LG580P Series
Dual-antenna Heading Application Note

GNSS Products

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About the Document

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-	2025-03-14	Creation of the document
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1 Introduction

Quectel LG580P series (comprising LG580P (03) and LG580P (06)) GNSS module supports GPS, GLONASS, Galileo, BDS, QZSS and NavIC (IRNSS) positioning and heading technology. When the two supported antennas are connected, high-precision carrier phase differential technology is used to calculate the carrier's high-precision heading information in real time, which makes it an ideal solution for achieving precise positioning and high-precision heading in various vertical industries.

This document mainly outlines the functions and usage of dual antenna heading of LG580P series module. In the document, "baseline" and "heading" are used to describe the functions of heading:

- **Baseline:** Vector connecting antenna 1 to antenna 2. The LG580P series supports baseline lengths ranging from 0 m to 5 m.
- **Heading:** Angle from true north to baseline measured in a clockwise direction.

2 Reference Frame

2.1. Local Cartesian Coordinate System (ENU)

Local Cartesian coordinate system is a right-handed rectangular coordinate system where the coordinate origin is located at the station center. For the LG580P series module, the station center is the phase center of antenna 1 (which is to be connected to module RF_IN1 pin, as specified in *document [1] hardware design*). The heading angle (Heading) and pitch angle (Pitch) output by the module refer to this coordinate system.

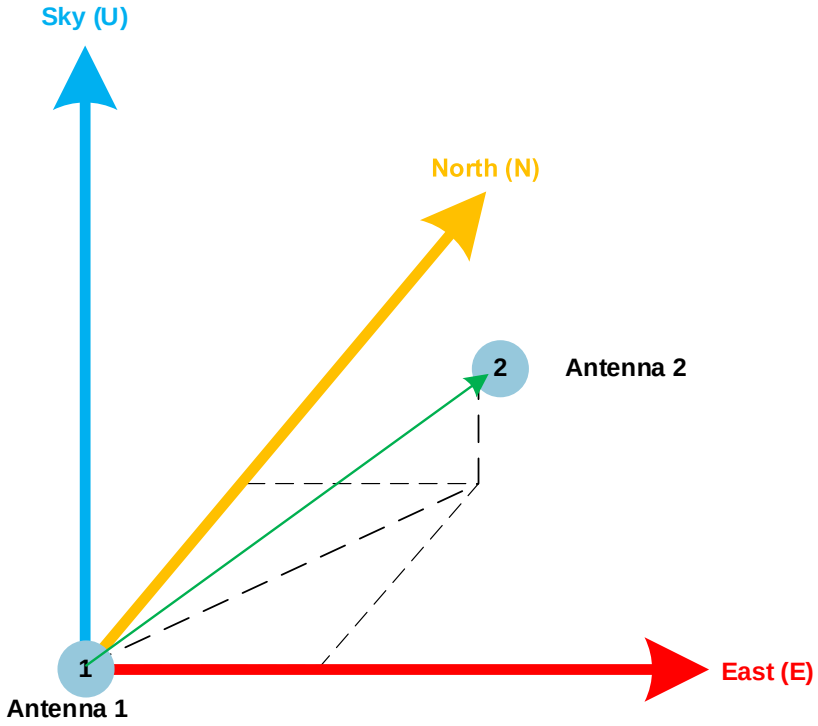

Figure 1: Local Cartesian Coordinate System

3 Angle Definition

This chapter provides the definitions of the heading and pitch angles.

3.1. Heading

In the dual antenna setup, the heading angle is referenced to the local Cartesian coordinate system (ENU). It is defined as the angle between the projection of the baseline vector (i.e., the vector connecting antenna 1 and antenna 2) on the horizontal plane and the true north (i.e., N-axis), with the effective range of [0, 360) by default. For details about the heading angle output, see the **HDT**, **THS**, and **PQTMTAR** messages. For details on the **HDT**, **THS** and **PQTMTAR** messages, see *document [2] protocol specification*.

