

Carlson X-Port

Overview

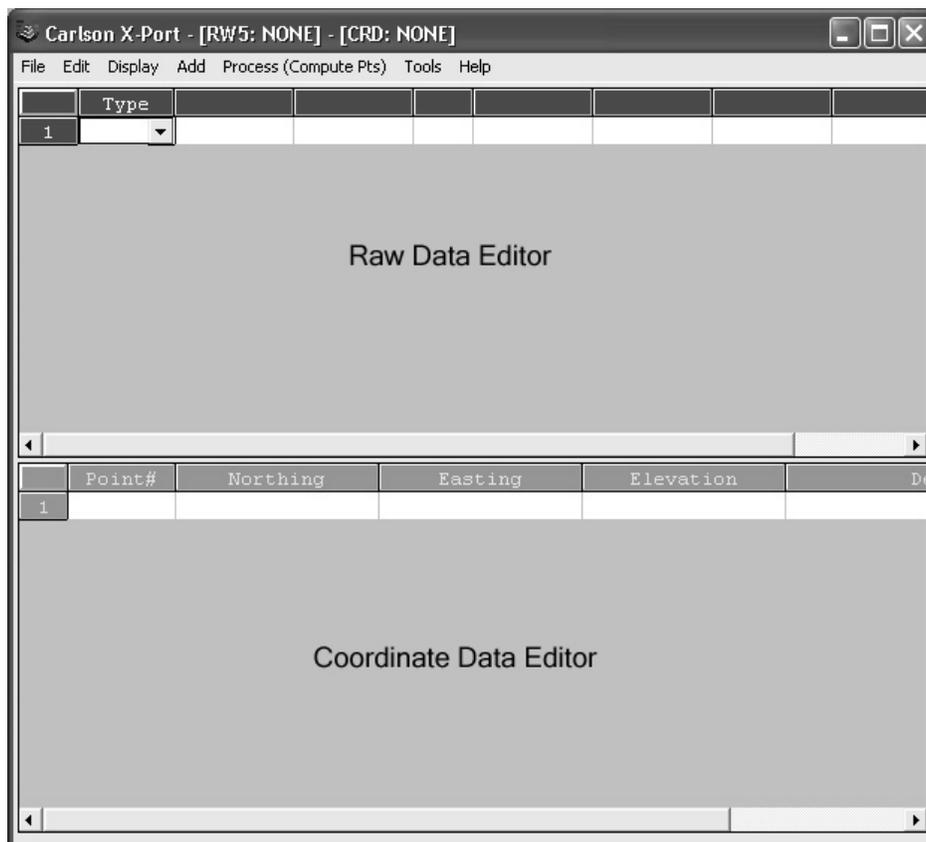
Introduction

Carlson X-Port is a file transfer and data editing utility designed to aid in the processing of electronic data collection files. Features include raw survey adjustments, coordinate processing, numerous conversion utilities of coordinate and raw data formats and communications with all of the popular data collection platforms.

This program reads or creates a raw file (.RW5) that contains lines of data (records) that could be likened to a surveyor's field book. You can specify point coordinates, job information, notes, and the angles and distances that make up traverse or sideshots records. Once the raw data is created or read, it can be processed/reduced to coordinates that are stored in the current coordinate file (.CRD file).

The file name extension of the Carlson X-Port raw file is RW5.

When you start the program, a blank editor is shown. You can choose several options from the File menu to get started. To change the current coordinate file, use the Open or New Coordinate File commands. Each row of the spreadsheet represents one record of data. There are 15 types of data records. The type of data record is shown in the first column. Different record types use different numbers of columns. Whenever the data record type changes between rows, a record header is added to the spreadsheet that describes each column of data in the rows that follow it. See the Format of the Raw File section later in this chapter for a complete list of the supported record header codes and their field headers.



Data Collectors

Communications are supported for the following electronic data collectors:

1. Carlson SurvCE & SurvStar
2. C&G Field
3. Sokkia SDR33 & G2
4. Leica
5. Topcon 210/310/220/GPT2000
6. Nikon
7. SMI
8. Geodimeter
9. TDS

Raw Data

Raw data editing supports the importation of the following formats:

1. Carlson
2. C&G
3. CAiCE (Caltrans Format)
4. AutoDesk Fieldbook
5. Geodimeter
6. Leica
7. Nikon
8. SMI
9. Sokkia/SDR
10. TDS

Raw data editing supports the exportation of the following formats:

1. CAiCE (Caltrans Format)
2. AutoDesk Fieldbook
3. Sokkia/SDR

Coordinate Data

Coordinate editing supports the importation of the following formats:

1. Text/ASCII (Most common formats)
2. Geodimeter
3. Leica
4. Sokkia/SDR
5. TDS

Coordinate editing supports the exportation of the following formats:

1. Text/ASCII (Most common formats)
2. Geodimeter
3. Leica
4. TDS

Survey Adjustment

The following survey adjustment methods are supported:

1. Angle Balance
2. Compass
3. Crandall
4. Transit
5. Least Squares (Linear method - Does not support redundant data)
6. Network Least Squares (Optional)

File Menu

Open RW5 File

Opens any Carlson raw data file (*.RW5) and displays the data in the raw data editor.

New RW5 File

Creates and opens a blank Carlson raw data file (*.RW5) for editing.

Save RW5 File

Saves the existing raw data file (*.RW5) in its current location. If the current file has not been saved as a result of using the “New RW5 File” function, the user will be prompted for the file name and location prior to saving the file.

Save RW5 As

Allows the user to save the current raw data file (*.RW5) as a new file name or in a different location. The current raw data file will be the saved file and the original raw data file will close and continue to reside in its current location.

Open CRD File

Opens any Carlson coordinate file (*.CRD) and displays the data in the coordinate file editor.

New CRD File

Creates and opens a blank Carlson coordinate file (*.CRD) for editing.

Save CRD File

Saves the existing coordinate file (*.CRD) in its current location. If the current file has not been saved as a result of using the “New CRD File” function, the user will be prompted for the file name and location prior to saving the file.

Save CRD As

Allows the user to save the current coordinate file (*.CRD) as a new file name or in a different location. The current coordinate file will be the saved file and the original coordinate file will close and continue to reside in its current location.

Print → Raw Data

Opens the Carlson text editor and allows the user to print a report of the raw data.

Print → Coordinates

Opens the Carlson text editor and allows the user to print a report of the coordinate data.

Print → Printer Settings

This function allows the user to specify printing area parameters.

- Use Degree Symbol - This option lets you choose between using the degree circle symbol and a “d” for degree angles in the report. The “d” can be used for printers that don't handle the degree circle symbol.
- Use Page Numbers - This option adds a page number to the bottom of each page in the report.
- Lines/Page - This option specifies the number of lines per page of the report viewer.
- Left Margin - This option specifies the left margin of the report.
- Top Margin - This option specifies the top margin of the report.
- Bottom Margin - This option specifies the bottom margin of the report.
- Text Size - This option specifies text size for the reports.

Exit

This menu item will exit the Carlson X-Port program. If a file has not been saved, the user will be prompted to do so upon exiting the program.

Edit Menu

Find in RW5 File

Searches for a text string in the raw data file (*.RW5).

Find in CRD File

Searches for a text string in the coordinate data file (*.CRD).

Replace in RW5 File

Searches for a text string in the raw data file (*.RW5) and replaces either all instances or a single instance of the found text string with the user specified replacement text string.

Replace in CRD File

Searches for a text string in the coordinate data file (*.CRD) and replaces either all instances, or a single instance of the found text string with the user specified replacement text string.

Delete Row

This function will delete an entire row of data. The current cell selected by the user will determine the row that gets deleted.

Cut

This function allows the user to remove the data in the selected cell and place the cut value on the windows clipboard.

Copy

This function will copy the contents of the selected cell to the windows clipboard.

Paste

This function will allow the user to paste any data that may have been cut or copied to the windows clipboard into the selected cell.

Display Menu

Vertical → Vertical Angle

Displays vertical angles.

Vertical → Zenith Angle

Displays zenith angles.

Vertical → Elevation Difference

Displays the elevation difference between the occupation location and the measured locations without consideration of the instrument or target heights. Difference displayed is based solely on the reduction of the slope distance and the zenith angle.

Vertical → None

Removes the vertical circle column from the displayed data.

Distance → Slope

Displays slope distances.

Distance → Horizontal

Displays horizontal distances.

Add Menu

You can add records by pressing the Insert key, pressing the down arrow key from the last line in the spreadsheet, or by choosing one of the add records from the Add menu of the Raw Editor.

The types of records are the following:

Traverse

Inserts a traverse record (TR) into the raw data file (*.RW5). When processed, this record calculates and stores the coordinates for the foresight point. Traversing also moves the setup by making the traverse foresight point the next occupied point and the traverse occupied point the next backsight point. The different angle modes are: NE for northeast bearing, SE for southeast, SW for southwest, NW for northwest, AZ for azimuth, AL for angle left, AR for angle right, DL for deflection angle left, DR for deflection angle right, and GN for gons. To set the angle code, pick on the Code down arrow and choose from the list. The horizontal and vertical angles must be entered as dd.mmss. For example, 45.2305 is 45 degrees, 23 minutes, and 5 seconds. The vertical angle can be shown as vertical angle (0 degrees level), zenith angle (90 degrees level), or elevation difference. The vertical angle mode is set in the Raw Editor Display menu. The distance mode is also set in the Raw Editor Display menu, as either slope or horizontal distance. The description field is used as the foresight point description.

Elements of this record include:

1. Occupied Point ID (OcPt)
2. Foresight Point ID (FsPt)
3. Angle Type - NE, SE, SW, NW, AZ, AR, AL, DR, DL, GN (Code)
4. Horizontal Angle Value in dd.mmss (HorzAngle)
5. Distance Value (SlopeDist or HorzDist)
6. Vertical Angle in dd.mmss or Elevation Difference Value (ZenithAng, VertAng or ElevDiff)
7. Description

Sideshot

Inserts a sideshot record (SS) into the raw data file (*.RW5). The sideshot record is the same as the traverse record except that sideshot does not move the setup.

Elements of this record include:

1. Occupied Point ID (OcPt)
2. Foresight Point ID (FsPt)
3. Angle Type - NE, SE, SW, NW, AZ, AR, AL, DR, DL, GN (Code)
4. Horizontal Angle Value in dd.mmss (HorzAngle)
5. Distance Value (SlopeDist or HorzDist)
6. Vertical Angle in dd.mmss or Elevation Difference Value (ZenithAng, VertAng or ElevDiff)
7. Description

Backsight

Inserts a backsight record (BK) into the raw data file (*.RW5). This record should precede any traverse and sideshot records that use this setup. If no backsight point is entered, the command turns angles from the backsight azimuth. The Set Azimuth is the circle reading of the instrument when sighting the backsight. A Set Azimuth of zero is the default.

Elements of this record include:

1. Occupied Point ID (OcPt)
2. Backsight Point ID (BsPt)
3. Backsight Azimuth in dd.mmss (Azi)
4. Set Azimuth in dd.mmss (SetAzi)

Instrument Height

Inserts an instrument height record (HI) into the raw data file (*.RW5). The raw data file, when viewed by a text editor, will designate this record as "LS". This record sets the instrument and rod heights used in elevation calculations. This record should precede any traverse and sideshot records that you want the heights applied to.

Elements of this record include:

1. Instrument Height (InstHt)
2. Target Height (RodHt)

Elevation

Inserts an elevation record (Z) into the raw data file (*.RW5).

Elements of this record include:

1. Point ID (PntID)
2. Elevation

GPS

Inserts a GPS record into the raw data file (*.RW5).

Elements of this record include:

1. Point ID (PntID)
2. Latitude in dd.mmss
3. Longitude in dd.mmss (Negative for West)
4. WGS84 Ellipsoid Elevation (Elevation)
5. Description (Desc)

Note

Inserts a descriptive note record (DS) into the raw data file (*.RW5). The descriptive note record is an additional note that appears in the spreadsheet editor and printouts. This record is not used in processing.

Elements of this record include:

1. Note

Point (To RW5 File)

Inserts a stored coordinate record (PT) into the raw data file (*.RW5). The raw data file, when viewed by a text editor, will designate this record as "SP". When processing, this data is stored as a point in the coordinate file.

Elements of this record include:

1. Point ID (PntID)
2. Northing
3. Easting
4. Elevation
5. Description

Point (To CRD File)

Inserts a stored coordinate record into the coordinate data file (*.CRD).

Elements of this record include:

1. Point ID (PntID)
2. Northing
3. Easting
4. Elevation
5. Description

Reference Azimuth (Network Least Squares Only)

Inserts a known reference azimuth record (AZ) in dd.mmss between two points into the raw data file (*.RW5). This azimuth will be held and adjusted to during the Network Least Squares reduction process.

Elements of this record include:

1. Occupied Point ID (OcPt)
2. Foresight Point ID (FsPt)
3. Known Azimuth (Azi)

Control Standard Error (Network Least Squares Only)

Inserts a Control Standard Error record (CSE) into the raw data file (*.RW5). This in-line standard error record must contain values in all fields. This record will override the project default control standard errors for all coordinate point records that follow.

- If you want to hold a coordinate value fixed, use the “!” sign for the Standard Error.
- If you want to allow the coordinate record to “float”, use the “#” sign.
- If you enter a small standard error, the values will contain more weight than if you enter a large standard error.
- A zero value entered for the azimuth record will not allow the azimuth to change during the adjustment.
- To return any standard error back to the project default settings, enter an “*” sign.

Elements of this record include:

1. Northing
2. Easting
3. Elevation
4. Azimuth in seconds (Azimuth(sec))

The Northing, Easting and Elevation standard errors reflect the weight of the coordinate records that follow this standard error record.

“Azimuth(sec)” is the standard error for azimuth/bearing (direction) records in seconds. For example, you may enter Reference Azimuth records based on known data or Solar or Polaris observations. This standard error controls these records.

Setup Standard Error (Network Least Squares Only)

Inserts a Setup Standard Error record (SSE) into the raw data file (*.RW5). This in-line standard error record must contain values in all fields. This record will override the project default setup standard errors for all records that contain occupied point, backsight point, instrument height or target height data that follow.

- If you want to hold a coordinate value fixed, use the “!” sign for the Standard Error.
- If you want to allow the coordinate record to “float”, use the “#” sign.
- If you enter a small standard error, the values will contain more weight than if you enter a large standard error.
- A zero value entered for an azimuth standard error record will disallow the azimuth to change during the adjustment.
- To return any standard error back to the project default settings, enter an “*” sign.

Elements of this record include:

1. Target Centering (Rod Ctr) error. This value reflects how close you can set the target prism up over the point.
2. Instrument Centering (Inst Ctr) error. This value reflects how close you can set the instrument up over the point.
3. Instrument Height (Inst Hgt) standard error. This value reflects how close you can measure the height of the instrument.
4. Target Height (Rod Hgt) standard error reflects how close you can measure the height of the target/rod.

Measurement Standard Error (Network Least Squares Only)

Inserts a Measurement Standard Error record (MSE) into the raw data file (*.RW5). This in-line standard error record must contain values in all fields. This record will override the project default measurement standard errors for all records that contain horizontal circle, vertical circle, or distance data that follow.

- If you want to hold a coordinate value fixed, use the “!” sign for the Standard Error.
- If you want to allow the coordinate record to “float”, use the “#” sign.
- If you enter a small standard error, the values will contain more weight than if you enter a large standard error.
- A zero value entered for an azimuth standard error record will disallow the azimuth to change during the adjustment.
- To return any standard error back to the project default settings, enter an “*” sign.

Elements of this record include:

1. Horizontal Reading Error (HA Rd(sec)) and Vertical Reading Error (VA Rd(sec)). These values reflect the total station angular reading error in seconds. If you have a 10 second theodolite, enter a reading error of 10 seconds.
2. Horizontal Pointing Error (HA Pt(sec)) and Vertical Pointing Error (VA Pt(sec)). These values reflect the total station angular pointing error in seconds. This value is how accurately the instrument man can point to the target. For example, you may set it higher in the summer because of the heat waves, or when shooting a prism pole versus a target mounted on a tripod, or if you are turning “Robotic Sets” versus manual pointing because robotic instruments lock on the targets less accurately than if you pointed manually.
3. Distance Standard Error (Distance). This value reflects the total station distance reading standard error.
4. Distance PPM Standard Error (Dist PPM). This value reflects the distance Parts per Million standard error.

