10 Geodetic Menu

```
DEFAULT.CPJ
DMS AZ N,E ▪D          UTM10 WGS84
‡Pts:25                       ▭▯
COGO  ADJU  SURV  TOOL  DATA  GEOD
[C]  Conversions
[D]  Ellipsoid Calcs
[_]  _____
[_]  _____
[_]  _____
[······http://sgss.ca······] EXIT  LOAD
```

10.1 Conversions

Geodetic conversions work with the current geodetic settings. Convert grid coordinates to geodetic (Latitude/Longitude) or vice versa with any of the available projections. All results are displayed to the maximum precision (12 digits) possible. Positional calculations are accurate to better than 1mm based on tests performed.

```
CONVERSIONS
1.Grid to Geodetic
2.Geodetic to Grid




                        CANCL  OK
```

Grid to Geodetic

Enter the grid coordinates and ellipsoid height of any point within the current projection zone to calculate the Latitude, Longitude, convergence angle, and scale factors. Use ⒡⁴ **gtXYZ** to retrieve the coordinates of a point in the current job database to use as the coordinates for the calculation.

```
UTM10 → GEODETIC
North: 5364281.26100m
East:  468058.568000m
EllHt: -14.7020m



Grid Northing
EDIT            gtXYZ CANCL  OK
```

The solution also displays the input to allow checking the input for correctness. Use ⒡ **EXPRT** to export the solution to the stack or write them to an ASCII file to save to the SD card COGOPLUS\ASCII directory or to the HOME directory on the calculator.

```
UTM10 → GEODETIC      1/2▾▴
North: 5364281.26100m
East:  468058.568000m
Lat:   48°25'51.124605"N
Long:  123°25'54.49229"W
Cnvrg: -0°19'23.0119999"


EXPRT                      OK
```

```
UTM10 → GEODETIC      2/2▾▴
EllHt: -14.7020m

ElevF: 1.00000230729
GridF: 0.99961253491
CombF: 0.99961484130



EXPRT                      OK
```
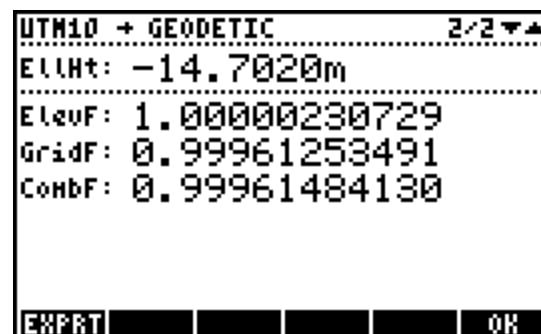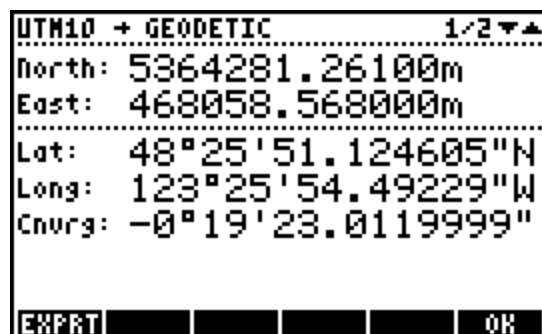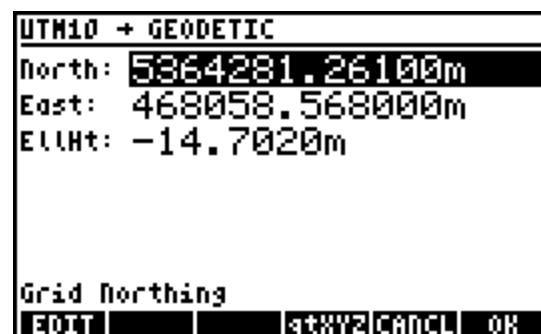
Geodetic to Grid