The heading angle (with north and east directions as reference planes) is illustrated below:

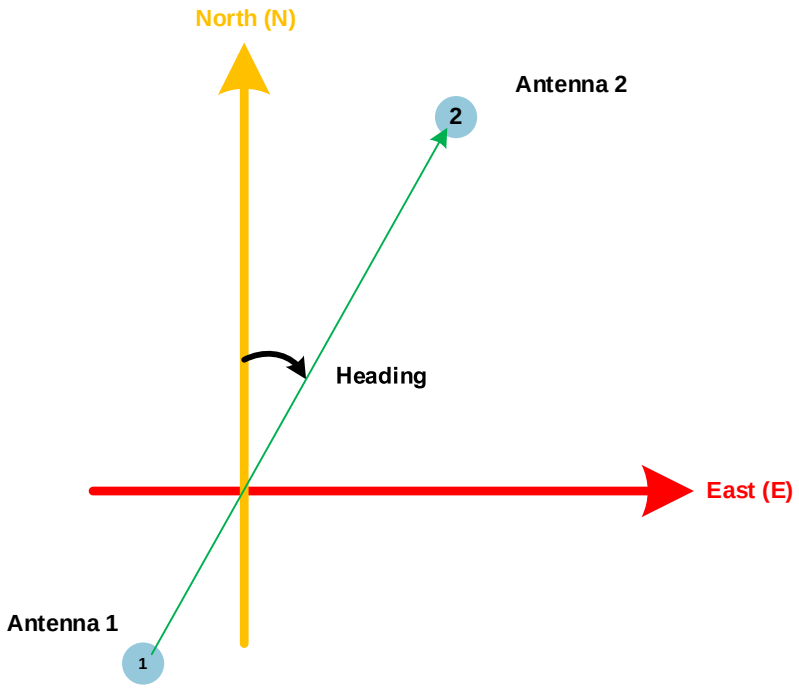

Figure 2: Heading Angle

The heading angle accuracy is related to the baseline length. Longer baselines result in higher heading angle accuracy. The corresponding relationship is illustrated in the following figure:

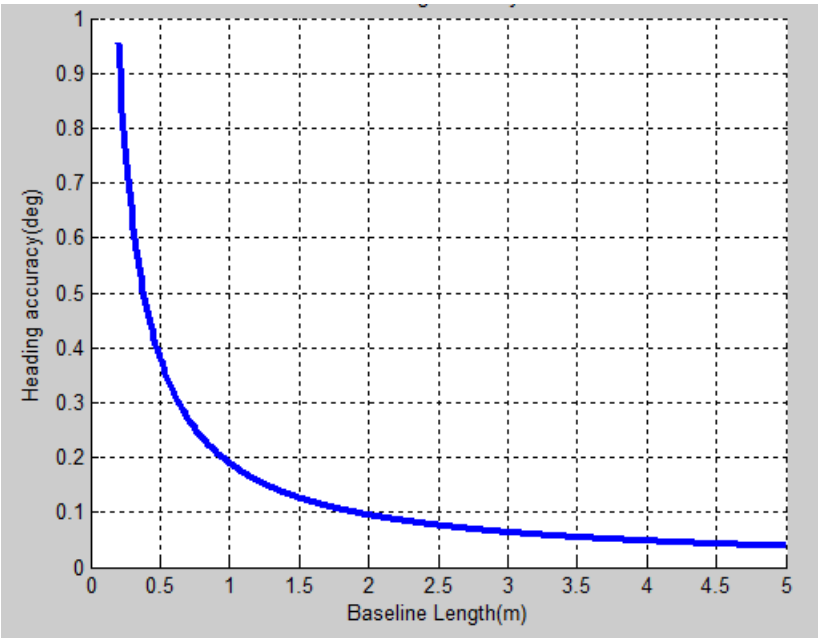

Figure 3: Relationship Between Heading Angle Accuracy and Baseline Length

NOTE

This heading angle is derived using dual antenna orientation, and it is different from the heading angle output in **RMC** messages.