Process (Compute Points) Menu

The commands under the Process (Compute Points) menu provide various methods for processing the raw file and for storing the calculated points in the coordinate file. The different types are described separately for each adjustment.

No Adjust

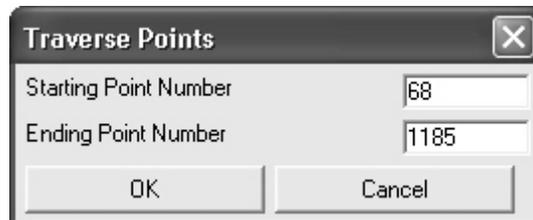
This command processes the raw file and stores the calculated coordinates to the coordinate file. The name No Adjust means that no angle balance or traverse adjustment will be applied.



The dialog box shown above prompts for the following options:

- Report SideShots - This option specifies whether to include the sideshot data in the process results report.
- Correct for Earth Curvature - This adjusts the calculated points for the effect of the Earth's curvature. Typically this adjustment is small and adjusts the elevation more than the horizontal.
- Scale Factor - This factor is multiplied by the slope distance for the traverse and sideshot records.

After you pick OK for the first dialog box, a Traverse Points dialog box appears. Enter the starting and ending point numbers.



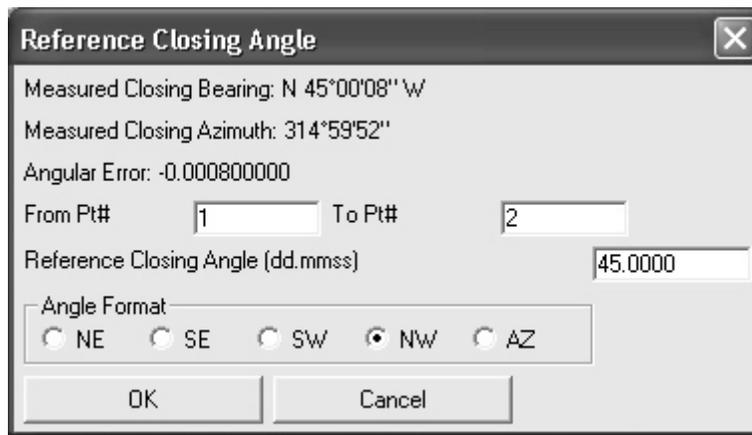
The command reads the raw file to set the defaults for these point numbers, which are used to calculate the closure. The difference between the ending point and the reference closing point is the closure error. The sum of the traverse distances from the starting to the ending point is used as the total distance traversed.

After you pick OK for the second dialog box, the program starts processing the raw file from the top record down. The result is displayed in the standard report viewer, which you can use to save, print, or draw the report.

Angle Balance

This process command applies an angle balance to the traverse lines when calculating the coordinates. This command initially displays the same dialog boxes as the No Adjust method.

One additional dialog is shown below.



The dialog box titled "Reference Closing Angle" contains the following information and controls:

- Measured Closing Bearing: N 45°00'08" W
- Measured Closing Azimuth: 314°59'52"
- Angular Error: -0.000800000
- From Pt#: 1 To Pt#: 2
- Reference Closing Angle (dd.mmss): 45.0000
- Angle Format: NE SE SW NW AZ
- Buttons: OK, Cancel

The angle balance takes the angular error divided by the number of traverse lines and adjusts the angle of each traverse line by that amount. The angular error is the difference between the angle balance shot and a reference angle. The angle balance shot is specified as a type AB or CL+AB record in the raw file. The angle from the angle balance shot is calculated as the angle from the occupied point to the foresight point. The reference angle can be specified as a bearing, as an azimuth, or by two point numbers in the dialog box shown. The angle balance report shows the unadjusted points, the unadjusted closure, the angular error, the adjusted points, and the adjusted closure. Typically, but not always, applying the angle balance correction improves the traverse closure.

Compass, Crandall, Transit, Least Squares

These process commands apply the selected rule of Compass, Crandall, Transit, or Least Squares to the traverse lines when calculating the coordinates. The dialog box is the same for all these methods.

The screenshot shows a dialog box titled "Closure Options". It contains the following fields and options:

- Reference Closing Point: Point # (1)
- North: 10000.0000
- East: 20000.0000
- Elev: 100.0000
- Apply Angle Balance
- Apply Vertical Adjustment
- Report SideShots
- Report Unadjusted Points
- Report Point Adjustments
- Scale Factor: 1.00000000
- Correct For Earth Curvature
- Buttons: OK, Cancel

- Reference Closing Point - This is the field for entering the point number and coordinates to compare the ending traverse point with. The reference closing point is used to calculate the closure.
- Apply Angle Balance - Applies the Angle Balance method to the traverse lines for calculating coordinates.
- Apply Vertical Adjustment - Adjusts the traverse elevations.
- Report SideShots - This option specifies whether to include the sideshot data in the process results report.
- Report Unadjusted Points - Includes the unadjusted points in the report.
- Report Point Adjustments - Reports the adjustment of each point.
- Correct for Earth Curvature - This adjusts the calculated points for the effect of the Earth's curvature. Typically this adjustment is small and adjusts the elevation more than the horizontal.
- Scale Factor: This factor is multiplied by the slope distance for the traverse and sideshot records.

After the command adjusts the traverse, it also recalculates the sideshots. The closure error is calculated as the difference between the closing shot and a reference point. The closing shot is specified as a type CL or CL+AB record in the raw file. If no CL record is found in the raw file, then the command prompts for which traverse shot to use as the closing shot. The foresight point is used as the closing coordinate. The reference point can be specified by point number or by entering the northing, easting, and elevation. The process results report shows the unadjusted points, closure error, adjustments to each traverse point, and adjusted points.

Network Least Squares

The Network Least Squares Adjustment program (NLSA) will perform a mathematically rigorous least squares adjustment and statistical analysis of a network of raw traverse field data.

The NLSA program will simultaneously adjust a network of interconnected traverses with any amount of redundancy. The raw data can contain any combination of traverse (angle and distance), triangulation (angle only), and trilateration (distance only) measurements. It can also calculate resections, where any combination of distances and angles can be measured from an unknown point to known points (points located in the traverse). The raw data does not need to be in a linear format, and individual traverses do not have to be defined using any special codes. All measurements will be used in the adjustment.

The NLSA program can adjust both 3D and 2D traverses, as well as 3D traverses that contain some 2D data. If you have Vertical Adjustment turned ON in the project settings, elevations will be calculated and adjusted only if there is enough information in the raw data file to do so. Least squares adjustment is used for elevation adjustment as well as the horizontal adjustment. To compute elevations the instrument record must have a HI, and the foresight record must have a rod height, slope distance and vertical angle. A 0.0 (zero) HI or ROD HEIGHT is valid (only when the field is blank will it be considered a 2D measurement). A 3D traverse must also have adequate elevation control in order to process the elevations. Elevation control can be obtained from the Control File, Coordinate records in the raw data file, or Elevation records in the raw data file.

The NLSA program can also automatically reduce field measurements to State Plane coordinates in either the NAD 83 or NAD 27 coordinate systems. A grid factor is computed for each individual line during the reduction. The elevation factor is computed for each individual line if the data is 3D. If the raw data has only 2D data, the user has the option of defining a project elevation to be used to compute the elevation factor.

A full statistical report containing the results of the least squares adjustment is produced reported. Coordinates will be written to the current coordinate (*.CRD) file.

Although the NLSA program does not output the standard "Error of Closure" statement, it produces statistical information that allows a much more effective way to evaluate the strength of your traverses, and the precision of your measurements.

Raw Data Files

The NLSA program processes Carlson raw data files (*.RW5). Measurement, coordinate, elevation and direction (Brg/Az) records will be recognized. Scale factor records are not processed because the software calculates the state plane scale factors automatically.

Standard Error Records in the Raw Data File

Although you can set default standard errors for the various types of measurements in the project settings, standard errors can also be placed directly into the raw data file. You can add Standard Error records by selecting the "Add" menu followed by selecting one of the standard error types. (See the "Add Menu" section of this document for a full description of the available standard errors.)

If you do not have standard errors defined in the raw data file, the standard errors in the project settings will be applied to the entire file.

Importing Coordinate Records into the Raw Data File

You may also add coordinate point records into the raw data file. Under the “Add” menu item, select “Point (To RW5 File)”.

This function allows you to bring in control points and assign them Coordinate Standard Error values that are different than the project default settings.

In order to process a raw data file, you must have at least one coordinate point record in either the raw data file.

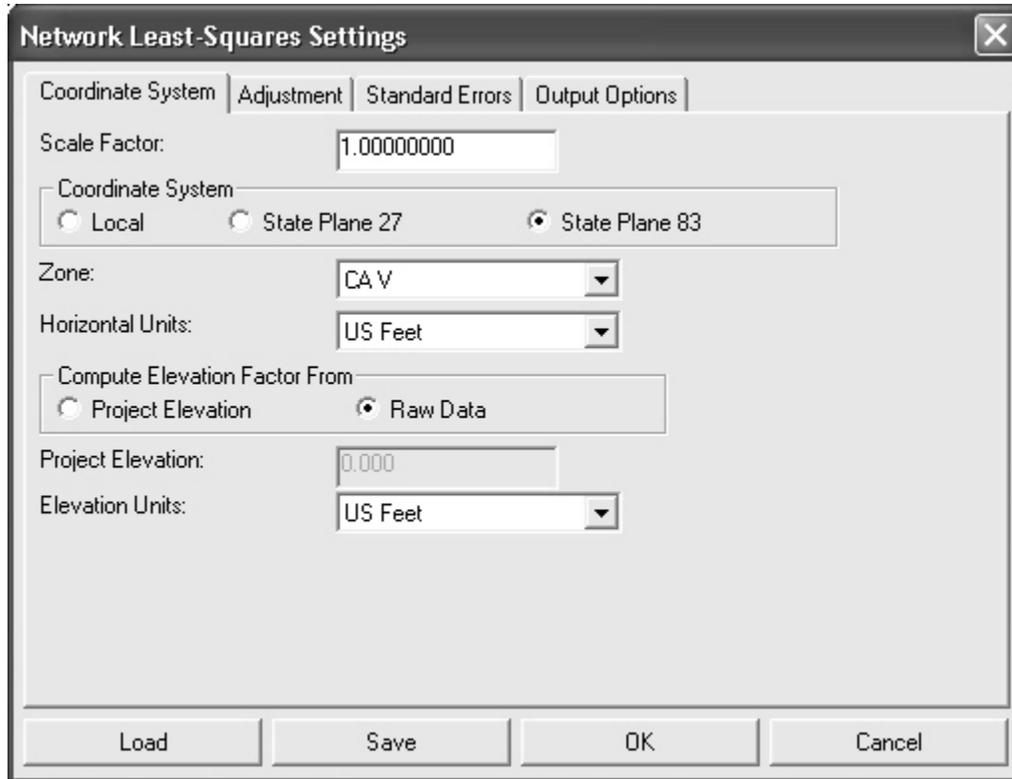
If you are putting control points in a Raw Data File, you may also put the standard error records in the file (as described above). If you do not include a SE record the standard error will be assigned from the X, Y, and Z standard errors from the project settings dialog box.

Network Least Squares Settings

The project settings dialog has four tabs; Coordinate System, Adjustment, Standard Errors and Output Options.

Coordinate System

You have the following options on the “Coordinate System” tab of the “Network Least Squares Settings” dialog box shown below.



The screenshot shows the "Network Least-Squares Settings" dialog box with the "Coordinate System" tab selected. The dialog has four tabs: "Coordinate System", "Adjustment", "Standard Errors", and "Output Options". The "Coordinate System" tab contains the following settings:

- Scale Factor: 1.00000000
- Coordinate System: Radio buttons for Local, State Plane 27, and State Plane 83. State Plane 83 is selected.
- Zone: CA V
- Horizontal Units: US Feet
- Compute Elevation Factor From: Radio buttons for Project Elevation and Raw Data. Raw Data is selected.
- Project Elevation: 0.000
- Elevation Units: US Feet

At the bottom of the dialog are four buttons: Load, Save, OK, and Cancel.

- Coordinate System - You can select Local (assumed coordinate system), SPC 1983 (State Plane NAD83), or SPC 1927 (State Plane NAD27).
- Zone - If you choose SPC 1983 or SPC 1927, you will be allowed to select the State and Zone you are in. The grid scale factor is computed for each measured line using the method described in section 4.2 of NPAA Manual NOS NGS 5, “State Plane Coordinate System of 1983”, by James E. Stem.
- Horizontal Units - This applies to the input/output of coordinate values (Meters, US Feet, or International Feet).
- Compute Elevation Factor From - When you select SPC 1983 or SPC 1927, in order to calculate the combined scale factor so as to adjust distances to sea-level, you will be given the choice of either entering a “Project Elevation”, or using the elevations of the calculated coordinate points. If you are reducing a 2D network, you will want to select “Project Elevation” since none of the calculated points will have elevations. For most survey projects it is sufficient to use an approximate elevation such as could be obtained from a Quad Sheet. For 3D networks the elevation factor is computed for each individual line.

Adjustment

You have the following options on the “Adjustment” tab of the “Network Least Squares Settings” dialog box shown below.

The screenshot shows the "Network Least-Squares Settings" dialog box with the "Adjustment" tab selected. The dialog has four tabs: "Coordinate System", "Adjustment", "Standard Errors", and "Output Options". The "Adjustment" tab contains two main sections: "Least Squares Adjustment Options" and "Raw Data Preprocessing".

Least Squares Adjustment Options:

- Maximum Iterations: 10
- Convergence Threshold: 0.001
- Apply Horizontal Adjustment
- Apply Vertical Adjustment
- Enable sideshots for relative error ellipses

Raw Data Preprocessing:

- Apply Curvature and Refraction Correction
- Horz Dist Tolerance: 0.020
- Vert Dist Tolerance: 0.030
- Horz Angle Tolerance (DD.MMSS): 0.0000

At the bottom of the dialog are four buttons: "Load", "Save", "OK", and "Cancel".

Least Squares Adjustment Options

- Maximum Iterations - Number of iterations allowed for convergence.
- Convergence Threshold - Stop when the corrections to the adjustment are less than this value.
- Apply Horizontal Adjustment - Check box for adjustment of North/East values.
- Apply Vertical Adjustment - Check box for adjustment of elevations.
- Enable sideshots for relative error ellipses - Check box for sideshot relative error ellipses.

You can adjust either horizontal and vertical data, horizontal data only, vertical data only, or no adjustment.

If Vertical Adjustment is not checked, elevations will not be calculated.

Raw Data Preprocessing

- Apply Curvature and Refraction Corrections - Do you wish to correct for curvature and refraction? We recommend that the curvature and refraction correction always be applied.
- Horz. Dist Tolerance - Display a warning if the difference between highest and lowest horizontal distance component exceeds this value.
- Vert. Dist Tolerance - Display a warning if the difference between highest and lowest vertical difference component exceeds this value.
- Horz. Angle Tolerance - Display a warning if the difference between the highest and lowest horizontal angle exceeds this value.

When multiple angles or distances are measured to a point, a single average angle, horizontal distance component and vertical difference component will be calculated for use in the least squares adjustment. You may set the tolerances so that you are warned if any angle or distance exceeds these values. Tolerance warnings will be shown in the report after processing the data.

Standard Errors

Standard errors are basically realistic errors you would expect to obtain based on the type equipment and field procedures you are using to take your measurements. For example, if you are using a 5 second theodolite, you could expect the angles to be measured within +/- 5 seconds (Reading error). The following options are available on the “Standard Errors” tab of the “Network Least Squares Settings” dialog box shown below.

The screenshot shows a dialog box titled "Network Least-Squares Settings" with a close button (X) in the top right corner. The dialog has four tabs: "Coordinate System", "Adjustment", "Standard Errors" (which is selected), and "Output Options".

