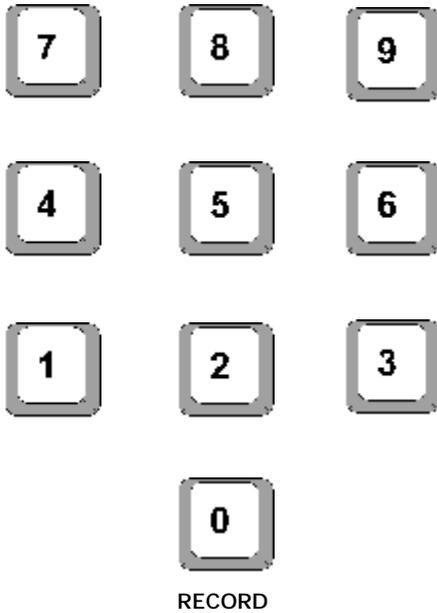


Enter in the Project Name along with the applicable settings for that project. Once these settings have been established, all subsequent control points that are added will be linked to these settings.

Screen title: **Control Point Settings**

- P** Project Name
- U** Units (Feet/Metric)
- S** State Plane Code (0901, 0902, 0903)
- N** NAD – North American Datum (NAD27, NAD83)
- V** NGVD – National Geodetic Vertical Datum (NGVD88, NGVD29)

Functions Available: Control Point Settings



RECORD Records the current control point setting data screen to the control point data file on the field computer. Data is written to the EFB database on the device drive.

Adding Control Points

Control Points are added by either importing or merging an existing .CTL (Control point) file or by selecting from the Main Menu: *Control Points > Add Point*. The following screen will appear:

A screenshot of the 'Control Point' screen. The title bar shows 'Control Point' and navigation icons. The screen contains several input fields: 'N:' (text), 'G:' (dropdown), 'A:' (dropdown), 'Z:' (dropdown), 'F:' (text), 'B:' (text), 'X:' (two text fields), 'Y:' (two text fields), and 'E:' (two text fields). There is a 'C:' button at the top right and a 'Q:FCB' button next to the 'F:' field. At the bottom, there is a status bar that says 'MSG> Select Field'.

Enter the applicable information for the Control Point being added.

Screen title: **Control Point**



User assigned point name.



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

DEFAULT: P

- A** DTM Attribute (G - ground point, F - feature point, U - User defined)
DEFAULT: G
- Z** Zone (1 through 9, as discussed previously)
- C** Comments button branches to comments screen pertaining to Control Points.
- F** Feature code (discussed previously)
- Q** Feature Code Builder
- B** Reference name (discussed previously)
- X** Easting (X)
- Y** Northing (Y)
- E** Elevation

Functions Available: Control Points



ROLL BACK

ROLL FWRD



DELETE



RECORD

- 0** **RECORD** Records the current control point data screen to the control point data file on the field computer. Data is written to the EFB database on the device drive.

- 3** **DELETE** Marks the current control point in the screen from the active edit list and from the control point data file.
- 4** **ROLL BACK** Rolls the active edit control point list in backward chronological order.
- 5** **ROLL FWRD** Rolls the active edit control point list in forward chronological order.

Record

The *Record* function is used to record the contents of a data screen to the EFB database file. 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. When an attempt to record the data screen is successful, the message "Saved" is displayed in the message field, indicating the Record

function was successful in its operation. The Record function will ALWAYS be located on **0**, for all data screens.

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 file as part of the permanent record of the survey.

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 a confirmation by responding to a Yes/No Message box prompt before the record is deleted.

This function will ALWAYS be located on **3** for the data screens that support the Delete function.

Roll

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, 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.

Editing Control Points

Select the Control Point that requires editing, enter the correct (updated) values, and then select

the  button to Record the change.

APPENDIX A - 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 held 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).

