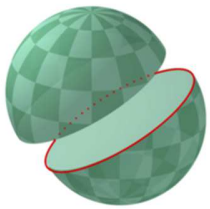
Determining Beam Headings

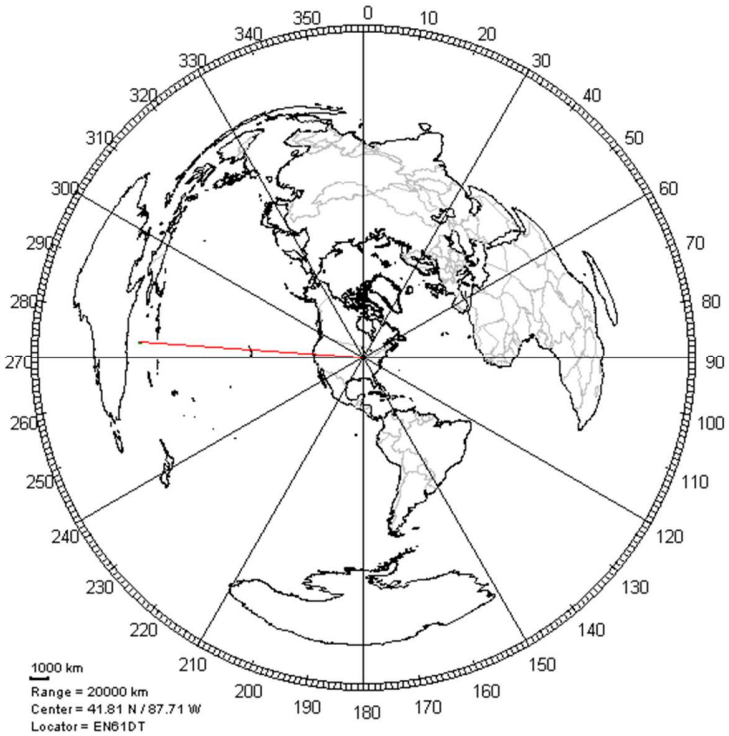
How does one determine beam headings to and from given locations on the earth?

The Great Circle Route is the shortest course between two points on the surface of a sphere. The earth is essentially spherical, so mathematics from the Great Circle Route can be applied to determine beam headings. The advanced mathematics uses spherical geometry to make these calculations.

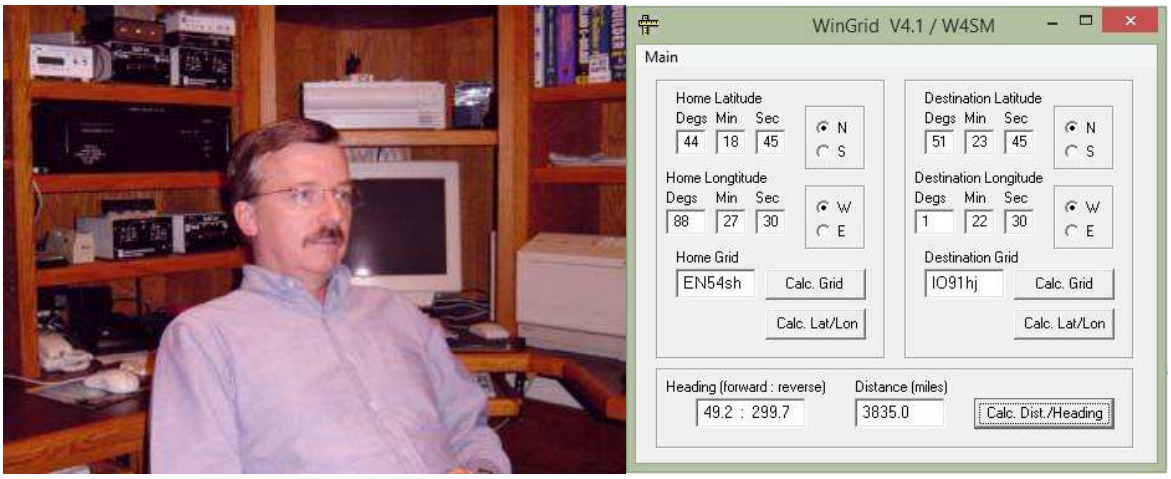
The Great Circle Route conceptually divides a sphere, or the world globe, into two equal halves. The circumference is approximately 40,000 kilometers, or 24,854 miles. The earth has a somewhat greater circumference around its equator.