Under the "Standard Errors" tab, the following settings are visible:

- Distance Standard Error: 0.010 PPM: 5
- Angle Standard Errors:
 - Horizontal Pointing (sec): 3 Reading (sec): 3
 - Vertical Pointing (sec): 3 Reading (sec): 3
- Instrument and Target Standard Errors:
 - Target Centering: 0.005 Instrument Centering: 0.005
 - Target Height: 0.100 Height of Instrument: 0.100
- Direction (Azimuth) Standard Error (sec): 5
- North Coordinate: 0.010 East Coordinate: 0.010

At the bottom of the dialog, there are four buttons: "Load", "Save", "OK", and "Cancel".

- Distance Standard Error - Precision of distance measurements, obtain from EDM specs.
- How precise are your distance measurements (obtain from EDM specs).
- PPM - Parts per Million, Obtain from EDM specs.
- Horizontal Pointing (sec) - Atmospheric conditions, optics, experience and care taken by instrument operator.
- Horizontal Reading (sec) - Precision of horizontal angle measurements, obtain from theodolite specs.
- Vertical Pointing (sec) - Atmospheric conditions, optics, experience and care taken by instrument operator.
- Vertical Reading (sec) - Precision of vertical angle measurements, obtain from theodolite specs.
- Target Centering - How close can you set the target (prism) over the point?
- Instrument Centering - How close can you set the instrument over the point?
- Target Height - How close can you measure the height of the target?
- Instrument Height - How close can you measure the height of the instrument?
- Direction (Azimuth) Standard Error (sec) - How precise are your bearing / azimuth records?
- North Coordinate, East Coordinate - How precise are your horizontal coordinate records?

The Distance, Angle Reading (Vertical and Horizontal) and PPM settings should be based on the equipment being used. Check the published specifications for the total station being used.

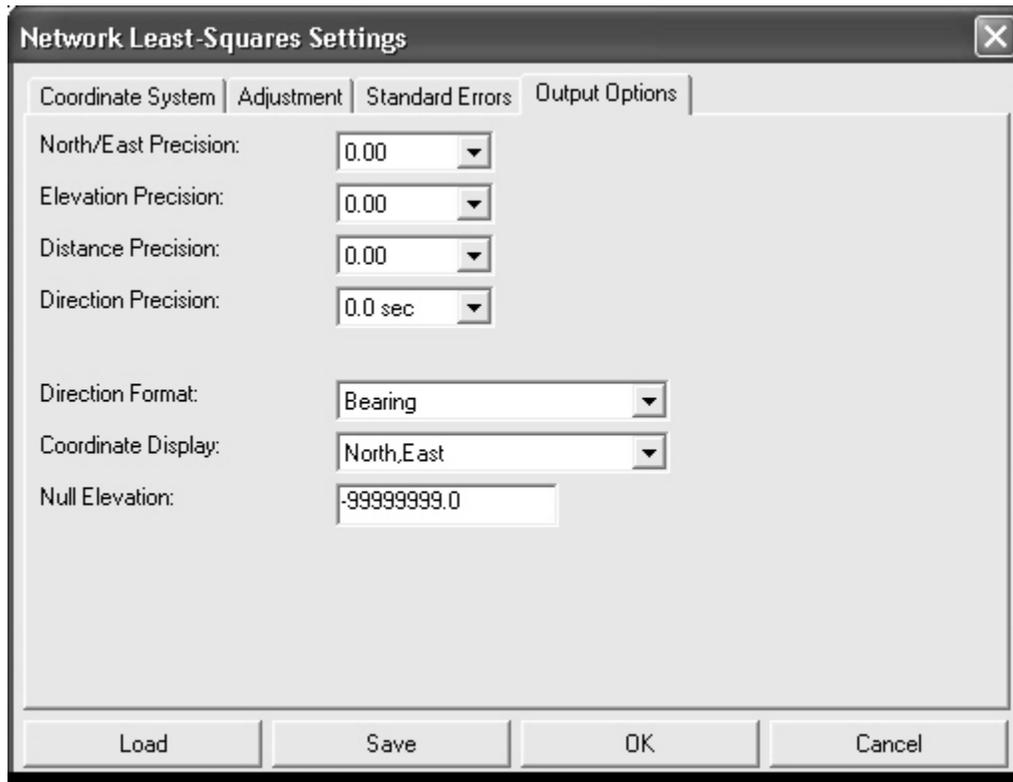
Survey methods should also be taken into account when setting standard errors. For example, you might set the Target Centering standard error higher when you are sighting a held prism pole than you would if you were sighting a prism set on a tripod.

The settings from this dialog box will be used for the project default settings. These default standard errors can be overridden for specific measurements by placing SE records directly into the Raw Data File (see the above section on raw data files).

If the report generated when you process the data shows that generally you have consistently high Standard Residuals for a particular measurement value (angles, distances, etc.), then there is the chance that you have selected standard errors that are better than your instrument and methods can obtain. (See explanation of report file).

Output Options:

The following options are available on the “Output Options” tab of the “Network Least Squares Settings” dialog box shown below. These settings apply to the output of data to the report and coordinate files.



The screenshot shows the "Network Least-Squares Settings" dialog box with the "Output Options" tab selected. The dialog has four tabs: "Coordinate System", "Adjustment", "Standard Errors", and "Output Options". The "Output Options" tab contains the following settings:

- North/East Precision: 0.00
- Elevation Precision: 0.00
- Distance Precision: 0.00
- Direction Precision: 0.0 sec
- Direction Format: Bearing
- Coordinate Display: North,East
- Null Elevation: -99999999.0

At the bottom of the dialog are four buttons: "Load", "Save", "OK", and "Cancel".

- North/East Precision - Select how many places you want to see after the decimal.
- Elevation Precision - Select how many places you want to see after the decimal.
- Distance Precision - Select how many places you want to see after the decimal.
- Direction Precision - Angular output of nearest second, tenth of second, or hundredth of second for directions (Azimuths or Bearings)
- Direction Format - Reported directions can be output in Bearing or Azimuth
- Coordinate Display - Reported coordinates can be output in either North-East or East-North.
- Null Elevation - Value to be reported for elevations that were not calculated.

Coordinate File Output

The calculated coordinates will be written directly to the current coordinate file.

If coordinate points already exist in the coordinate file, they will be overwritten and updated with the new coordinate values.

Process Network

If there is a problem with the reduction, you will be shown error messages that will help you track down the problem.

The data is preprocessed to calculate averaged angles and distances for sets of data. For a given setup, all multiple angles and distances to a point will be averaged prior to the adjustment. The standard error as set in the Project Settings dialog box is the standard error for a single measurement. Since the average of multiple measurements is more precise than a single measurement the standard error for the averaged measurement is computed using the standard deviation of the mean formula.

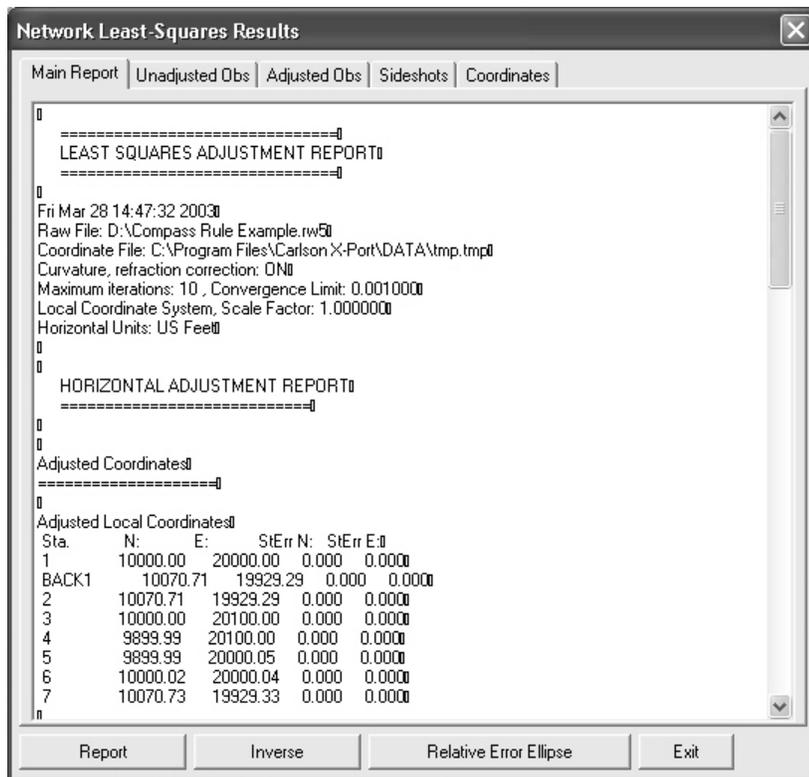
During the preprocessing, approximate coordinate values for each point will also be calculated. This saves the user from having to come up with a list of approximate coordinate values prior to processing.

Sideshots are separated from the raw data and processed after the adjustment.

If the raw data processes properly, a report file will be displayed and the coordinate file will be populated with the adjusted coordinates.

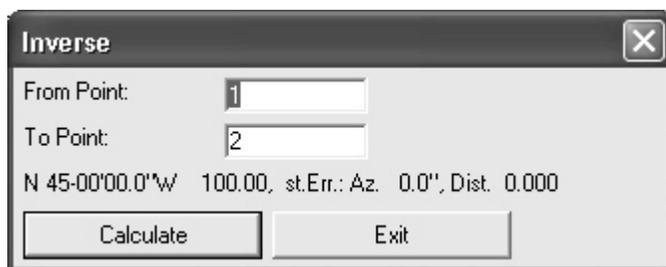
Network Least Squares Results Dialog

Once the adjustment is complete, the following dialog box will be presented.



Inverse Button

The "Inverse" button is found on the main window. This button is only active after a network has been processed successfully. This button can be used to obtain the bearing and distance between any two points in the network. Additionally the standard deviation of the bearing and distance between the two points is displayed. This information can be used to determine the relative precision between any two points in the network.

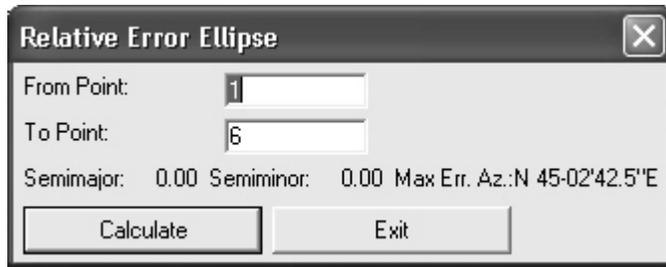


If you need to certify as to the "Positional Tolerances" of your monuments, as per the ALTA Standards, use this function to determine these values.

For example, if you must certify that all monuments have a positional tolerance of no more than 0.07 feet, inverse between the monuments in as many combinations as you deem necessary and make note of the standard deviations of the distances. If none of them are larger than 0.07 feet, you have met the standards.

Relative Error Ellipse

Report the relative error ellipse from one point to another.



Relative Error Ellipse

From Point: 1

To Point: 6

Semimajor: 0.00 Semiminor: 0.00 Max Err. Az.:N 45-02'42.5"E

Calculate Exit

Report

The report file will be shown in a text window so you can analyze the data. You can pick the "Printer" icon if you want a hardcopy.

The first section of the report displays the primary settings used when the project was adjusted.

The second section of the report displays warning and error messages generated during the preprocessing of the raw data. The primary messages displayed will be warnings when multiple angles, horizontal distances, and vertical differences exceed the tolerance settings as set in the project settings. The low and high measurement and the difference are displayed.

Unadjusted Observations

The next four sections list the reduced and averaged measurements that contribute to the network. When multiple measurements are used, the standard error for the averaged measurement will be computed using the average of the mean formula.

The first of the four sections is a list of the control coordinates used in the network adjustment. These coordinates would have been read from the raw data file. Notice that the standard errors for the control points are displayed.

The second of the four measurement sections shows the azimuths and azimuth standard errors used in the adjustment. Azimuths can only be defined as a direction record in the raw data file.

The third of the four measurement sections shows the distances and distance standard errors used in the adjustment. These distances are horizontal distances derived from all slope distance and vertical angles for that line, including all foresight and backsight distances. The standard error settings used to calculate the final distance standard error include the distance standard error, the PPM standard error, the target centering standard error and the instrument centering standard errors. The techniques and formulas used to calculate the final distance standard error are found in section 6.12 of the textbook "Adjustment Computations, Statistics and Least Squares in Surveying and GIS", by Paul Wolf and Charles Ghilani.

The fourth of the four measurement sections shows the angles and angle standard errors used in the adjustment. These angles are the averaged angle value for all the multiple angles collected. The standard error settings used to calculate the final angle standard error include the pointing standard error, the reading standard error, the target centering standard error and the instrument centering standard errors. The techniques and formulas used to calculate the

final angle standard error are found in section 6.2 of the textbook “Adjustment Computations, Statistics and Least Squares in Surveying and GIS”, by Paul Wolf and Charles Ghilani.

Adjusted Coordinates

If the adjustment of the network converges the next section displays a list of the final adjusted coordinates and the computed standard X, Y standard error. An interpretation of the meaning of the X, Y standard error, is that there is a 68% probability that the adjusted X, Y is within plus or minus the standard error of the X, Y of its true value.

The next section displays the error ellipses for the adjusted coordinates. The error ellipse is a truer representation of the error of the point than the X, Y standard error. The error ellipses are calculated to a 95% confidence interval. The error ellipse axis is larger than the X, Y standard errors since the error ellipses in this report are calculated at a 95% probability level. The maximum error axis direction is along the axis of the semi-major axis. The direction of the minimum error axis direction is along the semi-minor axis and is perpendicular to the semi-major axis. If a point is located from a variety of stations, you will see that the error ellipse will approach a circle, which is the strongest geometric shape.

Adjusted Observations

The next three sections list the adjusted horizontal distance, horizontal angle, and azimuth measurements. In addition to the adjusted measurement the, residual, the standard residual and the standard deviation of the adjusted measurement is displayed. The residual is defined as the difference between the unadjusted measurement and the adjusted measurement. The residual is one of the most useful and intuitive measures displayed in the report. Large residuals in relation to the standards of the survey are indications of problems with the data.

The standard residual is the a priori standard error divided by the computed standard deviation of a measurement. A standard residual of 1 indicates that the adjusted measurement is consistent with the standard errors defined for the measurement. One or a few measurements having high standard residuals, in relation to the rest of the standard residuals, may be an indication of a blunder in the survey. When all standard residuals are consistently large there is likely an inconsistency in the a priori standard errors and the adjustment. In other words the standard errors defined for the project are too small, in relation to the survey methods used.

The standard deviation of the measurement means that there is a 68% probability that the adjusted measurement is within plus or minus the standard deviation of the measurement's true value.

Statistics

The next section displays some statistical measures of the adjustment including the number of iterations needed for the solution to converge, the degrees of freedom of the network, the reference variance, the standard error of unit weight, and the results of a Chi-square test.

The degree of freedom is an indication of how many redundant measurements are in the survey. Degree of freedom is defined as the number of measurements in excess of the number of measurements necessary to solve the network.

The standard error of unit weight relates to the overall adjustment and not an individual measurement. A value of one indicates that the results of the adjustment are consistent with a priori standard errors. The reference variance is the standard error of unit weight squared.

The chi-square test is a test of the “goodness” of fit of the adjustment. It is not an absolute test of the accuracy of the survey. The a priori standard errors which are defined in the project settings dialog box or with the SE record in the raw data file are used to determine the weights of the measurements. These standard errors can also be looked at as an estimate of how accurately the measurements were made. The chi-square test merely tests whether the results of the adjusted measurements are consistent with the a priori standard errors. Notice that if you change the project standard errors and then reprocess the survey the results of the chi-square test change.

Sideshots

The next section displays the computed sideshots of the network. Sideshots are filtered out of the network adjustment as part of the preprocessing process. Least squares adjustment requires a lot of computer resources. Sideshots are filtered out to minimize the computer resources needed in a large network adjustment. The sideshots are computed from the final adjusted network points. The results of the sideshot computations are the same whether they are reduced as part of the least squares adjustment or from the final adjusted coordinates.