A	EFB Traverse Point	AVE	Avenue
AADT	Annual Average Daily Traffic	AWG	American Wire Gage
ABC	Asphalt Base Course	AX	Axle
ABD	Abandoned	AZ	Azimuth
ABS	Acrylonitrile-Butadiene-Styrene Pipe	AZMK	Azimuth Mark
AB	Anchor bolt		
ABV	Above	B	Base
AC	Acre(s)	BA	Barrel
ACC	Access	BAR	Barrier
ACEL	Acceleration	BARW	Barrier Wall
ACP	Asphalt Coated Pipe	BAS	Basin
ACPV	Asphalt Concrete Pavement	BASC	Bascule
ACT	Actuated	BBL	Bubble
ADJ	Adjoining	BC	Bottle Cap
ADJT	Adjust	BCATV	Buried Cable Television
ADL	Additional	BCCMP	Bituminous Coated Corrugated Metal Pipe Culvert
ADT	Average Daily Traffic	BCPA	Bituminous Coated Pipe Arch Culvert
AH	Ahead	BCPCMP	Bituminous Coated and Paved Corrugated Metal Pipe Culvert
AL	Aluminum	BCPPA	Bituminous Coated & Paved Pipe Arch Culvert
ALT	Alternate	BCT	Breakaway Cable Terminal
AM	Midnight until Noon	BDY	Boundary
ANG	Angle	BE	Buried Electric
AOS	Apparent Opening Size	BEG	Begin or Beginning
AP	Asphalt Pavement	BFLY	Butterfly
APPL	Applied or Application	BIN	Bin
APR	Approach	BIT	Bituminous
APRS	Approach Slab	BK	Book
APX	Approximate	BL	Base Line
ARCH	Architecture	BLC	Geodetic Base Line Control
ART	Artificial	BLDG	Building
ARW	Additional Right of Way	BLK	Block
AS	Assembly	BKHD	Bulkhead
ASP	Asphalt	BLVD	Boulevard
ASPC	Asphaltic Concrete	BM	Bench Mark
AT	Aerial Target	BNCH	Bench
ATTN	Attenuator	BNK	Bank
AUX	Auxiliary		
AV	Average		