Enter the Latitude, Longitude and ellipsoid height of any point to calculate the grid coordinates of the point within the current projection zone, the convergence angle and elevation/grid/combined scale factors. The menu features two toggle softkeys to eliminate the need to enter negative latitude or longitude input:

```
GEODETIC → UTM10
Lat:  48°25'51.124605"N
Long: 123°25'54.49229"W
ElHt: -14.7020m



Latitude
 EDIT  +N   +W        CANCL  OK
```
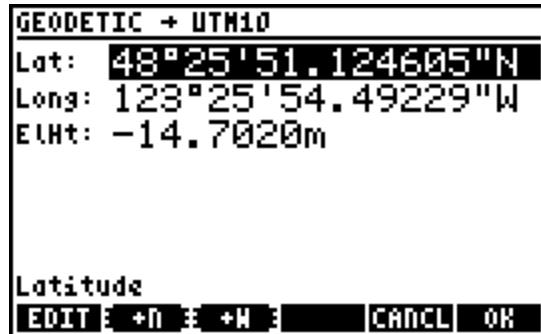
1. [F2]   **+N**   or   **+S**   – Toggle positive Latitude input to be north or south.
2. [F3]   **+E**   or   **+W**   – Toggle positive Longitude input to be east or west.

The solution also displays the input to allow checking the input for correctness. Use [F1] **EXPRT** to export the solution to the stack or write them to an ASCII file to save to the SD card COGOPLUS\ASCII directory or to the HOME directory on the calculator. Use [F2] **STORE** to store the solved grid coordinates and the entered ellipsoid height as a point in the current job database.

```
GEODETIC → UTM10        1/2▼▲
Lat:   48°25'51.124605"N
Long:  123°25'54.49229"W
North: 5364281.26122m
East:  468058.567949m
Cnvrg: -0°19'23.0120018"


EXPRT STORE            OK
```

```
GEODETIC → UTM10        2/2▼▲
El.Ht: -14.7020m
ElevF: 1.00000230729
GridF: 0.99961253491
CombF: 0.99961484130



EXPRT STORE            OK
```
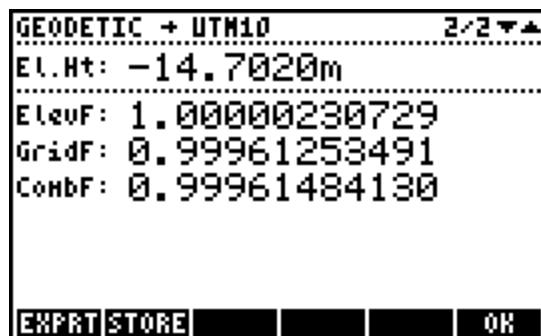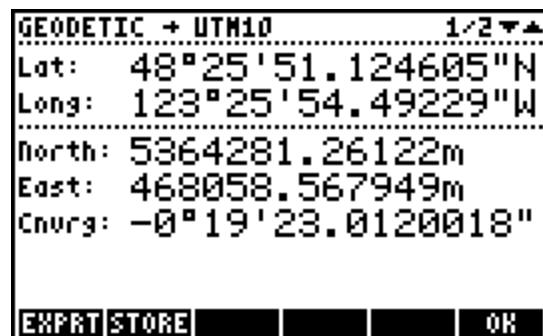
10.2 Ellipsoid Calculations

Direct and Inverse ellipsoid calculations are performed using Vincenty's equations. Both methods are iterative, and while most realistic calculations will converge in six iterations or less; there are certain scenarios that require many more iterations to converge. **COGO+** limits the iterations to 200, at which time a warning displays that the iteration maximum has been reached and the non-converged solution is displayed. The failure to converge involves antipodal or nearly antipodal inverse calculations.
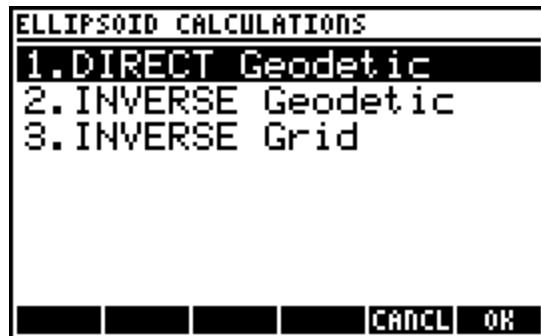
Direct Calculation

For a direct calculation, enter the Latitude and Longitude of the first point, the azimuth of the geodesic line from the first point to the second point, and the ellipsoidal distance from the first point to the second point. The solution calculates the Latitude and Longitude of the second point and the azimuth of the geodesic line from the second point to the first point. The menu features two toggle softkeys to eliminate the need to enter negative latitude or longitude input:

1. `F2` **+N** or **+S** – Toggle positive Latitude input to be north or south.
2. `F3` **+E** or **+W** – Toggle positive Longitude input to be east or west.