The next part of the report displays the results of the vertical adjustment. The horizontal and the vertical adjustments are separate least squares adjustment processes. As long as there are redundant vertical measurements the vertical component of the network will also be reduced and adjusted using least squares.

The first section displays the fixed vertical benchmarks used in the vertical adjustment. These points are fixed and will not be adjusted vertically. Next, is listed the points that will be adjusted as part of the vertical adjustment. The following section displays the measurements used in the adjustment. The measurements consist of the vertical elevation difference between points in vertical adjustment. The lengths between these points are used to determine the weights in the vertical adjustment. Longer length lines are weighted less in the vertical adjustment than shorter length lines.

LEAST SQUARES VERTICAL ADJUSTMENT REPORT

The next section displays the adjusted elevations and the computed standard deviations of the computed elevations. Following the adjusted elevation section is a section displaying the final adjusted elevation difference measurements and their residuals. Finally, the computed sideshot elevations are displayed.

State Plane Reduction Report File

When reducing to a state plane coordinate system, there will be additional information displayed in the report file.

First, notice the heading of the report. The heading indicates that the project is being reduced into the Florida east zone of the 1983 State Plane Coordinate System. The heading shows that the elevation factor is computed based on a project elevation of 20 meters:

```
Tue Jul 16 21:25:34 2002
Input File: D:\lsdata\cgstar\CGSTAR.RW5
Curvature, refraction correction: ON
Maximum iterations: 10 , Convergence Limit: 0.001000
1983 State Plane Coordinates, zone:0901 Florida East
Elevation factor computed from project elevation,5.000000.
Elevation Units: Meters
Horizontal Units: Meters
```

The first distance listing in the Unadjusted Observation section of the report shows the unadjusted ground distances:

```
Distances: 14 Observations
From Sta. To Sta. Ground Dist. StErr
1 5 290.450 0.0116
1 2 292.214 0.0116
2 6 52.388 0.0124
2 3 324.186 0.0113
3 4 275.603 0.0115
3 20 134.663 0.0147
20 21 116.073 0.0146
21 22 50.115 0.0144
4 5 309.647 0.0116
5 10 129.985 0.0126
10 11 126.010 0.0125
10 15 10.000 0.0142
11 12 129.426 0.0126
12 3 144.651 0.0126
```

There is a new section displaying the reduced unadjusted grid distances. The grid factor, the elevation factor, and the combined factor used to reduce the ground distance to a grid distance are included in the listing:

```
Grid Distances: 14 Observations
From Sta. To Sta. Grid Dist. Grid Factor Z Factor Combined Factor
1 5 290.458 1.00002753 0.99999922 1.00002674
1 2 292.221 1.00002801 0.99999922 1.00002723
2 3 324.195 1.00002802 0.99999922 1.00002723
3 4 275.611 1.00002752 0.99999922 1.00002674
3 20 134.666 1.00002773 0.99999922 1.00002694
20 21 116.076 1.00002759 0.99999922 1.00002680
4 5 309.655 1.00002725 0.99999922 1.00002646
5 10 129.989 1.00002734 0.99999922 1.00002656
10 11 126.014 1.00002755 0.99999922 1.00002677
11 12 129.429 1.00002775 0.99999922 1.00002697
12 3 144.655 1.00002782 0.99999922 1.00002703
```

In the Adjusted Coordinates section of the report there is a new section displaying the latitude and longitude of the final adjusted points. Additionally the convergence angle, the grid factor, the elevation factor, and the combined factor are displayed for each point:

Adjusted Geographic Coordinates

Sta.	Latitude	Longitude	Conv. Ang.	Grid Factor	Z Factor	Combined Factor
1	25-54'18.04854"N	80-09'50.01222"W	000-21'55"	1.00002780	0.99999922	1.00002701
5	25-54'22.19238"N	80-09'59.38867"W	000-21'51"	1.00002726	0.99999922	1.00002647
2	25-54'24.71981"N	80-09'42.54113"W	000-21'58"	1.00002823	0.99999922	1.00002744
3	25-54'32.95530"N	80-09'49.80362"W	000-21'55"	1.00002781	0.99999922	1.00002702
4	25-54'32.25098"N	80-09'59.67503"W	000-21'51"	1.00002724	0.99999922	1.00002645
20	25-54'36.61787"N	80-09'52.45127"W	000-21'54"	1.00002765	0.99999922	1.00002687
21	25-54'39.78404"N	80-09'54.71776"W	000-21'53"	1.00002752	0.99999922	1.00002674
10	25-54'25.52242"N	80-09'56.51499"W	000-21'52"	1.00002742	0.99999922	1.00002664
11	25-54'24.81748"N	80-09'52.05512"W	000-21'54"	1.00002768	0.99999922	1.00002689
12	25-54'28.26890"N	80-09'49.39720"W	000-21'55"	1.00002783	0.99999922	1.00002705

The remainder of the report is the same as the Local Coordinate System report that follows.

Sample Network Least Squares Adjustment Local Coordinate System Report

=====
LEAST SQUARES ADJUSTMENT REPORT
=====

Tue Jul 16 21:03:16 2002
Input File: D:\lsdata\cgstar\CGSTAR.CGR
Output File: D:\lsdata\cgstar\CGSTAR.RPT
Curvature, refraction correction: ON
Maximum iterations: 10 , Convergence Limit: 0.001000
Local Coordinate System, Scale Factor: 1.000000
Horizontal Units: Meters

Warning, Angle spread exceeds tolerance.
Inst. at 1, Backsight 5, Foresight 2
Low Angle: 109-19'10", High Angle: 109-19'17", Difference: 000-00'07"

Warning, Angle spread exceeds tolerance.
Inst. at 2, Backsight 1, Foresight 6
Low Angle: 190-32'02", High Angle: 190-32'10", Difference: 000-00'08"

Warning, Angle spread exceeds tolerance.
Inst. at 2, Backsight 1, Foresight 3
Low Angle: 096-03'48", High Angle: 096-03'56", Difference: 000-00'08"

Warning, Angle spread exceeds tolerance.
Inst. at 3, Backsight 2, Foresight 4
Low Angle: 124-03'50", High Angle: 124-03'56", Difference: 000-00'06"

Warning, Angle spread exceeds tolerance.
Inst. at 5, Backsight 4, Foresight 10
Low Angle: 039-26'35", High Angle: 039-26'45", Difference: 000-00'10"

Warning, Angle spread exceeds tolerance.
Inst. at 10, Backsight 5, Foresight 11
Low Angle: 241-56'23", High Angle: 241-56'35", Difference: 000-00'12"

Warning, Angle spread exceeds tolerance.
Inst. at 11, Backsight 10, Foresight 12
Low Angle: 114-56'20", High Angle: 114-56'34", Difference: 000-00'14"

Warning, Angle spread exceeds tolerance.
Inst. at 12, Backsight 11, Foresight 3
Low Angle: 140-39'18", High Angle: 140-39'31", Difference: 000-00'13"

Warning, Angle spread exceeds tolerance.
Inst. at 5, Backsight 4, Foresight 1
Low Angle: 117-30'35", High Angle: 117-30'50", Difference: 000-00'15"

Warning, Vertical distance between 1 and 5 exceeds tolerance.
Low Vert. Distance: 7.492, High Vert. Distance: 7.523, Difference: 0.031

Warning, Horizontal distance between 2 and 3 exceeds tolerance.
Low Distance: 324.154, High Distance: 324.195, Difference: 0.042

Warning, Vertical distance between 2 and 3 exceeds tolerance.
Low Vert. Distance: 6.612, High Vert. Distance: 8.357, Difference: 1.745

Warning, Vertical distance between 3 and 4 exceeds tolerance.
Low Vert. Distance: 11.459, High Vert. Distance: 11.516, Difference: 0.057

Warning, Vertical distance between 4 and 5 exceeds tolerance.
Low Vert. Distance: 4.340, High Vert. Distance: 4.375, Difference: 0.035

Warning, Horizontal distance between 12 and 3 exceeds tolerance.
Low Distance: 144.641, High Distance: 144.661, Difference: 0.020

HORIZONTAL ADJUSTMENT REPORT

=====

Unadjusted Observations

=====

Control Coordinates: 1 Observations

Sta.	N:	E:	StErr N:	StErr E:
1	10000.000	10000.000	0.0010	0.0010

Distances: 14 Observations

From Sta.	To Sta.	Dist.	StErr
1	5	290.450	0.0116
1	2	292.214	0.0116
2	6	52.388	0.0124
2	3	324.186	0.0113
3	4	275.603	0.0115
3	20	134.663	0.0147
20	21	116.073	0.0146
21	22	50.115	0.0144
4	5	309.647	0.0116
5	10	129.985	0.0126
10	11	126.010	0.0125
10	15	10.000	0.0142
11	12	129.426	0.0126
12	3	144.651	0.0126

Angles: 15 Observations

BS Sta.	Occ. Sta.	FS Sta.	Angle	StErr (Sec.)
5	1	2	109-19'13"	13.0
1	2	6	190-32'06"	41.0
1	2	3	096-03'52"	12.8
2	3	4	124-03'53"	13.1
2	3	20	185-23'56"	20.6
3	20	21	180-15'26"	22.5
20	21	22	183-26'45"	12.2
3	4	5	093-02'12"	13.2
4	5	10	039-26'40"	19.3
5	10	11	241-56'29"	8.6
5	10	15	056-23'10"	12.2
10	11	12	114-56'27"	8.6
11	12	3	140-39'24"	8.6
12	3	2	325-54'30"	8.6
4	5	1	117-30'42"	13.0

Azimuths: 1 Observations

Occ. Sta.	FS Sta.	Bearing	StErr (Sec.)
1	2	N 45-00'00"E	5.0

Adjusted Coordinates

=====

Adjusted Local Coordinates

Sta.	N:	E:	StErr N:	StErr E:
1	10000.000	10000.000	0.0010	0.0010
5	10125.859	9738.222	0.0153	0.0102
2	10206.625	10206.625	0.0089	0.0089
3	10458.769	10002.881	0.0111	0.0183
4	10435.346	9728.285	0.0183	0.0194
20	10571.010	9928.475	0.0191	0.0268
21	10668.042	9864.776	0.0274	0.0376
10	10228.844	9817.550	0.0152	0.0135
11	10207.941	9941.814	0.0143	0.0134
12	10314.625	10015.112	0.0143	0.0140

Adjusted Coordinates	Error Ellipses	95% CI	
Sta.	Semi Major	Semi Minor	Max. Error Az.
	Axis	Axis	
1	0.004	0.004	N 45-00'00"E
5	0.067	0.043	N 10-51'15"E
2	0.045	0.031	N 45-00'00"E
3	0.081	0.046	N 77-38'20"E
4	0.104	0.050	N 47-34'08"E
20	0.119	0.078	N 72-08'02"E
21	0.174	0.102	N 64-12'51"E
10	0.075	0.046	N 37-10'13"E
11	0.068	0.050	N 38-56'28"E
12	0.064	0.058	N 38-41'29"E

Adjusted Observations
=====

Adjusted Distances

From Sta.	To Sta.	Distance	Residual	StdRes.	StdDev
1	5	290.4621	0.0119	1.0	0.0104
1	2	292.2123	-0.0012	0.1	0.0104
2	3	324.1736	-0.0126	1.1	0.0103
3	4	275.5934	-0.0101	0.9	0.0102
3	20	134.6627	-0.0000	0.0	0.0147
20	21	116.0727	-0.0000	0.0	0.0146
4	5	309.6469	0.0003	0.0	0.0102
5	10	129.9959	0.0107	0.9	0.0107
10	11	126.0102	0.0000	0.0	0.0108
11	12	129.4370	0.0110	0.9	0.0108
12	3	144.6625	0.0118	0.9	0.0113

Adjusted Angles

BS Sta.	Occ. Sta.	FS Sta.	Angle	Residual	StdRes	StdDev(Sec)
5	1	2	109-19'21"	7.4	0.6	9.5
1	2	3	096-03'36"	-15.5	1.2	8.5
2	3	4	124-03'52"	-1.5	0.1	9.1
2	3	20	185-23'56"	0.0	0.0	20.6
3	20	21	180-15'26"	0.0	0.0	22.5
3	4	5	093-02'11"	-0.1	0.0	8.9
4	5	10	039-26'44"	4.1	0.2	10.4
5	10	11	241-56'32"	2.5	0.3	8.2
10	11	12	114-56'33"	6.0	0.7	8.1
11	12	3	140-39'32"	7.5	0.9	7.8
12	3	2	325-54'36"	6.5	0.8	7.2
4	5	1	117-31'00"	17.2	1.3	9.3

Adjusted Azimuths

Occ. Sta.	FS Sta.	Bearing	Residual	StdRes	StdDev(Sec.)
1	2	N 45-00'00"E	-0.0	0.0	5.0

Statistics
=====

Solution converged in 2 iterations
 Degrees of freedom:6
 Reference variance:1.83
 Standard error unit Weight: +/-1.35
 Passed the Chi-Square test at the 95% significance level
 0.680 <= 10.955 <= 18.550

Sideshots
=====

From	To	Bearing	Dist.	N	E	StDev. N	StDev. E
2	6	N 55-32'06"E	52.388	10236.272	10249.817	0.0114	0.0136
21	22	N 29-50'17"W	50.115	10711.514	9839.841	0.0396	0.0383
10	15	N 86-00'27"W	10.000	10229.540	9807.574	0.0135	0.0196

LEAST SQUARES VERTICAL ADJUSTMENT REPORT

Tue Jul 16 21:03:16 2002
 Input File: D:\lsdata\cgstar\CGSTAR.CGR
 Output File: D:\lsdata\cgstar\CGSTAR.RPT
 Curvature, refraction correction: ON

FIXED VERTICAL BENCHMARKS

Station	Elevation
1	900.0000

POINTS TO BE ADJUSTED

Station
5,2,3,4,10,11,12

MEASUREMENT SUMMARY

From	To	Elev. Diff. (unadjusted)	Length (weights)
1	5	7.5040	290.4502
1	2	7.5659	292.2135
2	3	6.9833	324.1861
3	4	-11.4907	275.6035
4	5	4.3557	309.6466
5	10	2.2647	129.9852
10	11	1.0938	126.0102
11	12	0.3836	129.4259
12	3	3.3600	144.6507

ADJUSTED ELEVATIONS

Station	Adjusted Elev	Standard Dev.
1	900.0000	0.00000
5	907.4862	0.02438
2	907.5838	0.02443
3	914.5869	0.02832
4	903.1124	0.03091
10	909.7506	0.02836
11	910.8441	0.03016
12	911.2273	0.03026

ADJUSTED MEASUREMENT SUMMARY

From	To	Elev. Diff. (adjusted)	Residuals
1	5	7.4862	-0.0178
1	2	7.5838	0.0179
2	3	7.0031	0.0199
3	4	-11.4745	0.0162
4	5	4.3739	0.0182
5	10	2.2644	-0.0003
10	11	1.0935	-0.0003
11	12	0.3832	-0.0003
12	3	3.3596	-0.0004

Sideshots

Station	Elevation
20	901.918
21	911.404
22	910.293
15	909.751

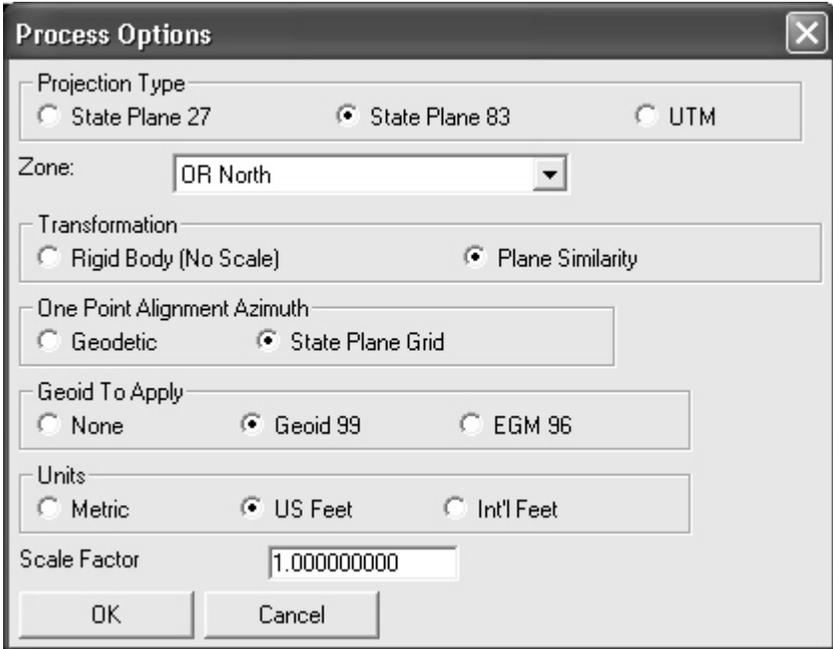
GPS

The process GPS routine allows you to reduce the GPS records that reside in a raw (*.RW5) file from latitude, longitude and WGS84 Ellipsoid Height to State Plane or local coordinates.