BOB	Bottom of Bank	CL	Center Line
BOC	Back of Curb	CLF	Chain Link Fence
BOD	Bottom of Ditch	CLG	Ceiling
BOG	Back of Gutter	CLM	Column
BOR	Border	CLMT	Column Tower
BOS	Beginning of Survey	CLNO	Cleanout
BOT	Bottom	CM	Concrete Monument
BOW	Back of Walk	CMB	Concrete Median Barrier
BP	Borrow Pit	CML	Commercial
BPWR	Buried Power, Size Unknown	CMON	Cast Monument
BR	Branch	CMP	Corrugated Metal Pipe
BRDG	Bridge	CMPA	Corrugated Metal Pipe Arc
BRG	Bearing	CMPST	Camp stove
BRGT	Bearing Tree	CNT	Control
BRK	Brick	CNTL	Controller
BRKWY	Breakaway	CNTR	Contour
BS	Back sight	CO	County
BT	Buried Telephone	COA	Course Aggregate
BTD	Buried Telephone Duct	COL	County Line
BTOB	Back to Back	COM	Common
BTT	Buried Telephone Toll	COMM	Commercial
BU	Bushel	COMP	Composite
BUS	Business	CON	Conduit
BVC	Beginning of Vertical Curve	CONC	Concrete
BW	Barbed Wire	CONCV	Concave
BWF	Barbed Wire Fence	COND	Conditional
BX	Box	CONS	Construction
BXC	Box Culvert	CONT	Continued or Continuation
BZ	Bronze	CONTR	Contractor
C	EFB Control Point	COOR	Coordinate
(c)	Calculated	COP	Copper
CA	Controlled Access	COR	Corner
CAN	Canal	CORR	Corrugated
CAP	Capacity	CP	Concrete Pipe
CAPS	Capital Letters	CPD	Compound
CATV	Cable Television Line	CPE	Corrugated Polyethylene Pipe
CATVS	Cable Television Service Box	CPVT	Concrete Pavement
CB	Catch Basin	CR	County Road
CBC	Concrete Box Culvert	CRA	Clear Recovery Area
CBS	Concrete Block Structure	CRS	Course
CBW	Concrete Barrier Wall	CRSA	Course Aggregate
CC	Cubic Centimeter	CRSO	Crossover
CCEW	Center to Center Each Way	CS	Curve to Spiral
CCB	Concrete Block	CSL	Concrete Slab
CCF	Concrete Floor	CSP	Corrugated Steel Pipe
CCR	Curb Cut Ramp	CST	Central Standard Time
CD	Cross Drain	CT	Central Time
CEM	Cement	CTLVR	Cantilever
CEMD	Cemented	CTOC	Center to Center
CEMT	Cemetery	CTR	Center
CERT	Certified	CU	Cubic
CF	Curb Face	CUFT	Cubic Foot
CFS	Cubic Feet per Second	CUL	Cul-de-sac
CG	Curb and Gutter	CULV	Culvert
CGD	Cattle Guard	CUR	Curve
CH	Chain	CUYD	Cubic Yard
CHAN	Channel	CY	City
CHCH	Channel Change	CYL	Cylindrical
CHD	Chord	CYLL	City Limits Line
CHG	Change	CZ	Clear Zone
CHX	Chiseled cross	D	Degree of Curvature
CI	Cast Iron	(D)	Deed
CINL	Curb Inlet	DA	Drainage Area
CIP	Cast Iron Pipe or Corrugated Iron Pipe	DAM	Dam
CIPL	Cast in Place	DBH	Diameter Breast Height
CIR	Circle	DBI	Ditch Bottom Inlet
CKT	Circuit	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
 ELEM 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 Boo
 MBM 1000' Board Measure
 MBX Mailbox
 MDPT Midpoint
 ME Meter, Electri
 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 Wate
 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

NADNorth American
 Datum
 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 Gag
 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 B - Pocket Guide

POCKET GUIDE FOR DEPARTMENT OF TRANSPORTATION EFB

FUNCTION KEYS:

HEADER SCREEN

- 0** KEY **RECORD HEADER** saves current screen data to the EFB database file on the field computer.
- 1** KEY **PAGE BACKWARD** pages through the data screens previously saved in reverse chronological order.
- 2** KEY **PAGE FORWARD** pages through the data screens previously saved in chronological order.

CALIBRATION SCREEN

- 0** KEY **RECORD CALIBRATION** saves current screen data to the EFB database file on the field computer.
- 1** KEY **PAGE BACKWARD** pages through the data screens previously saved in reverse chronological order.
- 2** KEY **PAGE FORWARD** pages through the data screens previously saved in chronological order.

TEST SCREEN

- 0** KEY **RECORD POINTING** saves current screen data to the EFB database file on the field computer.
- 9** KEY **POLL** causes total station to measure and transmit the observation data to the field computer.
(Axis test only)

SETUP SCREEN

- 0** KEY **RECORD SETUP** saves current screen data to the EFB database file on the field computer.
- 1** KEY **PAGE BACKWARD** pages through the data screens previously saved in reverse chronological order.

- 2** KEY **PAGE FORWARD** pages through the data screens previously saved in chronological order.
- 7** KEY **RE-USE** uses the current point name and point data for additional setup.
- 8** KEY **INCREMENT** gets the next available suffix for the current point name for a new point to be observed.

