



USING ANTENNA PROFILES IN WAYPOINT SOFTWARE

The exact location of the electrical phase center for any given GPS antenna varies depending on the elevation of the satellite's incoming signal. Since this is the point where the GPS measurements are made, it also represents the location of the resulting computed coordinates. The electrical phase center is, in fact, not a physical point, which means it cannot be measured to directly in the field. In order to account for all of these facts in Waypoint's software, you must use an antenna profile.

The antenna profiles found in Waypoint's software have been created using relative calibration data obtained from National Geodetic Survey (NGS). Therefore, it is important to note that NGS makes all measurements with respect to the base of the antenna, as opposed to its actual measurement mark. The antenna base is often referred to as the antenna reference point (ARP). If you make height measurements to points other than the antenna base, you will need to modify the antenna profiles provided with the software. This document is aimed at helping you configure the settings in your Waypoint project in a manner that is consistent with your antenna height information.

In terms of height measurements, there are four possibilities that can be handled by Waypoint's software.

Case 1: Measurement to Antenna Base (ARP)

In this scenario, the coordinates entered for the station represent those of the ground point (i.e. monument, etc). The antenna height measurement is made with respect to this point up to the base of the antenna (i.e. ARP). By selecting the proper antenna profile, the offsets from the ARP to the L1 and L2 phase centers are added.

The image shows two dialog boxes and a diagram. The 'Add Master GNSS Data File(s)' dialog box has the following fields:

- Base Station: Name: mtka, File: C:\GPSData\mtka2370.gpb
- Coordinates: Latitude: North 35 40 46.25328, Longitude: East 139 33 40.98452, Ellipsoidal Height: 108.937 (m), Datum: ITRF05
- Antenna Height: Use advanced method (requires antenna profile). Antenna height measurement: 1.30 (m), Antenna profile: ASH701073.1

The 'Antenna Info' dialog box shows:

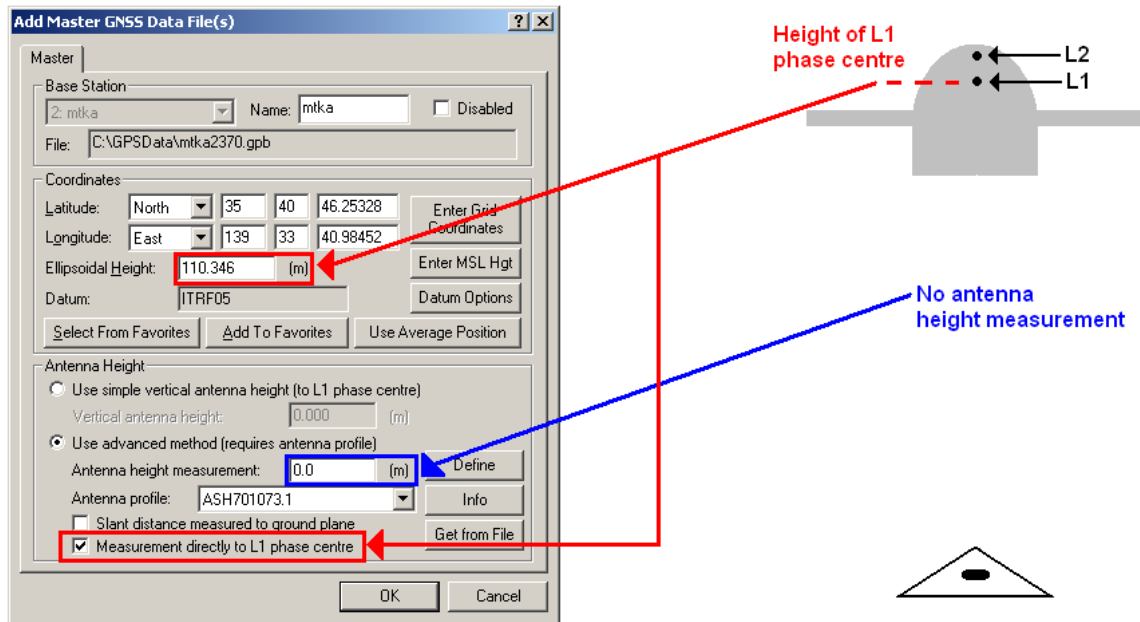
- Name: ASH701073.1, Description: GPS/GLONASS
- Ref. Point: Antenna Base, Source: NGS, TestDate: 00/04/20
- Horizontal Offset: 0.0 mm
- L1 Offsets (n,e,h): 1.4, -1.0, 108.9 mm
- L2 Offsets (n,e,h): 1.0, 0.5, 127.4 mm

The diagram shows an antenna on a tripod. A blue arrow points from the ground point to the ARP (Antenna Reference Point) at the base of the antenna. A red arrow points from the ground point to the 'Height of ground point' field in the dialog. A green arrow points from the 'Antenna height measurement' field to the 'Phase centre offsets (from ARP)' in the diagram. The diagram also shows L1 and L2 phase centers with their respective offsets from the ARP.

This scenario also applies if you have been provided with the coordinates of the ARP, which is often the case for CORS users. In such a case, you would enter the provided coordinates, set the *Antenna height measurement* field to zero, while still selecting the proper antenna profile to ensure the phase center offsets are taken into account.