Elements of the GPS record include:

1. Point ID (PntID)
2. Latitude in dd.mmss
3. Longitude in dd.mmss (Negative for West)
4. WGS84 Ellipsoid Elevation (Elevation)
5. Description (Desc)

The first dialog that you will receive from this routine is shown below.



The screenshot shows the 'Process Options' dialog box. The 'Projection Type' section has three radio buttons: 'State Plane 27', 'State Plane 83' (which is selected), and 'UTM'. Below this is a 'Zone:' dropdown menu with 'OR North' selected. The 'Transformation' section has two radio buttons: 'Rigid Body (No Scale)' and 'Plane Similarity' (selected). The 'One Point Alignment Azimuth' section has two radio buttons: 'Geodetic' and 'State Plane Grid' (selected). The 'Geoid To Apply' section has three radio buttons: 'None', 'Geoid 99' (selected), and 'EGM 96'. The 'Units' section has three radio buttons: 'Metric', 'US Feet' (selected), and 'Int'l Feet'. At the bottom, there is a 'Scale Factor' text box containing '1.000000000' and two buttons: 'OK' and 'Cancel'.

Projection Type

Defines the datum coordinate system to be used for converting the Latitude, Longitude and WGS84 Ellipsoid height collected from the GPS receiver into Cartesian coordinates.

For the United States two separate horizontal control systems have been developed by the Federal Government, State Plane 1927 and State Plane 1983.

For International use, the UTM (Universal Transverse and Mercator System) should be selected.

Zone

For State Plane projections, you must select the correct state zone that you are working in. For UTM, the Automatic Zone option will have the program automatically use the correct UTM zone for your location. Otherwise for UTM, you can manually set a specific UTM zone. This manual option applies to working on the border between zones and you want to force the program to always use one of those zones.

Transformation

The transformation in the Align Local Coordinates command can either be by plane similarity or rigid body methods. Both methods use a best-fit least squares transformation. The difference is that the rigid body method does a transformation with a translation and rotation and without a scale. The plane similarity does a rotation, translation and scale. This option only applies when two or more points are used in Align Local Coordinates.

One Point Alignment Azimuth

This option applies to the rotation when using one point in Align Local Coordinates. For this alignment method, the state plane coordinate is translated to the local coordinate. Then the rotation can use either the state plane grid or the geodetic as north. No scale is applied in this transformation. The state plane and geodetic true north diverge slightly in the east and west edges of the state plane zone. This option allows you to choose which north to use.

Geoid To Apply

This option will account for the geoid undulation in determining the orthometric elevation of the measurement. The definition of the geoid model as currently adopted by the National Geodetic Survey is the equipotential surface of the Earth's gravity field which best fits, in a least squares sense, global mean sea level. Orthometric elevation measurements are used in survey calculations. In order to convert ellipsoid heights (H_e) as measured by GPS into orthometric elevations (E_o), you must provide for a correction between the GPS-measured ellipsoid (reference ellipsoid) and a constant level gravitational surface, the geoid. This correction is the geoid undulation (U_g). The formula is $H_e = E_o + U_g$.

The Geoid models are essentially large elevation difference models in grid format. X-Port has two geoid models available.

Geoid99 covers the United States at 1 minute grid intervals.

EGM96 covers the entire globe at 15 minute intervals.

These Geoid models are huge and take a lot of disk space and memory. The Geoid model files are not installed automatically and instead need to be installed separately from the CD.

X-Port applies the Geoid model by subtracting the Geoid undulation from the GPS elevation. The resulting elevation is then used and displayed. In practice, the Geoid model is most applicable to two types of alignment scenarios. One of these types is when setting up the base over a known point and having no alignment control points. The other is when there is one alignment control point. When using multiple alignment control points, the Geoid model is not as important because X-Port can model the elevation difference which can generally pick up the local Geoid undulation.

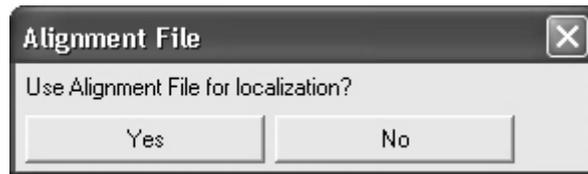
Units

Coordinates can be reduced into one of three available units, Metric, US Feet or International Feet.

Scale Factor

After converting the LAT/LONG from the GPS records to state plane coordinates and applying the coordinate alignment (Localization) file, the Project Scale Factor is applied as the final adjustment to the coordinates. This adjustment is used on the X,Y and not the Z. The Project Scale Factor is applied by dividing the distance between the coordinate and a base point by the Project Scale Factor. The coordinate is then set by starting from the base point and moving in the direction to the coordinate for the adjusted distance. The base point is the first point in alignment (Localization) file. If there are no points specified in the alignment (Localization) file, then 0,0 is used as base point.

The second dialog shown below will prompt if an alignment (Localization) file is to be used during the process. This file is typically created by SurvCE using the Localization routine or by Tsunami using the Align to Local Coordinates routine. This file (*.DAT) contains the parameters to transform the derived State Plane coordinates to the defined local coordinates.



At the end of the process, the coordinates will be written to the current coordinate (*.CRD) file and a report will be presented in the Carlson test editor for saving or printing purposes.

Tools Menu

Data Transfer → SurvCE/SurvStar/G2

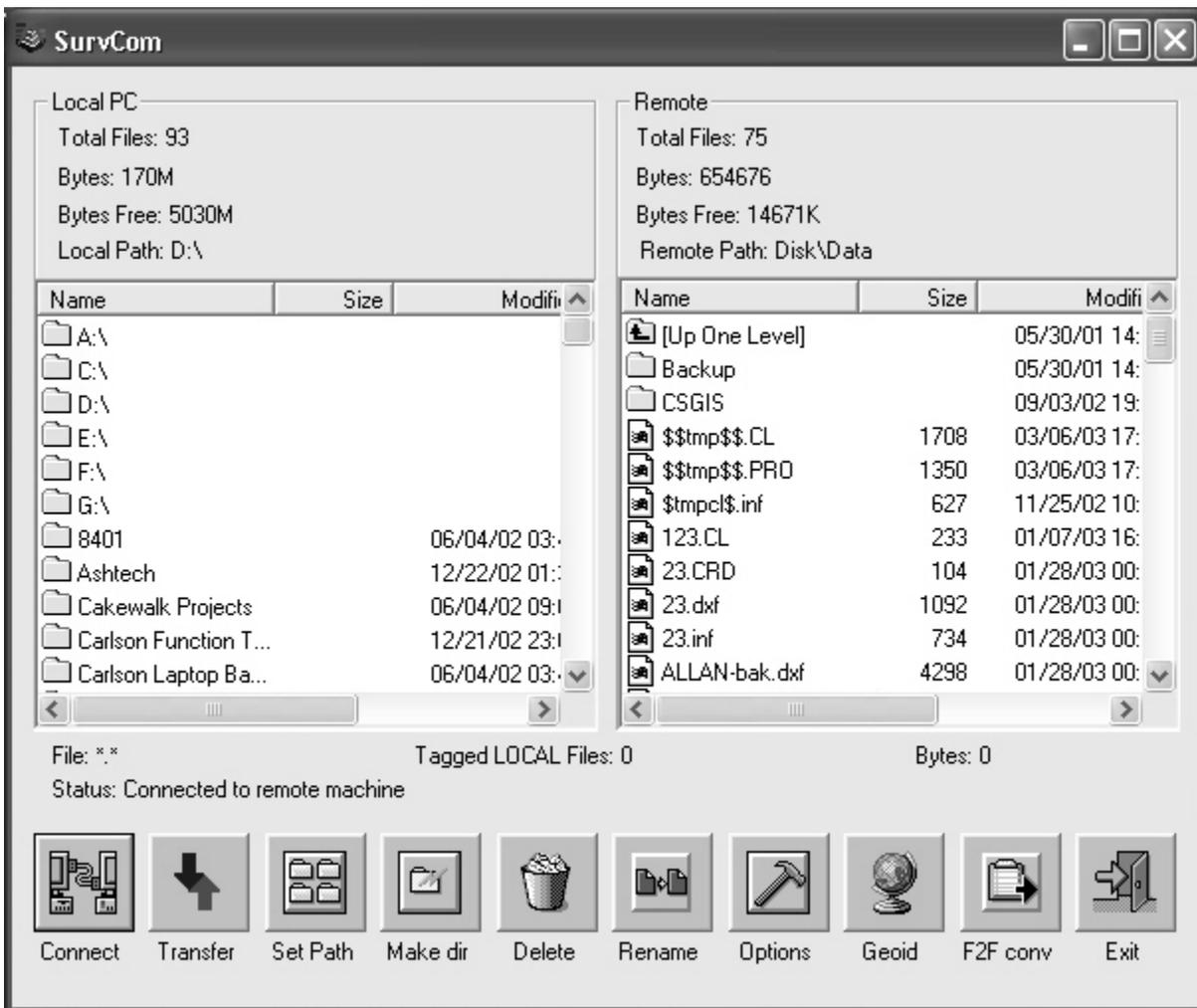
Make sure the data collector is connected to the Local PC.

In the SurvCE or G2 software, execute the command “Data Transfer” from the “File” menu.

In Carlson X-Port, choose Tools → Data Transfer → SurvCE/SurvStar/G2. The following dialog will be presented as communications are trying to be established.



Once connected the “SurvCom” dialog for data transfer will be presented as shown below.



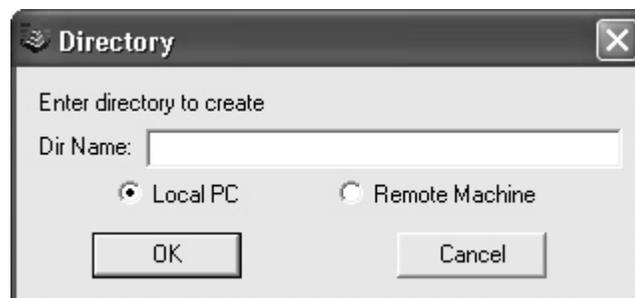
If the communication parameters are set correctly, a connection will be made and the directory listing from SurvCE or G2 will be retrieved.

Note: If a connection is not made, the SurvCom dialog shown above will open anyway. Choose the options button and adjust the COM port and/or baud rate settings to match those of the data collector and press the Connect button to try again.

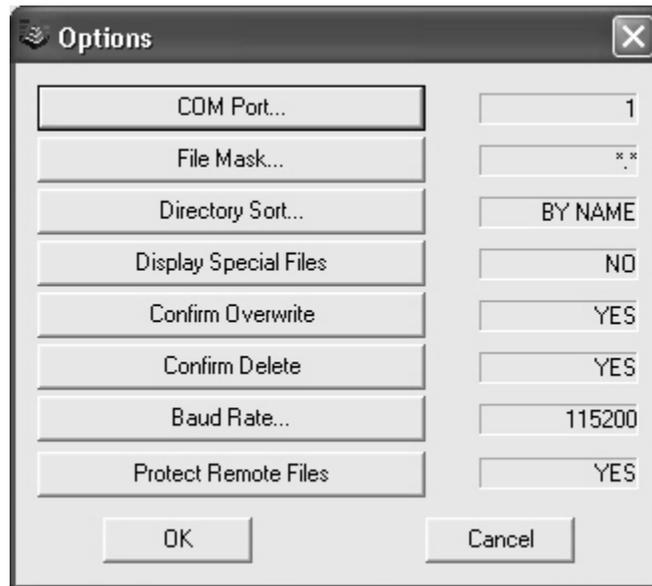
1. Connect - Connects the data collector to the local PC.
2. Transfer - Used to transfer files. The list on the left shows files on the PC. The list on the right shows files on the data collector. To move files from one to another, highlight the files and press the Transfer button.
3. Set Path - This command allows you to set the path on either the local PC or the remote data collector as illustrated below. Type in the path you wish to change to, choose Local PC or Remote Machine and then press OK. You may also change the path by navigating the directory structure shown in the main window of the SurvCom program.



4. Make Dir - This command allows you to create a directory on either the Local PC of the Remote Machine as illustrated below. Type in a directory name you want to create, choose Local PC or Remote Machine and then press OK. If you enter an invalid directory name, it will not be created. Invalid directory names are determined by the operating system.



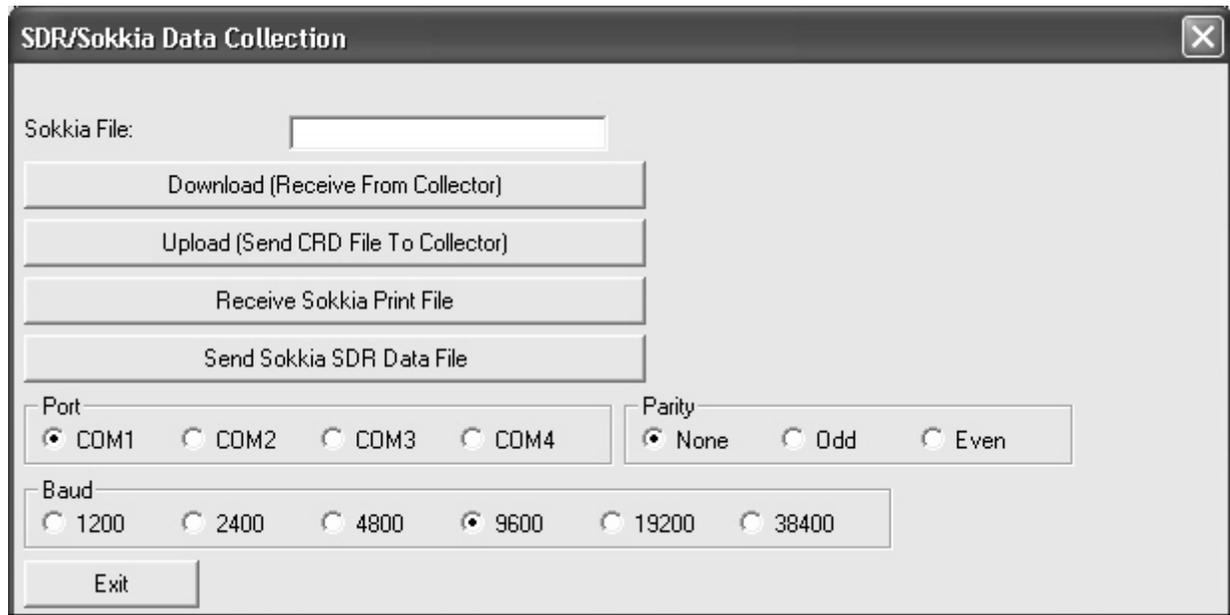
5. Delete - This command allows you to delete files and empty directories.
6. Rename - This command allows you to rename a file as needed.
7. Options - This command allows you to set various options as illustrated and outlined below.