OBSERVATION SCREEN - HVD & SOR

- 0** KEY **RECORD OBSERVATION** saves current screen data to the EFB database file on the field computer.
- 1** KEY **PAGE BACKWARD** pages through the data screens previously saved in reverse chronological order.
- 2** KEY **PAGE FORWARD** pages through the data screens previously saved in chronological order.
- 3** KEY **DELETE OBSERVATION** marks the observation screen deleted and removes it from the display list.
- 4** KEY **ROLL BACKWARD** rolls through a current listing of chain names and data in the chain active edit list.
- 5** KEY **ROLL FORWARD** rolls through a current listing of chain names and data in the chain active edit list.
- 6** KEY **MODIFY** modifies the current data screen with the edits that were made.
- 7** KEY **RE-USE** uses the current point name and point data for additional observations.
- 8** KEY **INCREMENT** gets the next available suffix for the current point name for a new point to be observed.
- 9** KEY **POLL** causes total station to measure and transmit the observation data to the field computer.

REMARKS SCREEN

- 0** KEY **RECORD REMARKS** saves current screen data to the EFB database file on the field computer.
- 1** KEY **PAGE BACKWARD** pages through the data screens previously saved in reverse chronological order.
- 2** KEY **PAGE FORWARD** pages through the data screens previously saved in chronological order.

CHAIN SCREEN

- 0** KEY **RECORD CHAIN** saves current screen data to the EFB database file on the field computer.
- 4** KEY **ROLL BACKWARD** rolls through a current listing of chain names and data in the chain active edit list.
- 5** KEY **ROLL FORWARD** rolls through a current listing of chain names and data in the chain active edit list.
- 7** KEY **DIRECTORY** shows a listing of all chains in order of recording that were not deleted.
- 8** KEY **INCREMENT** gets the next available suffix for the current chain name and records the chain incremented.

CONTROL POINT SETTINGS SCREEN

- 0** KEY **RECORD CONTROL POINT** saves current screen data to the EFB database file on the field computer.

CONTROL POINT SCREEN

- 0** KEY **RECORD CONTROL POINT** saves current control point screen to internal file on the field computer.
- 3** KEY **DELETE CONTROL POINT** marks the control point screen deleted and removes it from the display list.

4 KEY **ROLL BACKWARD** rolls through a current listing of point names and data in the control point active edit list.

5 KEY **ROLL FORWARD** rolls through a current listing of point names and data in the control point active edit list.

TAPING SCREEN

0 KEY **RECORD TAPE** saves current screen data to the EFB database file on the field computer.

1 KEY **PAGE BACKWARD** pages through the data screens previously saved in reverse chronological order.

2 KEY **PAGE FORWARD** pages through the data screens previously saved in chronological order.

6 KEY **MODIFY** modifies the current data screen with the edits that were made.

7 KEY **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.

8 KEY **INCREMENT** gets the next available suffix for the current point name for a new point to be taped.

9 KEY **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:

B KEY **BRAND** selects instrument from a listing of supported total stations, theodolites, levels, etc.

M KEY **MODEL** selects model of the selected brand of instrument.

SETUP, OBSERVATION SCREENS:



KEY GEOMETRY type (point or curve) of the object being observed.



KEY ATTRIBUTE (G-ground point, F-feature point, U-user defined) of the object being observed, indicates relationship of target to ground surface.



KEY ZONE (1 through 9) of the object being observed, indicates which surface the attribute represents.

OBSERVATION SCREEN:



KEY PLATE POSITION setting (increments up from 01 -> NN, toggling between N and N+1 until an observation is recorded at N+1).

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

Input measured in the horizontal plane

ECCENTRICITY

Input as a scalar quantity (measured offset from target location to object being located) followed by eccentric position 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.

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
 RRRMP Railroad Milepost
 SAT Hub & Tack Monument
 STMD Stamped Disk
 STMP Stamped Plate

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

PLANTS

OP Ornamental Plant
 SHR Shrub, Bush
 SHRC Coniferous Shrub
 SHRD Deciduous Shrub
 STM Stump
 TREE Tree, Describe?
 TREC Coniferous Tree
 TRECIC Citrus Tree
 TRECYP Cypress Tree
 TRECED Deciduous Tree
 TREEOA Oak Tree
 TREEPA Palm Tree
 TREEPC Palm Tree Cluster
 TREEPI Pine Tree

POLES

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

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?

