

Grid InQuest II

The Grid InQuest II software provides a means for transforming coordinates between ETRS89 (WGS84) and the National coordinate systems of Great Britain, Northern Ireland and the Republic of Ireland.

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Introduction

Welcome to Grid InQuest II

This Help Document provides a complete reference for using and understanding the Grid InQuest II package. It is intended to help you get started using Grid InQuest II and to illustrate the methods and procedures involved in accurate coordinate conversion in Great Britain, Northern Ireland and the Republic of Ireland.

The Help Document is divided into several basic sections. The first section, Application Use, teaches you the basics of the Grid InQuest II software and how to quickly get the software application up and running. It then gives a detailed description of all the menu items, options and dialog boxes and how to use the software. The second section details usage of the more advanced utilities intended for programmers and other technicians. The last section contains reference information related to the supported coordinate systems and details of the coordinate transformations used within Great Britain, Northern Ireland and the Republic of Ireland.

Application Use

Overview

Grid InQuest II provides a means for transforming coordinates between ETRS89 (WGS84) and the National coordinate systems of Great Britain, Northern Ireland and the Republic of Ireland. If necessary, it provides a fully three dimensional transformation incorporating the latest geoid model.

NB: For more information, see the reference topic About Transformations.

A coordinate may be set and retrieved as any of the following:

ETRS89 Geocentric
ETRS89 Geodetic
OSGB 1936 / British National Grid
TM75 / 4Irish Grid
IRENET95 / Irish Transverse Mercator
ETRS89 / UTM Zone 29N
ETRS89 / UTM Zone 30N
ETRS89 / UTM Zone 31N

In addition, depending on where the coordinates are located, it will convert between ETRS89 ellipsoidal heights and the following orthometric height datums:

Ordnance Datum Newlyn
St Mary's
Douglas02
Stornoway
St Kilda
Lerwick
Newlyn
FairIsle
Flannan Isles
North Rona
Sule Skerry
Foula
Malin Head
Belfast
Offshore

Getting Started

Once initialised, the Grid InQuest II application will open the main window otherwise know as the softwares interactive mode.

This window is split into two sections on the left being the interactive coordinate conversion interface and the right being an interactive map of the globe that will pinpoint the coordinate you have entered. The input and output systems are arranged horizontally to the left of the interactive map allowing you to easily be able to enter the coordinate you wish to transform. The only parameters required for conversion are your X,Y,Z (or latitude longitude etc... depending on what system you are using).

Converting a coordinate

The interactive section of the program is what appears on opening. This details the interactive mode of Grid InQuest II.

Select the coordinate type from the drop down list next to the “Input System Text” (e.g. ETRS89, Cartesian, Geodetic... etc.). You can not enter a coordinate without first choosing a reference system. Enter the coordinate values (as either: latitude, longitude and altitude; X, Y and Z or Eastings, Northings and Elevation). The entry options will change depending on which coordinate system you choose.

Underneath the Input System section, select the coordinate type from the drop down list “Output System” (e.g. ETRS89, Cartesian, Geodetic... etc.). The new coordinates will automatically convert once you have chosen an output coordinate system for the transformation.

{Screenshot}

Example:

In this example there is a coordinate from a GPS receiver that is to be converted to the British National Grid (GPS data appears as an ETRS89 Geodetic coordinate) as the coordinate is local.

In the “Input System” drop down menu, select ETRS89 Geodetic. Enter the Latitude, Longitude and Altitude from the GPS receiver.

Grid InQuest II can accept most text formats for geodetic coordinates, and in the example the following has been entered:

N 53 26

-2 58

70

Select “OSGB36 / British National Grid (TN15/GM15)” as the coordinate reference in the “Output System” drop down box since the point is inside the UK. The point will automatically convert from the ETRS89 Geodetic into the OSGB36 / British National Grid (TN15/GM15).

The converted grid coordinates (Eastings and Northings) will be displayed in Output System:

335874.381m E

393383.579m N

17.70m

{screenshot}

A pinpoint location of the coordinate will be displayed on the three-dimensional map appearing on

the right of the window.

{screenshot}

The vertical datum will be automatically set to Newlyn since the coordinates we have chosen are only applicable to this vertical datum.