Case 2: Measurement to L1 Phase Centre

Often times, precise station coordinates are published with respect to the L1 phase centre. In such a case, we do not want the software to use any additional offsets, but we still want to take advantage of the elevation-based corrections for the antenna. By selecting **Measurement directly to L1 phase centre** and leaving the *Antenna height measurement* field as zero, we can force the software to ignore the offsets contained in the profile while still making use of the corrections. In this scenario, the coordinates entered would be those of the L1 phase centre.



Case 3: Measurement to Mark

In this scenario, the antenna height measurement has been made with respect to a mark or “notch” on the antenna. In order to use this measurement in Waypoint’s software, you must modify the existing profile for your antenna so that the vertical offsets are measured with respect to the mark instead of the ARP. This is done by clicking the **Define** button, selecting the profile, and then clicking **Add From**. Only the fields concerning the vertical distances need to be changed, since none of the other values are affected. You should be able to derive the new values by using the documentation for your antenna. Make sure that the difference in height between the L1 and L2 offsets is the same before and after you have modified the profile.

The image shows two software dialog boxes and a diagram illustrating the measurement process. The 'Add Master GNSS Data File(s)' dialog box has the following fields:

- Base Station: 2: mlka, Name: mlka, Disabled:
- File: C:\GPSData\mlka2370.gpb
- Coordinates:
 - Latitude: North, 35, 40, 46.25328
 - Longitude: East, 139, 33, 40.98452
 - Ellipsoidal Height: 108.937 (m)
 - Datum: ITRF05
- Antenna Height:
 - Use simple vertical antenna height (to L1 phase centre):
 - Use advanced method (requires antenna profile):
 - Vertical antenna height: 1.409 (m)
 - Antenna height measurement: 1.36 (m) [Define]
 - Antenna profile: ASH701073.1 (copy) [Info]
 - Slant distance measured to ground plane:
 - Measurement directly to L1 phase centre:

The 'Antenna Profile' dialog box has the following fields:

- Name of Antenna Profile: ASH701073.1 (copy)
- Description: GPS/GLONASS
- Test source: NGS, Test date: 00/04/20
- Physical Parameters:
 - Reference point location: Measurement Mark
 - Horizontal distance from antenna centre to ground plane edge: 0.0 (mm)
 - Vertical distance from reference point to L1 phase centre: 48.9 (mm)
 - Vertical distance from reference point to L2 phase centre: 67.4 (mm) (use 0.0 for single frequency)
- Elevation Corrections (Relative to Dome Margolin):

Elev (deg)	L1 (mm)	L2 (mm)
0.0	0.0	0.0
5.0	0.0	0.0
10.0	0.8	0.1
15.0	0.9	0.3
20.0	1.0	0.4

The diagram shows an antenna on a tripod. A 'Measurement mark/notch' is indicated on the antenna. A blue arrow points from the ground point to the mark, labeled 'Measured height from ground point to mark/notch'. A red arrow points from the ground point to the L1 phase centre, labeled 'Height of ground point'. A green arrow points from the mark to the L1 phase centre, labeled 'Phase centre offsets (from mark/notch)'. The L1 and L2 phase centres are marked with dots and arrows.

Modified profile with respect to mark/notch (not ARP)

Case 4: Slant Measurement to Ground Plane

Waypoint software is also compatible with slant height measurements, although it requires additional modifications to the antenna profile. In this scenario, you would need to edit the profile to include the horizontal distance from the center of the antenna to the edge of the ground plane. This is done by clicking the **Define** button, selecting the profile, and then clicking **Add From**. Through Pythagorean Theorem, the software uses this value in conjunction with the entered slant height to derive the vertical height from the ground point to the center of the ground plane. Therefore, the antenna profile must also be edited to ensure that the vertical phase centre offsets are with respect to the center of the ground plane. It is important that you enable the **Slant distance measured to ground plane** option when using slant height measurements.

The image shows two screenshots of the Waypoint software interface and a diagram illustrating the geometry of slant height measurements.

Add Master GNSS Data File(s) Dialog:

- Base Station: 2. mka, Name: mka, Disabled:
- File: C:\GPSData\mka2370.gpb
- Coordinates: Latitude: North 35 40 46.25328, Longitude: East 139 33 40.98452, Ellipsoidal Height: 108.937 (m), Datum: ITRF05
- Antenna Height: Use simple vertical antenna height (to L1 phase centre), Vertical antenna height: 1.410 (m); Use advanced method (requires antenna profile), Antenna height measurement: 1.40 (m), Antenna profile: ASH701073.1 (copy), Slant distance measured to ground plane, Measurement directly to L1 phase centre

Antenna Profile Dialog:

- Name of Antenna Profile: ASH701073.1 (copy)
- Description: GPS/GLONASS
- Test source: NGS, Test date: 00/04/20
- Physical Parameters: Reference point location: Center of Ground Plane, Horizontal distance from antenna centre to ground plane edge: 200.0 (mm), Vertical distance from reference point to L1 phase centre: 24.0 (mm), Vertical distance from reference point to L2 phase centre: 42.5 (mm) (use 0.0 for single frequency)
- Elevation Corrections (Relative to Dome Margolin):

Elev (deg)	L1 (mm)	L2 (mm)
0.0	0.0	0.0
5.0	0.0	0.0
10.0	0.8	0.1
15.0	0.9	0.3
20.0	1.0	0.4

Diagram:

- Phase centre offsets (from center of ground plane): L2, L1
- Centre of ground plane
- Slant height measured from ground point to ground plane
- Height of ground point
- Modified profile with respect to centre of ground plane (not ARP)