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)
 VCV Valve Cover, Water

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

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
 GRL Guard Rail Left
 GRR Guard Rail Right
 GS Glare Screen
 GYS Span Guys
 HNDRL Handrail, Walls
 LL Lane Line
 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 C – 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: peripheral device used to extend the capabilities of the computer

address: identification of a specific location in memory or a specific device to access such a memory location or device

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

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

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

batch file: 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: contraction of the term binary digit. The binary numbering system contains only two members, 0 and 1; therefore, a bit can be either a 0 or a 1.

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

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

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

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

byte: binary character operated upon as a unit, usually shorter than a computer word, that constitutes the smallest addressable unit in a computer system **CD:** (Carrier Detect) RS-232 interface signal that indicates whether or not the serial port is receiving data

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

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

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

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

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

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

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

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

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

diagnostic: 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: visual presentation of information on the screen.

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

DTE: (Data Terminal Equipment) device necessary to control and maintain the communications link; PC is an example of a DTE (Compare with DCE)

DTR: (Data Terminal Ready) 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: ability to display characters on the computer screen

EOF: end-of-file; EOF code immediately follows the last record or data element in a file indicating the end of that file; EOF marker in MS-DOS files is Ctrl-Z (1A hex)

Esc: (Escape) code 1B hex or the key that produces this code; Esc code typically indicates that the character or characters following should be interpreted according to a different set of conventions

field: specified area in a record used for a particular category of data, or the smallest unit of data that can be referred to

file: collection of related data records or program code that is processed as a single entity

flag: indicator, the presence or absence of which indicates the occurrence of a significant event during a process

format: 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: physical equipment and accessories manipulated by computer software during the processing of data

hexadecimal: numbering system containing 16 members, the numbers 0 through 9 followed by the letters A through F

interface: device or environment that converts signals or data from a hardware or software source into a form suitable to different hardware or software

interrupt: 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; type of display producing high contrast with low power consumption

loopback: diagnostic procedure in which signals are returned from one stage directly into another to produce a test loop; transmitted signal in an analog loopback connected to the receiver to verify local operation

mass storage: 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: integrated circuit that contains a complete CPU in a single package

modem: contraction of modulator/demodulator; 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

parallel: processing method in which data transfers occur simultaneously as logical units rather than sequentially as physical units; data is processed in groups of eight bits, or a byte (contrast with serial) during parallel data communications to a printer

parity: 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 be set 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 (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: series of computer instructions designed to perform some computational task or the process of constructing such a series of instructions

prompt: symbol or statement indicating further input or action is required to continue the current process; DOS prompt is d:\>, in which d: represents the current default drive

protocol: set of rules and standards governing the interaction of electronic devices, particularly as regards communications

RAM: Random Access Memory; changeable temporary information

read: retrieval of data from a storage device for comparison or manipulation

record: collection of related data, treated as a unit of information.

ROM: Read Only Memory; permanent non-changeable

RS-232: EIA interface standard controlling the communications interface between data terminal equipment and data communications equipment

RTS: (Request to Send) RS-232 interface signal that indicates whether or not the serial port is in the transmit or receive mode

screen: physical visual output device

serial: processing method in which data transfers occur sequentially as discrete units rather than simultaneously as logical units. For example; data processed bit-by-bit during serial communications (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: 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; transmitting and receiving devices that operate at the same fixed frequency and phase during synchronous transmission (Contrast with asynchronous)

syntax: 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: temporary location (Transient Program Memory) into which programs and data are loaded for use by a program (Contrast with mass storage)

time-out: 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.

video: any function, either text or graphics, visually displayed on the computer screen

virtual disk: term synonymous with RAM disk

write: recording of data on a device for storage or display