NB: The conversions to Ordnance Survey local datums are only valid on mainland Great Britain, Northern Ireland and the Republic of Ireland. There is a 10 kilometre buffer extended from the coastline to cover near-shore transformations, however, it is not valid any further offshore.

This example operates solely in Grid InQuest II's interactive mode as this is the main way of the user interacting with the coordinates.

The transformations are not valid in the Channel Islands.

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Coordinate Conversion

Conversion can be achieved either through use of the programs interactive mode or alternatively Grid InQuests II's File Mode.

The coordinates will convert automatically in the interactive mode of the program.

Options

The output format of the converted coordinate may be altered by selecting 'Options' from the 'Edit' menu to activate the Options dialogue box. Here you will be able to alter the format options for both your input and output coordinates.

{Screenshot}

Interactive Settings

In " Latitude and longitude coordinates may be entered in any format (e.g. degrees minutes and seconds, degrees and decimal minutes, decimal degrees...). The number of decimal places to which coordinates will be formatted to, can also be selected. The number of decimal places used can be independently set for each type of coordinate value. Geodetic Display Format Settings have additional options as well as changing the style and the decimal places. You may also edit the units used (symbols, letters, none...). You may select what quadrants you use (signs, letters, none...). There are also options to compact the whitespace in the coordinate. There is also the option to display the coordinate as an all positive longitude.

When editing the Height Output Format, you may also check a tick box that shows which datum suffix the location is using i.e. Newlyn, Malin Head.

output coordinate settings

The exact same options appear for your output coordinate settings.

Irish Border Options

For the areas which cross the border between Northern Ireland and the Irish Republic, it is possible to select the required border option for use of the Vertical Datum. This applies to both the ITM and the IG systems. The options are as displayed below...

Converting Files

Using the Text File Decoder

Defining Input and Output CRS

Defining Coordinate Format and Decimal Places

Loading / Saving a pre-defined format

Defining the File Format

Decoding the Data

Running the File Transformation

File Conversions

Grid InQuest II will allow ASCII files of coordinates to be converted from one datum (and/or projection) to another. From the File menu select Convert File... and navigate to select the file that is to be converted. The conversion wizard will convert all delimited ASCII text files as well as Microsoft Excel files.

Selecting the Convert File... option will activate the Text File Decoder. This enables the user to import ASCII data files, choose how the data is represented, which coordinate system it is in and define its appearance.

Using the Text File Decoder

On initialising the Text File Decoder for the first time, the File Convert dialogue box will be activated.

This will display the imported file in the top pane and a lower pane will display the decoded formatted version (NB this will be automatically populated but may be incorrect and require manual decoding to correct).

Defining the Coordinate Reference Systems

At the top of the File Convert window, there are 2 fields...

Input CRS:

Output CRS:

Use the drop down list to select the correct CRS (Coordinate Reference System) for both the Input (imported) file and the Output file.

Use the Format buttons for each CRS, to specify the format (ie degrees, minutes, seconds) for Geodetic coordinates and the decimal places for Grid coordinates...

Manually decoding the File

Use the series of buttons in the top pane of the File Convert window to correctly decode the data.

Load

Click on Load to import a previously saved format.

Select the appropriate File Import Settings File (.fis)

Save

Click on Save to save the current format.

This is saved as a File Import Settings File (.fis)

Format

Click on the Format button to define the file format properties. This will activate the File Properties dialogue box...

These options define the format of the imported file and specify which records within the file should be used for the geodetic transformation.

Edit the fields as appropriate and click on OK to view the changes in the decoded file pane.

NB: Selecting Yes in any of the Record Selection fields will activate an extra field.

Fields

Click on the Fields button to decode the data into the correct columns.

Select the data type e.g. Latitude...

Then select which column from the input file to use for the latitude data...

Repeat this for all fields until the data is displayed as decoded correctly in the File Convert window

Running the File Transformation

When the file has been correctly decoded, select OK

Choose a name and location for the output file and Save

The File transformation will be run automatically and displays a summary window of the converted points...

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Programming with Grid InQuest II

The Grid InQuest II dll and DAT files

The Grid InQuest II DLL (GIQ60.DLL) is supplied as freeware and is available to use within third party applications at no extra cost.