- Com Port - You must select which COM port on the PC to use.
 - File Mask - You must select a file filtering syntax. *.* will show all files.
 - Directory Sort - You must select how to sort the list of files.
 - Display Special Files - Toggle whether or not you should see special files.
 - Confirm Overwrite - Toggle whether or not you want the file transfer program to have you confirm overwriting of files.
 - Baud Rate - You must choose the baud rate for transferring data.
 - Protect Remote Files - Toggle whether or not you want to protect files on the mobile device.
8. Set Geoid - This command will prompt you to select a directory with geoid grids, and enter the longitude and latitude near the center of your job. The geoid grids are a separate install program located on the SurvCE CD or are available via download from Carlson Software at <http://update.carlsonsw.com/public>.
 9. F2F conv - This command will copy a field to finish field to finish file (.FLD) to the data collector and convert it to the (.FCL) format used by SurvCE.
 10. Exit - This command will exit the data transfer program.

Data Transfer → Sokkia/SDR

This command applies to the Sokkia SDR-20, SDR-22, SDR-31 and SDR-33 as well as other collectors that have SDR format transfer, such as the Trimble and C&G.



Downloading

1. From the SDR data collector, go to the Communications menu from the Func menu. Choose Data Format SDR.
2. Press the Com function key, and then select all options to match the settings you will set in Carlson X-Port.
3. Press OK when all the communication settings are set.
4. Press the Optns function key, highlight current view and set it to Yes with the right arrow key. Make sure that all other options are set to No, then press OK.
5. Press the Send function key, then choose Select Jobs. From the list of jobs, highlight the job to transfer and set it to Yes with the right arrow key.
6. Switch to Carlson X-Port.
7. Pick Data Collectors from the Tools menu and choose Sokkia SDR.
8. Check that the COM port and baud rate are set correctly.
9. Click the Download button and within 10 seconds go back to the SDR and press OK. The file should transfer.

The SDR format contains both coordinate and raw data. The coordinate data is converted to a CRD file and the raw data is converted to a RW5 file. The original SDR transfer file is stored on the computer as a SDR file.

When the transfer is complete, the program will ask you for the coordinate file unless you specified a file name in the dialog box.

The SDR has different modes for storing and transferring data.

In coordinate mode, the download creates points in the CRD file and the RW5 file contains only some basic header lines.

In the raw data mode, the download creates all the measurement data in the raw file and no points are created in the CRD file. When you see raw data mode, you will need to run Edit-Process Raw File in the Tools menu to calculate the points from the raw data.

The third mode in the SDR creates both raw data in the RW5 file and points in the CRD file.

The Include Time Stamps in Notes option sets whether all the date-time records for each point are included in the RW5 file as description records. The Include Point Attributes in Notes option will store SDR code 13(AT) codes to the point note (.NOT) for the coordinate file.

Uploading

Point data from the CRD file can be uploaded into the SDR.

1. Begin at the Communications menu from the SDR Func menu.
2. Choose Data Format SDR. Switch to Carlson X-Port and choose Sokkia SDR from the Data Transfer command in the Tools menu.
3. Check that the COM port and baud rate are set correctly.
4. In the Sokkia/SDR Data Collection dialog box, pick the Select File button next to the CRD File edit box and choose the CRD file to send.
5. Click the Upload button. A Sokkia/SDR Options dialog box appears for setting the job parameters for the file to be created on the collector.
6. Choose the Distance Unit that matches your coordinate file (meters, US feet, or
7. International feet), change all other options to meet your requirements and click OK.
8. In the dialog box that appears, specify the range of point numbers to upload.
9. Before you click the Start Transfer button for range of points, switch to the SDR and press the Recv function key. The SDR is now waiting to receive.
10. Return to Carlson X-Port and click Start Transfer on the Points to Transfer dialog box. The file should transfer.

Receive Sokkia Print File

This command downloads a print report from the SDR data collector. This file is used only for printing report purposes. This file is not used to generate coordinate files or raw files.

To receive a print file:

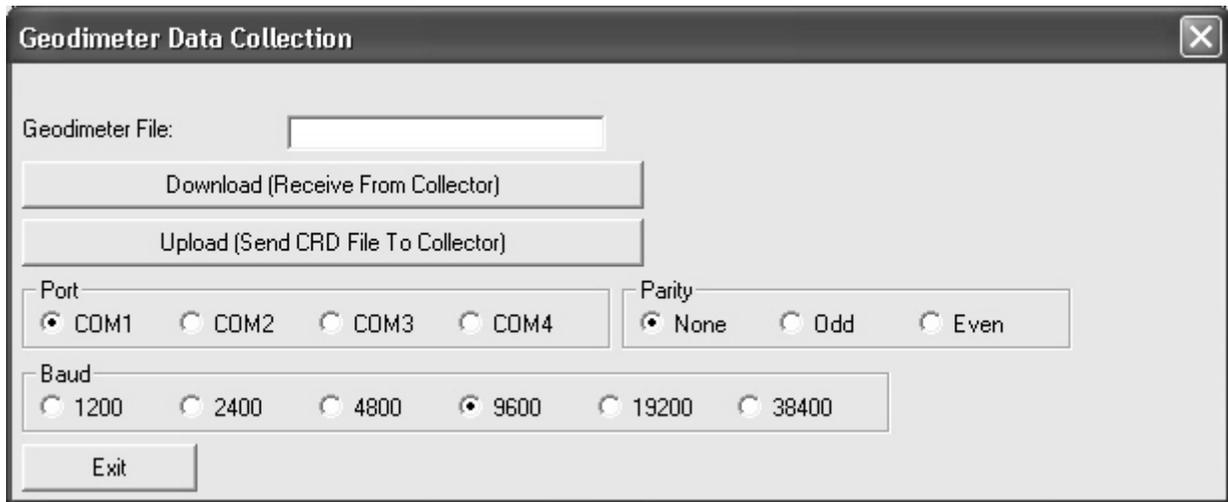
1. Choose Data format Printed in the Communications menu from the SDR Func menu.
2. Click the Receive Sokkia Print File button in Carlson X-Port.
3. On the SDR, press the Send Func key and select a job to send. The file is immediately transferred and displayed in the standard report viewer.

Send Sokkia SDR Data File

This command uploads a Sokkia .SDR or .RAW file to the data collector. If there is not an SDR file name already entered (at the top of this dialog), then you will be prompted to select either a (*.SDR) file or a (*.RAW) file to send.

Data Transfer → Geodimeter

This command applies to the Geodimeter 600 and Trimble 5600 total stations.



Downloading

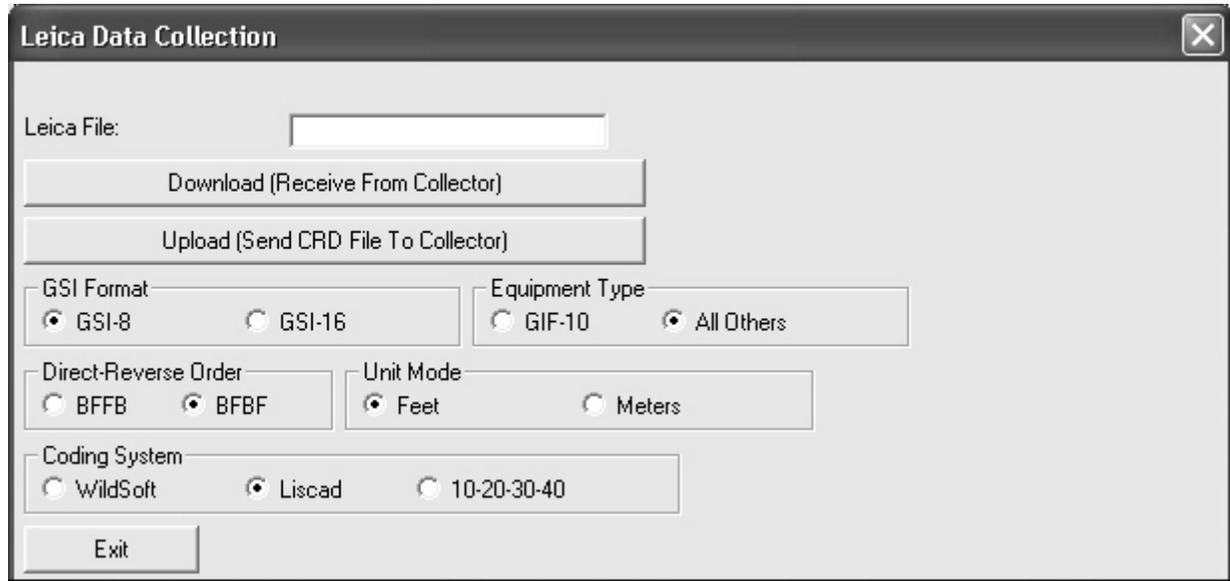
1. From the Geodimeter data collector, go to the file transfer command by pressing the PRG (Program) key and entering program 54.
2. Choose Imem (option 1) as the source.
3. Choose the file type to send as either Job (measurement data) or Area (point data). The Geodimeter then prompts for the job name.
4. Enter Serial (option 3) as the destination. A confirmation screen appears showing the serial port settings. Here are some typical settings: COM=1,8,0,9600
5. Before pressing ENT (enter) key, go to Carlson X-Port and pick Data Collectors from the Tools menu and choose Geodimeter.
6. Click the Download button and within 15 seconds, go back to the Geodimeter and press Enter. The file transfer then proceeds.
7. When the transfer is complete, the program prompts for the coordinate file (.CRD) and raw file (.RW5) to create if you haven't already specified a file name in the dialog box.

Uploading

1. In Carlson X-Port, choose Geodimeter under Data Collectors from the Tools menu.
2. Pick the Select File button next to the CRD File edit box and choose the CRD file to send.
3. Verify that the COM port and baud rate are set correctly and then click the Upload button.
4. In the dialog box that appears, specify the range of point numbers to upload.
5. Before clicking OK, go to the Geodimeter data collector and start the file transfer routine by pressing the PRG key and entering program 54.
6. Choose Serial (option 3) as the source. The Geodimeter displays the serial port settings, check these values and press enter.
7. Next choose Area (option 2) as the destination, and then enter the job name. The Geodimeter is now prepared to receive data.
8. In Carlson X-Port, click the OK button for the range of points to send. The file transfer proceeds.

Data Transfer → Leica

There are two types of Leica transfers: GIF-10 and GeoCom for all other Leica instruments. The type is set in the Equipment Type field on the main dialog box. For transferring with Leica instruments, the GeoCom program shows a dialog box of the available COM ports on your computer. The first time that you transfer to an instrument, you will need to pick the Instruments button and register the instrument from the list. Pick the Port Settings button to make sure that the communication settings match the instrument.



Downloading (GeoCom)

1. To download a file with GeoCom, make sure that the instrument is on and connected to the computer by serial cable and choose Download.
2. In the GeoCom program, open the computer COM port that the instrument is connected to by picking the '+'.
3. Open the Memory Card and GSI folders.
4. Select the file to transfer and click the OK button.

Uploading (GeoCom)

1. To upload a file with GeoCom, specify the file name to be created on the instrument in the Leica File field, and choose Upload. The command will prompt for the range of points to transfer.
2. Enter the range and pick the Start Transfer button. The GeoCom program will start.
3. Open the computer COM port by picking the '+'.
4. Open the Memory Card folder, highlight the GSI folder, and click OK.
5. The upload and download file transfer works with the GIF-10 data collector. The GIF-10 communication settings should be the following:

Baud: 9600

Parity: NONE

Protocol: NONE

Stop Bit: 1 1

End Mark: CR/LF

Connected As: some computers use DCE and others use DTE

Downloading (GIF-10)

1. From the GIF-10 data collector, run the file transfer command.
2. In Carlson X-Port, select Data Collectors from the Tools menu, and choose Leica.
3. Verify that the COM port and baud rate are set correctly.
4. Click the Download button and within 10 seconds switch back to GIF-10 and select the file to send. The file transfer should begin.
5. When the transfer is complete, the program will ask you for the CRD file to create unless you already specified a file name in the dialog box.

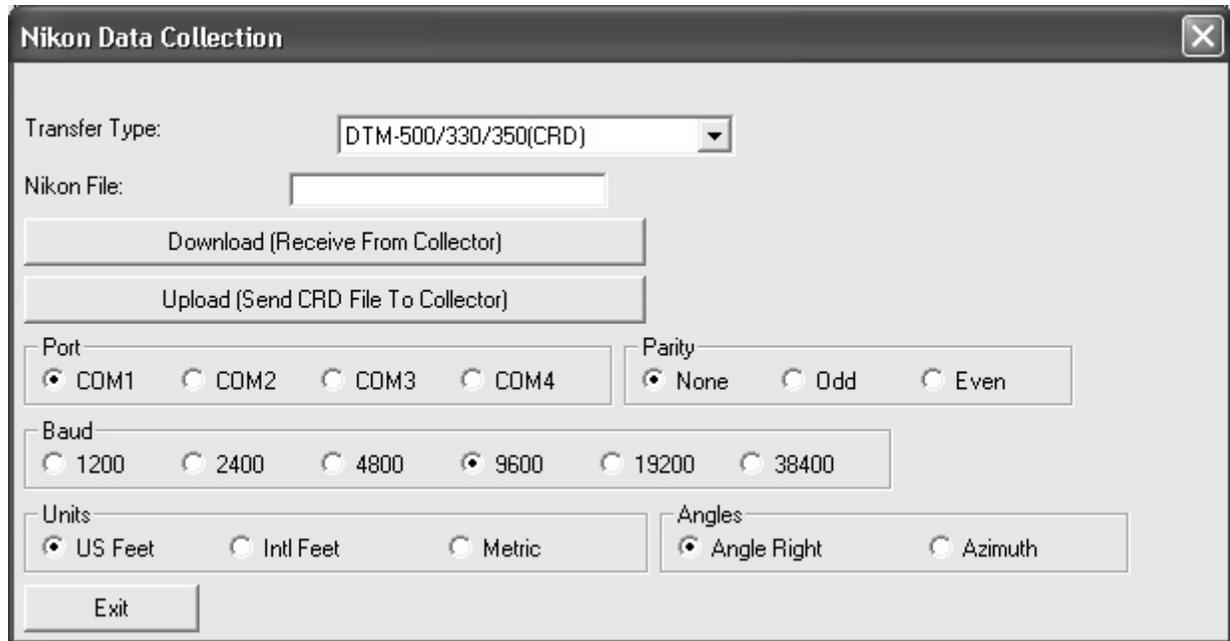
Uploading (GIF-10)

1. From the GIF-10 data collector, run the file transfer command.
2. In Carlson X-Port, select Leica under Data Collectors from the Tools menu.
3. In the Leica Data Format Conversion dialog box, specify the job name in the Leica File field.
4. Pick the Select File button next to the CRD File edit box and choose the CRD file to send.
5. Check that the COM port and baud rate are set correctly.
6. Click the Upload button.
7. Specify the range of point numbers to upload. Before clicking the OK button for the range of points, switch to the GIF-10.
8. Start to receive by highlighting Receive and pressing the Run button. The GIF-10 shows the available job numbers.
9. Use the arrow buttons to choose a job to receive the transfer, then press the Run button.