The solution also displays the input to allow checking the input for correctness. Use `F1` **EXPRT** to export the solution to the calculator stack or write them to an ASCII file to save to the SD card COGOPLUS\ASCII directory or to the HOME directory on the calculator.
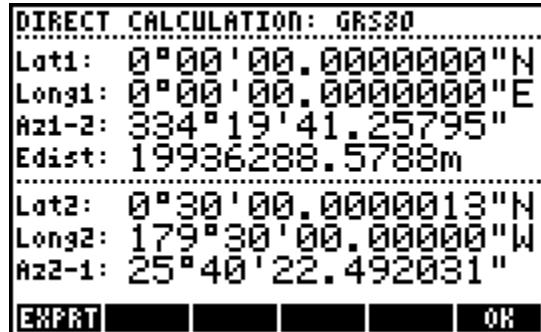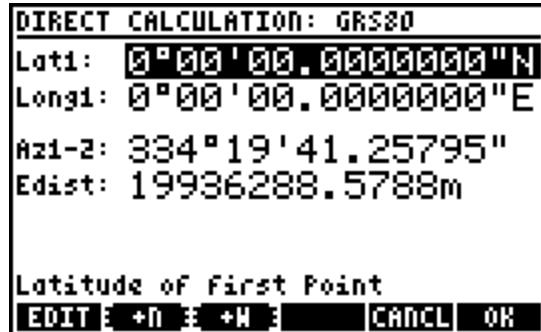
Inverse Calculation

Inverse calculations are possible from geodetic coordinates and from grid coordinates.

Inverse Geodetic

Enter the Latitude and Longitude of two points to calculate the ellipsoidal distance between the two points and the azimuths of the geodesic lines in each direction. The menu features two toggle softkeys to eliminate the need to enter negative latitude or longitude input:

```
INVERSE CALCULATION: GRS80
Lat1:   0°00'00.0000000"N
Long1:  0°00'00.0000000"E
ElHt1:  0.0000m
Lat2:   0°30'00.0000000"N
Long2:  179°30'00.00000"W
ElHt2:  0.0000m
Ellipsoid Height of second Point
EDIT   +N    +W        CANCL  OK
```

1. `F2` **+N** or **+S** – Toggle positive Latitude input to be north or south.

2. `F3` **+E** or **+W** – Toggle positive Longitude input to be east or west.

The solution also displays the input to allow checking the input for correctness. Use `F1` **EXPRT** to export the solution to the calculator stack or write them to an ASCII file to save to the SD card COGOPLUS\ASCII directory or to the HOME directory on the calculator.

```
INVERSE CALCULATION: GRS80 1/2
Lat1:   0°00'00.0000000"N
Long1:  0°00'00.0000000"E
Lat2:   0°30'00.0000000"N
Long2:  179°30'00.00000"W
Edist:  19936288.5788m
Az1-2:  334°19'41.25795"
Az2-1:  25°40'22.492031"
EXPRT                      OK
```

NOTE: THE EXAMPLE IN THE SCREEN CAPTURES IS A CASE WHERE THE SOLUTION FAILS TO CONVERGE IN 200 ITERATIONS. THE RESULTS HOWEVER AGREE VERY CLOSELY TO THE EXAMPLE INPUTS FOR THE DIRECT CALCULATION. THIS ILLUSTRATES THAT 200 ITERATIONS IS ADEQUATE FOR ALMOST EVERY IMAGINABLE SCENARIO.

The second page of the results (see next page for example) display the ellipsoidal heights of both points as provided, the averaged azimuth between the two points and ground-level distance between the two points. The ground-level distance is only accurate when accurate ellipsoidal elevations are provided.