Upon installation of Grid InQuest II, the DLL file, by default, will be found in...

C:\Program Files\Common Files\GridInQuest\Geodetics\GIQ60.dll

The DLL must be distributed with the associated data file (GIQ60.DAT).

This file is usually installed into the folder "<AllUsersAppData>\GridInQuest\GIQ60" but this path can be specified to the Grid InQuest II DLL.

On XP this is...

C:\Documents and Settings\All Users\Application Data\GridInQuest\GIQ60.DAT

NB: The folder Application Data is by default a hidden folder. To see this folder and its contents, go to Tools > Folder Options > View to Show Hidden Files and Folders

On Vista this is...

C:\Program Data

When working with the dll file, the Unlock Code is: GIQ.6.0 and is detailed in the Programming Manual

Documents to download

A Merge Module

Programming Information for using the Grid InQuest II DLL can be found in the document Grid InQuest II Programming Manual

This Grid InQuest II Users Manual

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About Transformations

Transformations For Great Britain and Northern Ireland and the Republic of Ireland.

All Ordnance Survey mapping relates to a coordinate reference system. In Great Britain OSGB coordinates relate to OSGB36 (the National Grid), within Northern Ireland and the Republic of Ireland the coordinate reference system is the Irish Grid. These reference systems are traditionally realised on the earth's surface by monumented triangulation stations. The users of mapping products, in both the public and private sectors, have invested in geographical information systems (GIS) and asset management systems based on these Grid systems which have been accepted as de facto national standards.

In order to relate GPS-derived positions to the Ordnance Surveys' mapping, GPS derived coordinates need to be converted to Irish Grid or to National Grid, which requires a specialised datum transformation. For this reason, the Ordnance Survey of Northern Ireland and Ordnance Survey Ireland have developed a polynomial transformation, which is the standard datum transformation for use throughout Ireland. The Ordnance Survey of Great Britain have developed OSTN02, the standard datum transformation for Great Britain.

Ordnance Survey mapping also includes height information that relates to a regional vertical datum. Height information in Great Britain refers to Ordnance Datum Newlyn (ODN), which is established from mean sea level. Although ODN is the national height datum used across mainland Great Britain there are a number of additional datums that are used on the surrounding islands, namely: Lerwick on the Shetland Islands; Stornoway on the Outer Hebrides; St. Kilda; Douglas02 on the Isle of Man and St. Marys on the Scilly Isles. The Ordnance Survey of Northern Ireland relates heights within Northern Ireland to Belfast Lough datum, and Ordnance Survey Ireland relates heights within the Republic of Ireland to the Malin Head datum. The resulting Ordnance Survey Geoid model (OSGM02) incorporates all the above vertical datums.

OSTN02

The Ordnance Survey of Great Britain has developed the horizontal transformation OSTN02. This transformation consists of a 1,250km by 700km grid of translation vectors at 1km resolution. This provides a fit between the GPS coordinate system ETRS89 and the OSGB36 National Grid. ETRS89 coordinates can be determined in Great Britain by linking a GPS survey to Active or Passive stations from the British 'National GPS Network', see www.gps.gov.uk

OSTN02 is in agreement with major triangulation stations at the level of 0.1m root mean square (RMSE).

Within Great Britain OSTN02 (the Ordnance Survey National Grid Transformation), in conjunction with the ETRS89 positions of the active GPS Network stations, is now the official definition of OSGB36 National Grid coordinate system. This means that using OSTN02 with the National GPS Network, surveyors using GPS have no need to occupy triangulation stations in order to relate GPS coordinates to National Grid coordinates.

OSi/OSNI Polynomial Transformation

Ordnance Survey Ireland and Ordnance Survey of Northern Ireland recommend the OSi/OSNI polynomial transformation for all horizontal transformations in the Republic of Ireland and

Northern Ireland. This transformation has been developed in association with the Institute of Engineering Surveying and Space Geodesy, University of Nottingham.