Data Transfer → Nikon

This command applies to the following Nikon data collectors and total stations:

DR-48
AIMS CE
DTM-300
DTM-310
DTM-400
DTM-500/330/350
DTM-700
DTM-800



Downloading

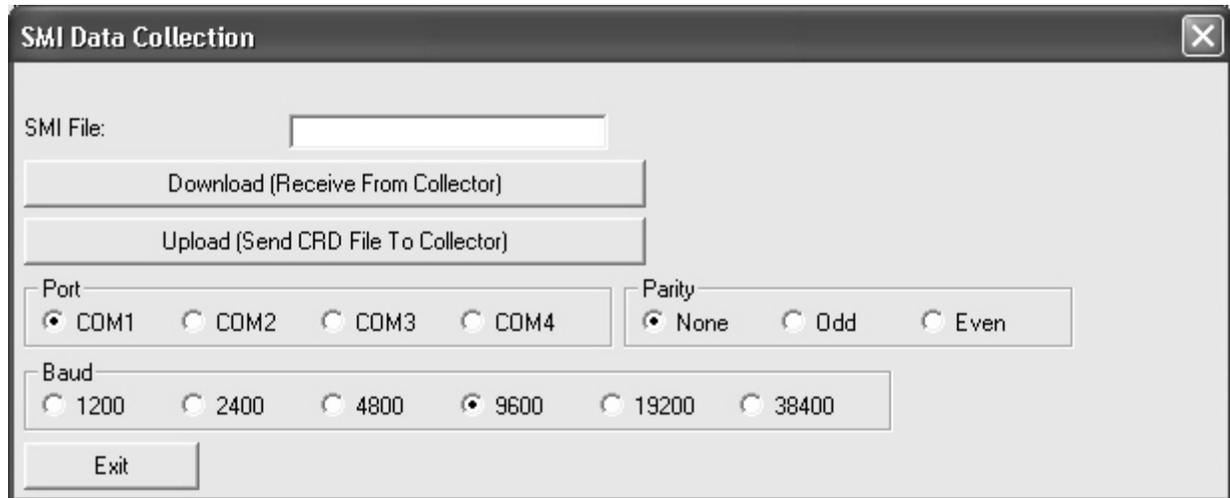
1. Choose the equipment and data type under the Transfer Type list. Also, check that the communication and data format settings match your collector.
2. Then, click the Download button and follow the on-screen directions.
3. When the transfer is complete, the program will ask you for the coordinate file (.CRD) and raw file (.RW5) to create if you haven't already specified a file name in the dialog box.
4. The original data from the collector is stored in a file name with the same name as the coordinate file except with a .TRN extension. For example, job5.crd would have job5.trn.

Uploading

1. Pick the Select File button next to the CRD File edit box and choose the CRD file to send.
2. Check that the COM port and baud rate are set correctly and then click the Upload button.
3. In the dialog box that appears, specify the range of point numbers to upload.
4. Click the Start Transfer button. The file transfer then proceeds.

Data Transfer → SMI

This command applies to SMI data collectors.



Downloading

1. To send point data from the SMI data collector, go to the file transfer command by typing [More] [NXT] [TOPC] [COMM].
2. In SMI version 6 or later, type [Job][KERM][SEND].
3. Also in version 6, make sure that first function key reads [NE] and not [XY] in the [Job][KERM] screen. Otherwise, the coordinate northing and easting will be reversed.
4. Enter the first point to send, followed by the last point to send, but before you press Enter for the last point, switch to Carlson X-Port. Pick Data Collectors from the Tools menu and choose SMI.
5. Check that the COM port and baud rate are set correctly.
6. Click the Download button and within 10 seconds switch back to SMI and press Enter to send the last point.
7. When the transfer is complete, the program will ask you for the coordinate file to create unless you already specified a file name in the dialog box.
8. To send raw data, use the [Print][Raw] command in SMI then follow the same procedure used for point data.

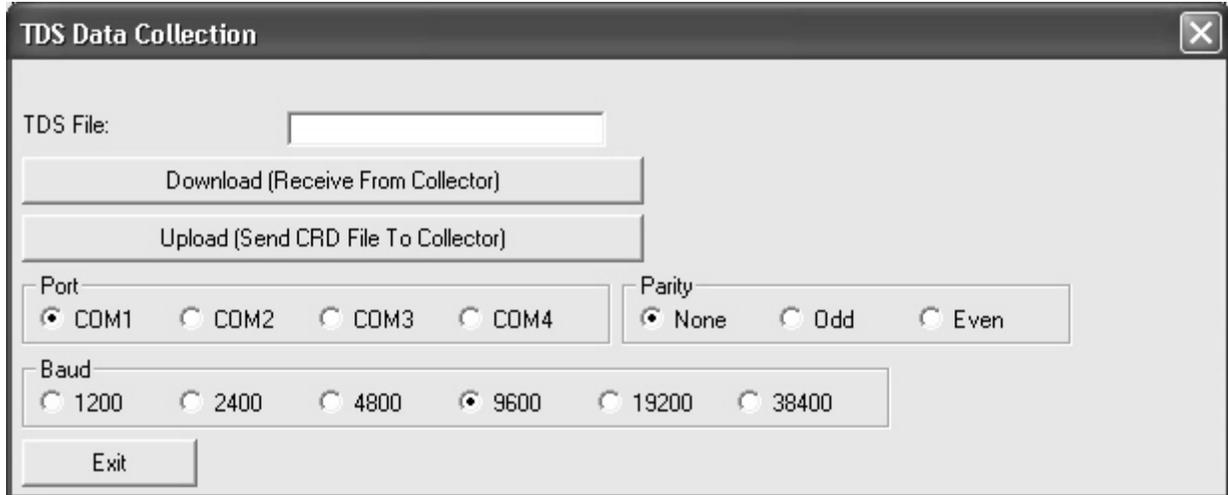
Uploading

1. From the SMI data collector, go to the file transfer command by typing [More] [NXT] [TO48] [COMM].
2. In SMI version 6 or later, type [Job][KERM][RECV].
3. Also in version 6, make sure that first function key reads [NE] and not [XY] in the [Job][KERM] screen. Otherwise, the coordinate northing and easting will be reversed.
4. Enter the first point to send, followed by the last point to send.
5. Enter the job name, but before you press Enter, switch to Carlson X-Port. Pick Data Collectors from the Tools menu and choose SMI.
6. In the SMI HP-48 Data Collection dialog box, specify the same job name that you entered in SMI.
7. Pick the Select File button next to the CRD File edit box and choose the CRD file to send.
8. Check that the COM port and baud rate are set correctly, then click the Upload button.
9. In the dialog box that appears, specify the range of point numbers to upload.

10. Enter the same range of points that you entered on the SMI.
11. Go back to SMI and press Enter for job name, then switch back to Carlson XPort and press the OK button for the range of points. The file should transfer.

Data Transfer → TDS

This command applies to TDS data collectors.



Downloading (HP-48 and Husky)

1. In the TDS program, run the File Transfer command.
2. Choose the type of data to transfer (CRD or RAW) and pick the Send function key.
3. In Carlson X-Port, pick Data Collectors in the Tools menu then pick TDS.
4. Make sure that the COM port and baud rate are set correctly, then pick the Download button.
5. While the program waits to receive the TDS file, you have 10 seconds to select the file to send from the TDS program.
6. When the file transfer is complete, the command will ask you for the file to create unless you already specified a file name in the dialog box.

Downloading (Ranger and Windows CE)

1. In the TDS program, run the Transfer command and pick the Send File function.
2. Set the "Connecting To" field to HP-48.
3. Make sure that the COM port, baud rate, and parity are set correctly, then pick OK.
4. In the Type field of the file selection dialog box, choose Coordinate Files or Raw Files.
5. In Carlson X-Port, pick Data Collectors from the Tools menu, then pick TDS.
6. Make sure that the COM port and baud rate are set correctly, then pick the Download button.
7. While the program waits to receive the TDS file, you have 10 seconds to select the file to send from the TDS program.
8. When the file transfer is complete, the program will ask you for the file to create unless you already specified a file name in the dialog box.

Uploading (HP-48 and Husky)

A Carlson X-Port coordinate file can be converted to a CR5 file and uploaded into TDS.

1. Start in the TDS program File Transfer command.
2. Pick Data Collectors from the Tools menu, and choose TDS.
3. In the TDS Data Collection dialog box, enter a TDS File name. This name should not include the drive and directory path or file extension. For example, if the CRD file is c:\data\simo2.crd, then the TDS File name could be just SIMO2.
4. Next pick the Select File button next to the CRD File edit box and choose the CRD file to send.
5. Check that the COM port and baud rate are set correctly.
6. Press the Upload button.
7. In the dialog box that appears, specify the range of point numbers to upload.
8. Enter the range of points, but before clicking the Start Transfer button, go to TDS and press the Receive function key.
9. Within 10 seconds go back to Carlson X-Port and click the Start Transfer button on the range of points dialog box. The file should then transfer.

Uploading (Ranger and Windows CE)

A Carlson X-Port coordinate file can be converted to a CR5 file and uploaded into TDS.

1. Start in the TDS Transfer command, and pick the Receive File function.
2. Set the "Connecting To" field to HP-48.
3. Make sure that the COM port, baud rate, and parity are set correctly and pick OK.
4. In Carlson X-Port, pick Data Collectors from the Tools menu then pick TDS.
5. In the TDS Data Collection dialog box, enter a TDS File name. This name should not include the drive and directory path or file extension. For example, if the CRD file is C:\data\simo2.crd,
6. then the TDS File name could be just SIMO2.
7. Pick the Select File button next to the CRD File edit box and choose the CRD file to send.
8. Check that the COM port and baud rate are set correctly.
9. Pick the Upload button.
10. A dialog box allows you to specify the range of point numbers to upload.
11. Enter the range of points and click the Start Transfer button.

Data Transfer → Topcon

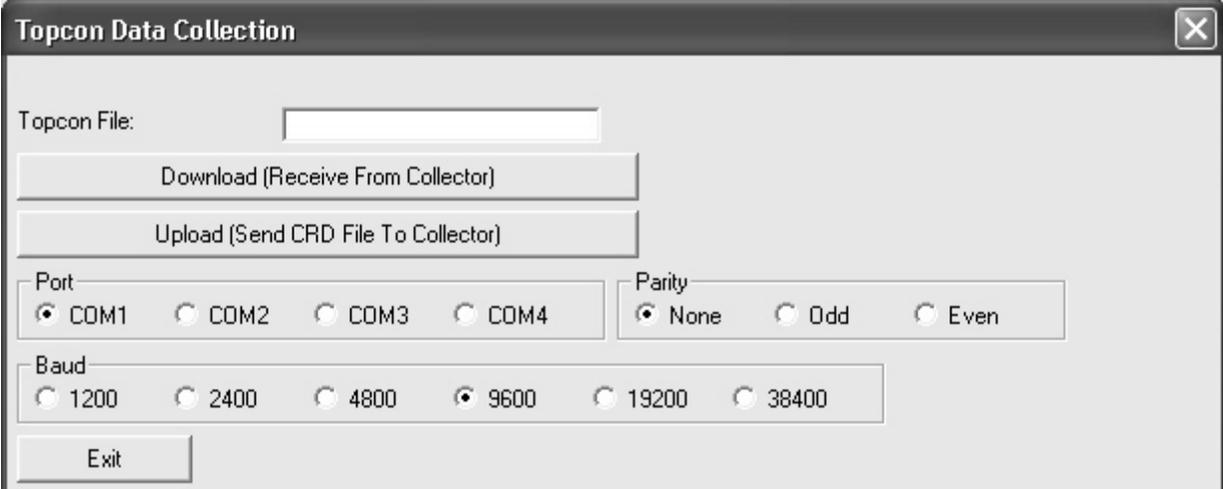
This command applies to the following Topcon total stations:

210

310

220

GPT2000



The image shows a software dialog box titled "Topcon Data Collection". It features a close button (X) in the top right corner. The dialog contains the following elements:

- A text label "Topcon File:" followed by an empty text input field.
- A button labeled "Download (Receive From Collector)".
- A button labeled "Upload (Send CRD File To Collector)".
- A "Port" section with four radio buttons: COM1 (selected), COM2, COM3, and COM4.
- A "Parity" section with three radio buttons: None (selected), Odd, and Even.
- A "Baud" section with six radio buttons: 1200, 2400, 4800, 9600 (selected), 19200, and 38400.
- An "Exit" button at the bottom left.

Import Raw Data

These commands convert raw data from other formats into the current Edit-Process RW5 file. The converted raw data will be added to the end of the existing data in the current RW5 file. In many cases, the raw file to import can be downloaded directly from the data collector or instrument using the appropriate Data Collector command. In other cases, the file to import is the output from another software program.

The following formats are supported:

- C and G
- CAiCE (Caltrans raw format only)
- Carlson (*.rw5)
- TDS (.rw5)
- Fieldbook (.fbk)
- Geodimeter (.obs or .raw)
- Leica (.gsi or .raw)
- Nikon (.trn or .raw)
- SMI (.raw)
- Sokkia/SDR (.raw or .sdr)

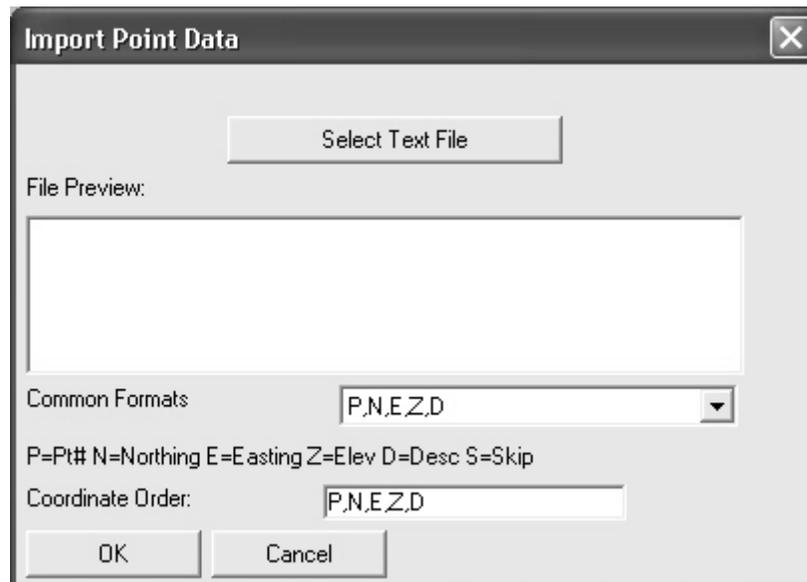
Export Raw Data

These commands export raw data from the editor to the following formats.

- Sokkia/SDR: (.raw)
- Fieldbook: (.fbk)
- CAiCE (Caltrans raw format only)

Import Point Data → Text/ASCII File

The Import Point Data dialog box allows you to convert point data from an ASCII text file into the current coordinate file (.CRD). Each line of the text file can contain any combination of point number, northing, easting, elevation, and description. All of the information for a point should be on one line with the values separated by a comma, space, or other delimiter.



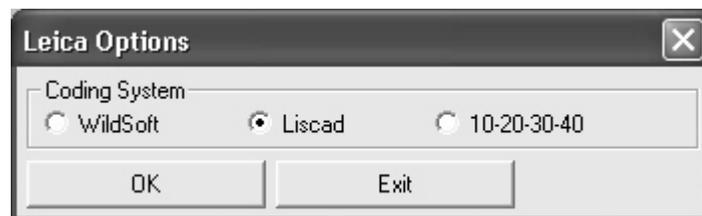
- Select Text File - You must select a text file to read into a coordinate file. The selected file is displayed in the PreviewWindow to help you fill out the Coordinate Order.
- Common Formats - This is a listing of common formats. Choose the format that matches the ASCII file you are importing. When you choose a format, it will be copied to the Coordinate Order edit box.
- Coordinate Order - The format of the text file here is specified in the Coordinate Order field where the value identifiers are listed with the appropriate delimiters
- Press OK to start the import process. After it completes, you will receive the following dialog to confirm success.

Import Point Data → Geodimeter

Allows you to select an .obs or .raw Geodimeter file to read into the CRD file.

Import Point Data → Leica

Presents the dialog shown below so that you can select the appropriate Leica coding system. After pressing OK, a standard file dialog appears. Select the .gsi or .raw file to import.



Import Point Data → Sokkia/SDR

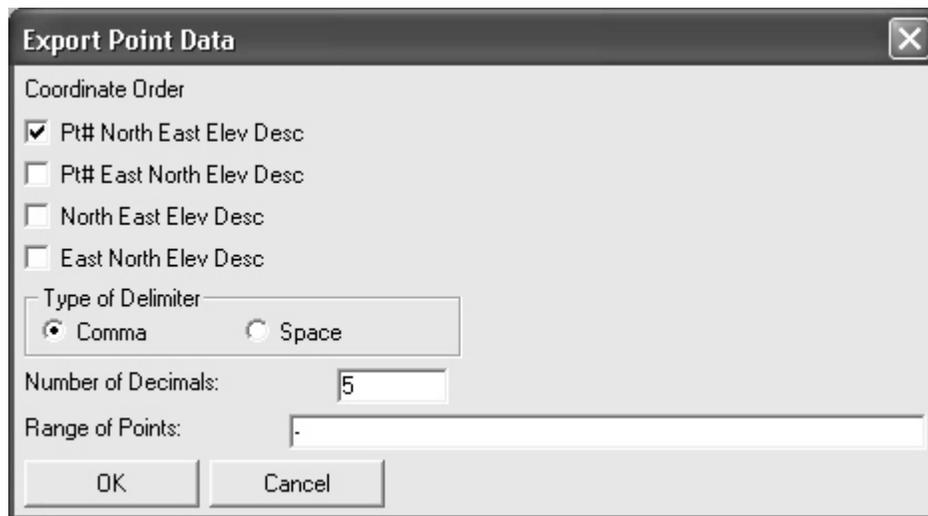
Allows you to select an .sdr or .raw file to read into the CRD file.