From my QTH in Appleton, WI, I view the closest route to locations around the world as depicted by the following Great Circle map. Except for South America, most of the world's population, and certainly hamdom, is located towards my north--somewhat northeast and somewhat northwest. For this reason, many rotors are configured for a center of rotation through the north heading, with rotation stops at 180 degrees south.

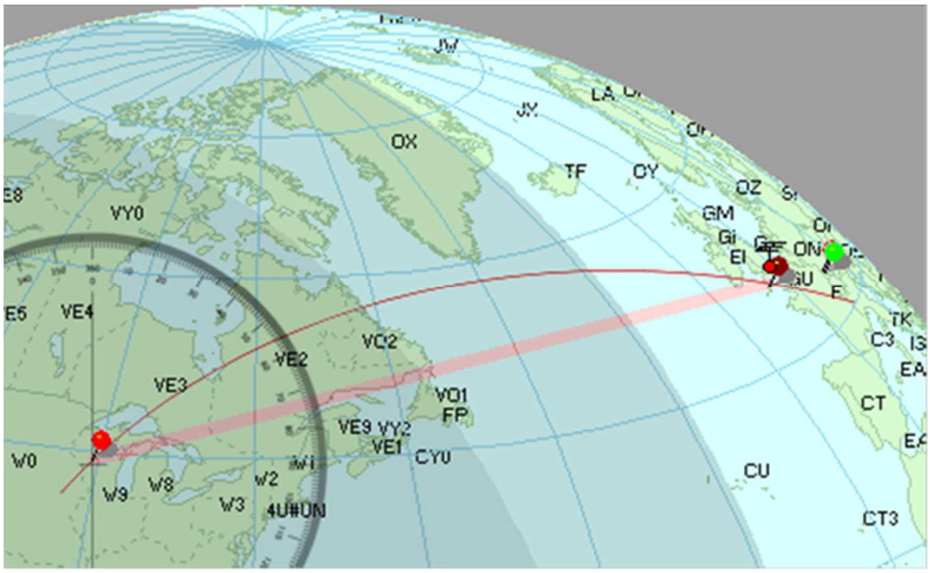


For any two points on the surface of a sphere there is a unique great circle through those two points. For amateur radio use, we can conveniently define these locations as grid squares. This makes it easy to utilize software to determine beam headings to and from two ham QTHs. I use WinGrid 4.1 created by Stacey W4SM to make calculations.



My friend, Gary G7SLL, lives in Newbury, England. I can go to QRZ.com to find his grid square. It is IO91hj. My grid square in Appleton, WI is EN54sh. This is all I need to find my beam heading to Gary, ie, 49.2 degrees. From his point of view, his Great Circle Route beam heading towards me is 299.7 degrees. Our short path distance is approximately 3,835 miles. This is the same bearing as given on QRZ.com for a beam setting to Gary's QTH. (Gary would suggest pointing somewhat further north in practice to minimize noise and enhance the signal-to-noise (SNR) ratio for better reception.)

The difficulty with beam headings comes from our visualization in 2-dimensions of a 3-dimensional problem. The broad, red stripe is the heading one gets from plotting on a flat plane, eg. ARRL wall maps. That is a longer path than the Great Circle Route.



Note that while I can find the long path route to G7SLL simply by subtracting the 3,835 mile short path from 24,854 miles, I CANNOT determine his beam heading simply by adding 180 degrees to my 49.2 beam heading. (If one is at the equator pointing east at 90 degrees, then adding 180 degrees would be correct to calculate the opposite beam heading of 270 degrees.) The Great Circle calculation instead calls for a 299.7 degree heading towards me from his QTH.

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