The transformation is based on 183 points evenly distributed throughout Ireland and Northern Ireland. The precise ETRS89 and Irish Grid coordinates of these points are determined by GPS and terrestrial survey methods, and a one-dimensional 3rd order polynomial individually fitted to the latitude and the longitude. The resulting polynomial allows calculation of the coordinate differences at additional points. The polynomial transformation has an accuracy of 0.4m (95% data).

Ordnance Survey Geoid Model: OSGM02

To provide the third dimension of the transformation, the Ordnance Surveys have, with others, developed the Geoid model OSGM02. The model is derived from precise gravity surveys across UK, Ireland, and surrounding waters, additionally the model includes data from the global geopotential model (EGM96). Alignment to each regional vertical datum is based on precise GPS observations at Ordnance Survey levelling marks. Within Great Britain these include the Ordnance Survey fundamental benchmark network.

The Geoid model consists of a 1km grid with geoid-ellipsoid separation values covering all of Great Britain, Ireland and Northern Ireland. This model can be used with GPS determined positions to establish height above mean sea level, as defined by the respective vertical datums, to the accuracies shown in the table below. The Ordnance Surveys recommend the use of the Geoid Model OSGM02 and the active GPS network to produce orthometric height compatible with Ordnance Survey mapping.

OSGB intend that OSGM02 is the official definition of the relationship between GPS ellipsoid heights and orthometric height in Great Britain. In the way that GPS and the transformation model OSTN02 define the horizontal coordinate system, precise GPS surveying using the OSGB active GPS Network in conjunction with the Geoid model will become the standard method of determining orthometric height.

OSTN02 covers Great Britain and the Isle of Man. The OSi/OSNI polynomial transformation covers the Republic of Ireland and Northern Ireland. It should be noted that the Irish Grid and the National Grid are two independent coordinate reference systems, and that Irish Grid coordinates are not directly compatible with OSGB36 coordinates.

OSGM02 covers all of Great Britain, Isle of Man, Republic of Ireland, and Northern Ireland. The Geoid model comprises of 14 patches in order to relate to mean sea level as defined by the specific vertical datum for each region. The Datum Flag which forms part of each data record specifies to which datum the geoid/ellipsoid separation value relates.

Both models have been cookie-cut to a boundary which extends 10km offshore. Any point outside this boundary will return null values in the shift and datum flag records. It is strongly suggested that any software written to incorporate this data be capable of recognising a null value and to return an outside of model boundary error message.

Within Ireland and Northern Ireland, OSGM02 returns orthometric heights relative to the Malin Head and Belfast Lough datums respectively. OSGM02 will return orthometric height relative to either the Malin Head or the Belfast Lough datums for points within 2km of the border between the Republic of Ireland and Northern Ireland. It is recommended that software written to incorporate this data does not extend the model beyond these limits.

Accuracy

Accuracy of Ordnance Survey 2d Transformations

Within Great Britain, OSTN02 is the definitive OSGB36/ETRS89 transformation. OSTN02 in combination with the ETRS89 coordinates of the active GPS Network stations, rather than the fixed triangulation network, now define the National Grid. This means that, for example, the National Grid coordinates of an existing OSGB36 point, refixed using GPS from the National GPS Network and OSTN02, will be the correct ones. The original archived OSGB36 National Grid coordinates of the point (if different) will be wrong, by definition, but the two coordinates (new and archived) will agree on average to better than 0.1m (0.1m rmse, 68% probability).

Within the Republic of Ireland and Northern Ireland, OSi/OSNI polynomial transformation is recommended for coordinate transformations between ETRS89 and the Irish Grid. Transformed ETRS89 coordinates will agree with Irish Grid coordinates derived from traditional survey control to within 0.4m (95% data).

Accuracy of OSGM02

The heights output by precise GPS positioning in the ETRS89 coordinate system are geometric distance above the WGS84 (GRS80) reference ellipsoid. Note that GPS heights are typically two to three times less precise than horizontal positions. OSGM02 converts ETRS89 ellipsoidal heights to orthometric heights above mean sea level.

In mainland Great Britain, the datum (origin Point) representing mean sea level is Ordnance Datum Newlyn, defined at Newlyn in Cornwall. In the Republic of Ireland, Northern Ireland and the islands surrounding GB, mean sea level is defined by specific independent vertical datums which are all incorporated in OSGM02 and hence OSGM02 is compatible with the products from each of the Ordnance Surveys. Other Geoid models may give mean sea level heights that are incompatible with the Ordnance Surveys products.