Please Note: The ellipsoidal elevation and the averaged azimuth are NOT related to grid distance and azimuth. Simply inverse the grid coordinates with Inverse Points program to obtain grid information.

Inverse Grid

Enter the grid northings and eastings of two points to calculate the ellipsoidal distance between the two points and the azimuths of the geodesic lines in each direction. Optionally also enter the ellipsoidal heights for each point to allow a ground distance calculation. Use ⌗F4 **geXYZ** to retrieve the coordinates of a point in the current job.

```
INVERSE CALCULATION: GRS80
North 1: 5373964.26400m
East 1:  471570.600000m
EllHt 1: 58.2550m
North 2: 5373538.35700m
East 2:  471629.465000m
EllHt 2: 56.5120m
Grid Northing of first Point
 EDIT               gtXYZ CANCL  OK
```

The solution displays the input converted to geodetic coordinates. Use ⌗Fl **EXPRT** to export the solution to the calculator stack or write them to an ASCII file to save to the SD card COGOPLUS\ASCII directory or to the HOME directory on the calculator.

```
INVERSE CALCULATION: GRS80 1/2▼▲
Lat1:  48°31'05.328845"N
Long1: 123°23'05.94718"W
Lat2:  48°30'51.544912"N
Long2: 123°23'02.97326"W
Edist: 430.123437093m
Az1-2: 171°50'33.14062"
Az2-1: 351°50'35.36850"
EXPRT                         OK
```

```
INVERSE CALCULATION: GRS80 2/2▼▲
EllHt1: 56.5120m
EllHt2: 58.2550m
AVGaz: 171°50'34.26161"
Gdist: 430.127329243m



EXPRT                         OK
```

The second page of the results display the ellipsoidal heights of both points as provided, the averaged azimuth between the two points and ground-level distance between the two points. The ground-level distance is only accurate when accurate ellipsoidal elevations are provided.

Please Note: The ellipsoidal elevation and the averaged azimuth are NOT related to grid distance and azimuth. Simply inverse the grid coordinates with Inverse Points program to obtain grid information.

Appendix A

The table below includes the parameters used for the ellipsoid definitions in **COGO+**.

$$b = a \times (1 - f) \qquad\qquad f = (a - b) \div a$$

$$e' = \sqrt{\frac{a^2 - b^2}{a^2}} \qquad\qquad e'' = \sqrt{\frac{a^2 - b^2}{b^2}}$$

Reference Ellipsoid	Defining and Calculated Parameters	
Clarke 1866 (NAD27)	**a = 6378206.4** f = 0.00339007530392879	**b = 6356583.8** 1/f = 294.978698213898
GRS80 (NAD83)	**a = 6378137** f = 0.00335281068118232	b = 6356752.31414036 **1/f = 298.257222101**
WGS84	**a = 6378137** f = 0.00335281066474748	b = 6356752.31424518 **1/f = 298.257223563**
International 1924 (Hayford)	**a = 6378388** f = 0.00336700336700337	b = 6356911.94612795 **1/f = 297**
Clarke 1880 (ARC)	**a = 6378249.145** f = 0.00340754619444173	b = 6356514.96639875 **1/f = 293.4663077**
Clarke 1880 (IGN)	**a = 6378249.2** f = 0.00340754952001565	**b = 6356515** 1/f = 293.466021293627
Clarke 1880 (RGS)	**a = 6378249.145** f = 0.00340756137869933	b = 6356514.86954978 **1/f = 293.465**
Airy 1830	**a = 6377563.396** f = 0.00334085064149708	b = 6356256.90923729 **1/f = 299.3249646**
Australian National Spheroid	**a = 6378160** f = 0.00335289186923722	b = 6356774.71919531 **1/f = 298.25**
Krassovsky 1940	**a = 6378245** f = 0.00335232986925913	b = 6356863.01877305 **1/f = 298.3**
Bessel 1841	**a = 6377397.155** f = 0.00334277308160762	b = 6356078.96345955 **1/f = 299.1528218**
Parametry Zemli 1990 (PZ-90)	**a = 6378136** f = 0.00335281317789691	b = 6356751.30156878 **1/f = 298.257**