Import Point Data → TDS/CR5

Allows you to select a .cr5 file to read into the CRD file.

Export Point Data → Text/ASCII

The Export Text/ASCII File dialog box allows you to output point data from the current coordinate file to an ASCII text file.



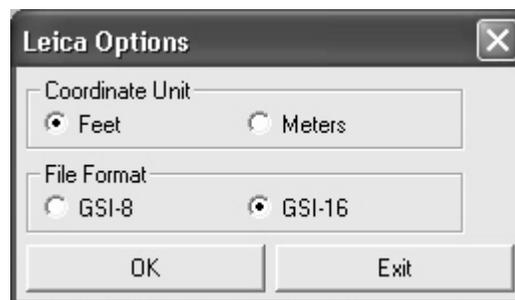
- Coordinate Order - You select the type of file you want to write. You can choose from among several variations on point number, northing, easting, elevation, and descriptions.
- Type of Delimiter - Choose type of delimiter, comma or space.
- Number of Decimals - Choose the precision for the exported coordinates.
- Range of Points - Specify the range of point numbers to export
- OK - Presents a standard file dialog where you must specify the file name for the exported file.

Export Point Data → Geodimeter

Allows you to specify a file name for Geodimeter export (.obs file format).

Export Point Data → Leica

Allows you to specify a file name for Leica export (.gsi file format). Then the dialog shown in below will appear where you can specify the unit of measurement and the file format.

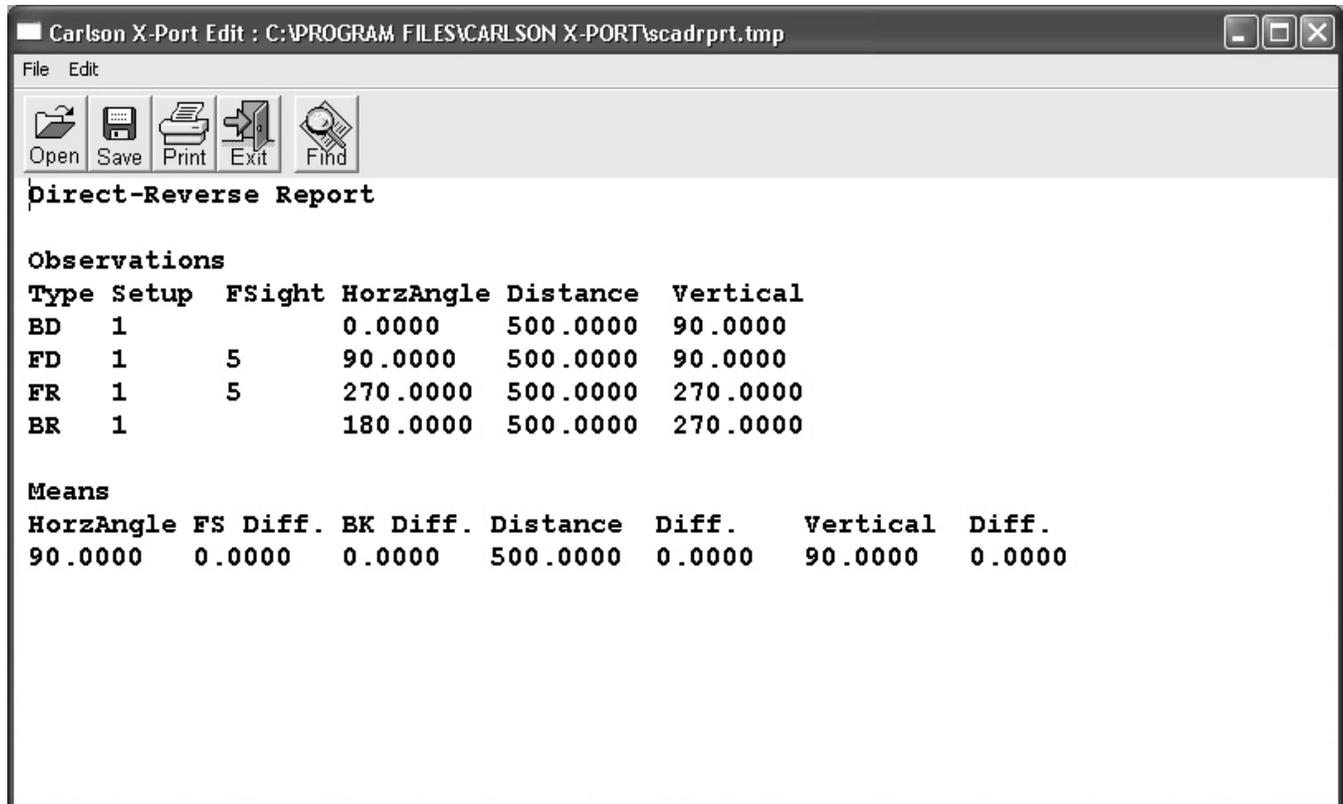


Export Point Data → TDS CR5

Allows you to specify a file name for TDS export (.cr5 file format).

Direct Reverse Report

This command allows you to analyze angle sets and produce a report of the results.



The screenshot shows a window titled "Carlson X-Port Edit : C:\PROGRAM FILES\CARLSON X-PORT\scadrprt.tmp". The window has a menu bar with "File" and "Edit", and a toolbar with icons for "Open", "Save", "Print", "Exit", and "Find". The main content area displays the following report:

Direct-Reverse Report

Observations

Type	Setup	FSight	HorzAngle	Distance	Vertical
BD	1		0.0000	500.0000	90.0000
FD	1	5	90.0000	500.0000	90.0000
FR	1	5	270.0000	500.0000	270.0000
BR	1		180.0000	500.0000	270.0000

Means

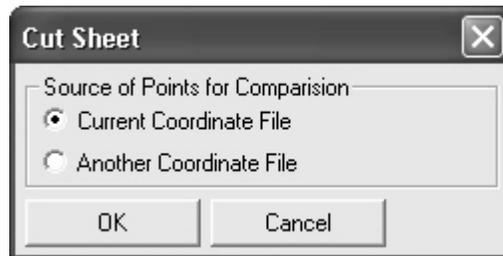
HorzAngle	FS Diff.	BK Diff.	Distance	Diff.	Vertical	Diff.
90.0000	0.0000	0.0000	500.0000	0.0000	90.0000	0.0000

Cut Sheet

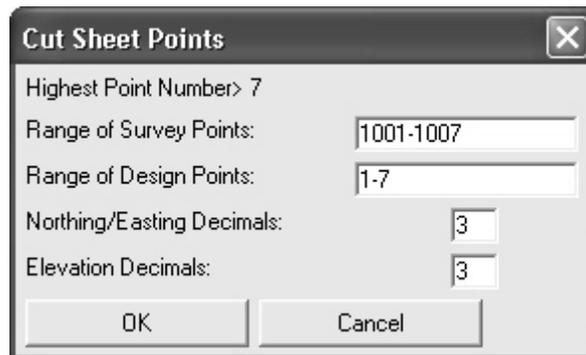
This command creates a report of the elevation difference between points and a design elevation, which can be defined by other points in the current CRD file or points in another CRD file.

Example 1 - Comparing points in the same CRD file.

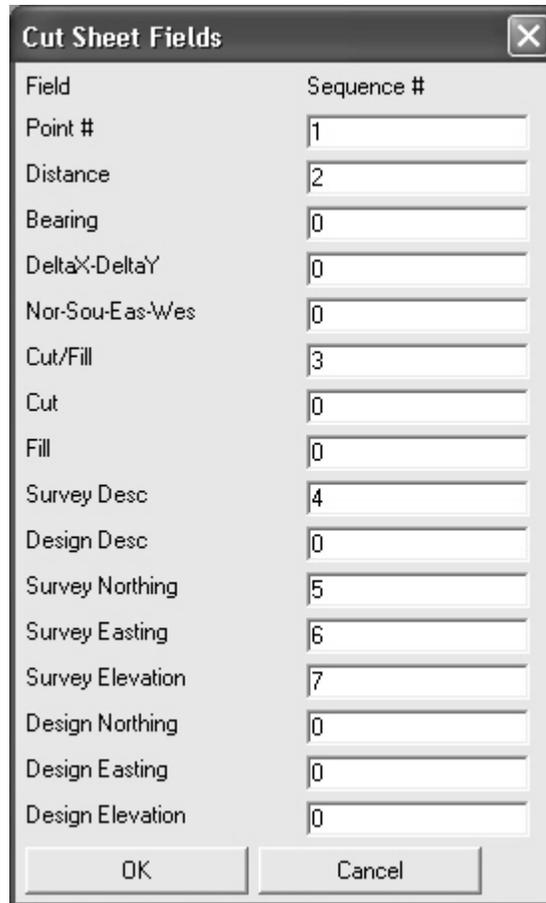
The first dialog box shown below allows you to select the Current Coordinate File containing the source points for comparison. Press OK to continue.



The next dialog box shown below is where you must specify the range of survey points, range of design points, and the precision.



The next dialog is shown below allows you to specify the fields that you want to see in the report and their order. Use a 0 (zero) to exclude a field.

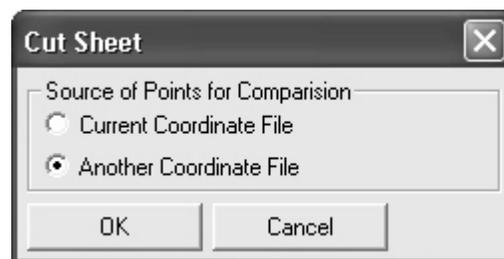


The 'Cut Sheet Fields' dialog box contains a table with two columns: 'Field' and 'Sequence #'. The fields listed are Point #, Distance, Bearing, DeltaX-DeltaY, Nor-Sou-Eas-Wes, Cut/Fill, Cut, Fill, Survey Desc, Design Desc, Survey Northing, Survey Easting, Survey Elevation, Design Northing, Design Easting, and Design Elevation. The sequence numbers are: 1, 2, 0, 0, 0, 3, 0, 0, 4, 0, 5, 6, 7, 0, 0, 0. At the bottom are 'OK' and 'Cancel' buttons.

Field	Sequence #
Point #	1
Distance	2
Bearing	0
DeltaX-DeltaY	0
Nor-Sou-Eas-Wes	0
Cut/Fill	3
Cut	0
Fill	0
Survey Desc	4
Design Desc	0
Survey Northing	5
Survey Easting	6
Survey Elevation	7
Design Northing	0
Design Easting	0
Design Elevation	0

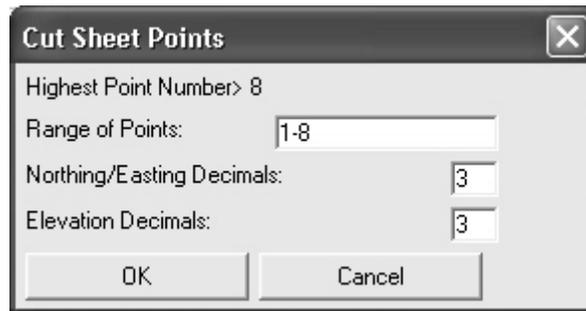
Example 2 - Comparing points from two different CRD files

The first dialog box shown below allows you to select Another Coordinate File containing the source points for comparison. Press OK to continue.



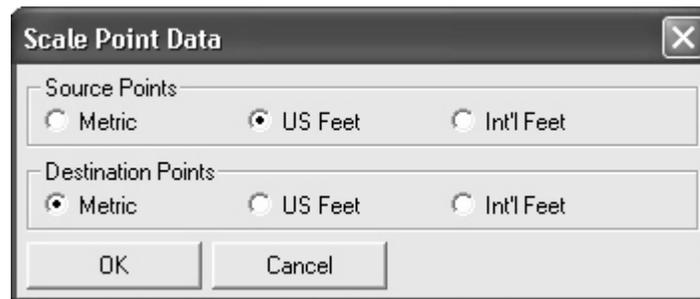
The 'Cut Sheet' dialog box has a section titled 'Source of Points for Comparison' with two radio button options: 'Current Coordinate File' and 'Another Coordinate File'. The 'Another Coordinate File' option is selected. At the bottom are 'OK' and 'Cancel' buttons.

Next, a standard file dialog lets you select another CRD file for comparison. The next dialog shown below allows you to specify the range of points to compare, and the precision. In this example, we are comparing all the points. Press OK to continue. Configure the fields in the following dialog box and select OK to generate the cut sheet report.



Scale Point Data

This command allows you to scale points in the current coordinate file. The northing, easting, and elevation are scaled based on the settings you specify in the dialog shown below. Choose the units of your source points and the units of the destination points and press OK.



Edit Field Code List

This command allows you to edit the field code list for use in SurvCE/G2 or the SDR33. The main dialog is shown below.



- Load - Used to load an existing Field Code List (.fcl file format)
- Edit - Used to edit an existing field code. Highlight a code and press Edit to get the dialog shown below. You can edit the code, the full name, and the entity type. Press OK to accept the changes.

The image shows a dialog box titled "Edit Field Code". It has a close button in the top right corner. The dialog contains the following fields and options:

- Code:** A text box containing "NG".
- Full Name:** A text box containing "GROUND, Nat. Ground".
- Entity Type:** A group box containing three radio buttons:
 - Points Only
 - 2D-Polyline
 - 3D-Polyline
- Buttons:** "OK" and "Exit" buttons at the bottom.

- Add - Used to add a field code to the list. When you press Add, you will get the same dialog as shown above, except all the fields will be blank. Enter the necessary data and press OK.
- Remove - Used to remove a code from the list. Highlight a code and press Remove. The item is removed immediately.
- Save - Saves the currently loaded file.
- Exit - Exits the Field Code List editor.

Convert DXF to FLT

Creates a Carlson triangulation file (*.FLT) from any DXF file containing a TIN where the triangle entities are 3D Faces.

Convert Section Data → Import IGRDS Section

Creates a Carlson section file (*.SCT) from an IGRDS section file.

Convert Section Data → Export IGRDS Section

Creates an IGRDS section file from a Carlson (*.SCT) section file.

Format of the Raw File (.RW5 extension)

The following are supported record header codes with their field headers:

--	Point Description/Note
AB	Angle Balance Record
BC	Back Circle
BK	Backsight
BP	Backsight Point Number (if 0 the next field's azimuth will be used for)
BS	Back Azimuth
CL	Closure Record
DS	Description
E	East Coordinate
EL	Elevation
FP	Foresight Point Number
HI	Height of Instrument
HR	Height of Rod/Target
LS	Line of Sight
N	North Coordinate
OP	Occupy Point Number
PN	Point Number
SP	Store Point
SS	Side Shot
TR	Traverse

Measurement Record - Horizontal (one of the following 6)

AL	Angle Left (angle code 6)
AR	Angle Right (angle code 7)
AZ	Azimuth (angle code 5)
BR	Bearing (angle code 1 = NE, 2 = SE, 3 = SW, 4 = NW)
DL	Deflection Angle Left (angle code 8)
DR	Deflection Angle Right (angle code 9)

Measurement Record - Vertical (one of the following 3)

CE	Change/Difference in Elevation from Instrument Point
VA	Vertical Angle (0 degrees level)
ZE	Zenith Angle (90 degrees level)

Measurement Record - Distance

HD	Horizontal Distance (if CE above)
SD	Slope Distance (if ZE or VA above)