The estimated accuracies of OSGM02 for each regional vertical datum are included in the table below. The figures quoted assume precise ellipsoidal heights are used, for lower quality GPS observations additional error budget must be included.

Regional Datum
Standard Error (m)

Great Britain
0.02

Republic of Ireland
0.03

Northern Ireland
0.02

Orkney
0.08

Shetland
0.03

Outer Hebrides
0.09

Isle of Man
0.03

St. Kilda
0.06

Scilly Isles
Single offset from Newlyn

Any discrepancy found between an Ordnance Survey levelled bench mark (OSBM) and a OSGM02 computed orthometric height is likely to be due to bench mark subsidence or uplift and, assuming precise GPS survey has been carefully carried out, the orthometric height given by OSGM02 should be considered correct in preference to archive bench mark heights.

NB: For more information, see the reference topic [About Transformations](#).

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Coordinate Systems

Types of Coordinate

Coordinates can be entered into the conversion software using a number of different formats. For more information related to the Coordinate Systems used below, see the reference topic About Transformations.

Grid InQuest II's Coordinate Systems

Grind InQuest II features the following Coordinate systems that can be transformed:

ETRS89 / UTM Zone 29N

ETRS89 / UTM Zone 30N

ETRS89 / UTM Zone 31N

ETRS89 Cartesian

ETRS89 Geodetic

Irish Grid (IG/GM15)

Irish Transverse Mercator (ITM/GM15)

OSGB36 / British National Grid (TN15/GM15)

ETRS89 UTM Coordinates

Select ETRS89 / UTM Zone 29N as the coordinate reference system (or 30N or 31N as appropriate). The vertical datum will default to the appropriate one i.e Newlyn.

Enter the UTM projected Eastings and Northings in the relevant fields and the elevation (height above sea level), in metres. The zones will be restricted to those applicable to the transformation, i.e. zones 29, 30 and 31. When working in Northern Ireland and the Republic of Ireland the zone will be fixed to 29.

Cartesian Coordinates

Select ETRS89 Cartesian as the coordinate reference system. This gives input fields for X Coordinate, Y Coordinate and Z Coordinate. Heights are ellipsoidal and refer to height above the GRS1980 ellipsoid.

Enter the Earth centred, Earth fixed (XYZ) coordinates in metres.

ETRS89 Geodetic Coordinates

Select ETRS89 Geodetic as the coordinate reference system. This gives input fields for Latitude, Longitude and Altitude. Heights are ellipsoidal and refer to height above the GRS1980 ellipsoid.

The latitude and longitude of the point can be entered into the corresponding fields in a variety of formats. Grid InQuest II will accept decimal degrees, degrees and minutes and degrees, minutes and seconds (see Options). It will accept hemisphere codes (N, S, E and W) as well as signed numbers (+ and -).

Irish Grid Coordinates

When using the software in Ireland or Northern Ireland, select TM75 / Irish Grid as the Coordinate Reference System.

Enter the Irish Grid projected Eastings and Northings, and the orthometric height (height above mean sea level). If the coordinates are within the Irish Grid in Northern Ireland, the vertical datum will be fixed to Belfast Lough. If the coordinates are within the Irish Grid in the Republic of Ireland, the vertical datum will be fixed to Malin Head.

Irish Transverse Mercator Coordinates

When using the software in Ireland or Northern Ireland, select IRENET95 / Irish Transverse Mercators as the Coordinate Reference System.

Enter the Irish Transverse Mercator projected Eastings and Northings, and the orthometric height (height above mean sea level). If the coordinates are within the Irish Grid in Northern Ireland, the vertical datum will be fixed to Belfast Lough. If the coordinates are within the Irish Grid in the Republic of Ireland, the vertical datum will be fixed to Malin Head.

OSGB36 / British National Grid (TN15/GM15) Coordinates

When using the software in Great Britain, select OSGB36 / British National Grid (TN15/GM15) as the coordinate Reference System.

Enter the OSGB36 projected Eastings and Northings, and the orthometric height (height above mean sea level). The vertical datum will default to the appropriate one i.e. Newlyn.

Glossary

A

Accuracy:

The degree of closeness or conformity of an observation to its true value.

D

Datum:

The survey reference system used in a specific country or region. All geographical coordinates will be referenced to a chosen datum. Two principle datum types exist, namely global datums and astrogeodetic datums. A datum is created when a reference spheroid is tied to the earth at a particular point and coordinates are defined for that point. See spheroid, WGS84

E

Ellipsoid:

A closed quadric surface that is a three-dimensional analogue of an ellipse. The standard equation of an ellipsoid centred at the origin of a Cartesian coordinate system and aligned with the axes is.
(See Spheroid)

ETRS89:

The European Terrestrial Reference System 1989, used as the standard precise GPS coordinate system throughout Europe. In 2000, the difference between the WGS84 and ETRS89 coordinates was about 25 cm, and increasing by about 2.5 cm per year. ETRS89 has been officially adopted as a standard coordinate system for precise GPS surveying by most national mapping agencies in Europe.

G

Geoid:

A model of the level surface which is closest to MSL over the oceans. This surface is continued under the land and acts as the fundamental reference surface for height measurement, as an approximation of MSL on land.

GPS:

Global Positioning System. A satellite based navigation system which in the last five years has become the industry standard survey tool for positioning and navigation.

I

IG:

Irish Grid - The standard two-dimensional grid reference for Irish coordinates. Divided into 25 squares (each measuring 100 square kilometres) they are all represented by letters in alphabetical order excluding 'I'. The letters A, E, P, K, U, Y and Z do not cover any landmass in Ireland.

ITM:

Irish Transverse Mercator - The geographic coordinate system for Ireland. It was implemented jointly by the Ordnance Survey Ireland (OSI) and the Ordnance Survey of Northern Ireland (OSNI) in 2001. The name is derived from the Transverse Mercator projection it uses and the fact that it is optimised for the island of Ireland.

N

National Grid:

The primary coordinate system used in Great Britain.
(See OSGB36)

O

ODN:

Ordnance Datum Newlyn is the national standard vertical reference system for measuring height above MSL in GB. ODN is measured relative to a value taken at Newlyn, Cornwall.

Orthometric height:

Height above mean sea level

OSGB36:

The national standard coordinate system for topographic mapping, including all Ordnance Survey mapping, and for geographically referencing many kinds of information in relation to Ordnance Survey mapping.

OSGM02:

Ordnance Survey National Geoid Model 2002. A gravimetric model used to convert from ETRS89 to ODN heights.

OSGM15:

Ordnance Survey National Geoid Model 2015. A gravimetric model used to convert from ETRS89 to ODN heights.

OSTN02:

Ordnance Survey National Grid Transformation 2002. A horizontal transformation converting from ETRS89 to OSGB36 coordinates and vice versa.

OSTN15:

Ordnance Survey National Grid Transformation 2015. A horizontal transformation converting from ETRS89 to OSGB36 coordinates and vice versa.

P

Precision:

The degree of repeatability or closeness that repeated measurements of the same quantity display. Precision is used to describe the quality of data with respect to random errors. Measurements that are closely grouped are said to have a high precision because their random errors are small.

S

Spheroid:

A mathematical figure used to closely model the geoidal surface of the earth. The figure is described by the semi-major axis (a), semi-minor axis (b) and inverse flattening. Many spheroids are used to describe the figure of the geoid on different parts of the earth. The spheroid will be intrinsically tied to the geodetic datum and once a datum is used in a particular country or region it is unlikely to be changed.

T

Transformation:

A procedure to change from one coordinate system to another. GridInquest II's primary function.

U

UTM:

Universal Transverse Mercator. Special case of the Transverse Mercator projection where by the earth is divided into 60, 6 degree zones. All the zones have identical characteristics with the exception of their central meridians which increase by a factor of 6 degrees between adjacent zones. UTM projections are used extensively in oil exploration and particularly favoured for their easy of use. One down side is that they are not preferable when mapping large extents in an east-west direction.

W

WGS84:

The spheroid and datum used to model the geoidal surface for the entire globe. It is the principle datum for GPS since January 1987.