3.2. Pitch

In the dual antenna setup, the pitch angle is referenced to the local Cartesian coordinate system (ENU). It is defined as the angle between the baseline vector (antenna 1 to antenna 2) and the horizontal plane, with the effective range of [-90, +90]. Positive values correspond to upward pitch, while negative values correspond to downward pitch. For details about the pitch angle output, see **PQTMTAR** messages in *document [2] protocol specification*.

The pitch angle is illustrated below:

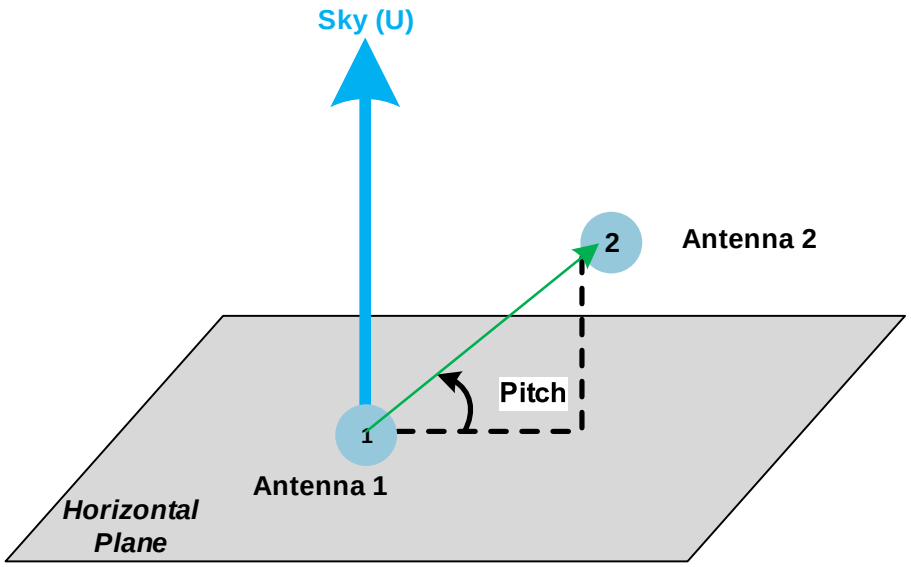

Figure 4: Pitch Angle

4 Standard Mounting

The LG580P series module features simple installation. To ensure that the module's output attitude is consistent with that of the carrier, the antennas must be parallel to the carrier plane, without relative movement between the antennas and the carrier, and their relative spatial positions must remain fixed to avoid errors caused by any displacement. The two full-band multi-system satellite antennas are connected (to ensure consistent performance, it is recommended to use two antennas of the same model and the same batch), and their signal reception environment must be good and consistent. Otherwise, it will affect orientation accuracy, or result in failure to output the orientation data.

The recommended mounting for GNSS antennas depends on the application. On drones, place the GNSS antennas on top of the drone to avoid obstructions and motor interference, as shown in the figure below:

Figure 5: Antenna Mounting – Drone

For mowers, install the GNSS antennas in an open, structurally unobstructed environment.

Figure 6: Antenna Mounting – Mower

On vehicles, install GNSS antennas on the same plane in a structurally unobstructed environment.

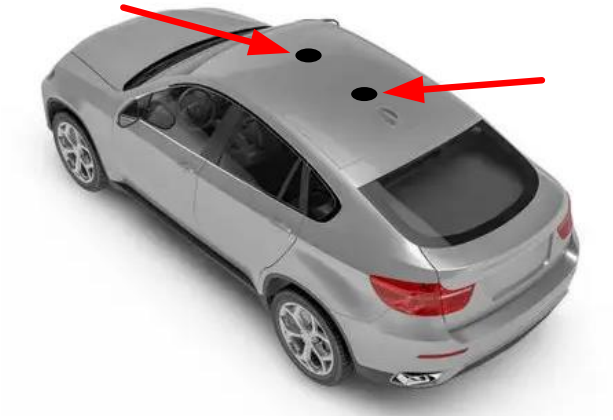

Figure 7: Antenna Mounting – Vehicle

5 Appendix References

Table 1: Related Documents

Document Name	
[1]	Quectel_LG580P(03)_Hardware_Design
[2]	Quectel_LG290P(03)&LGx80P(03)_GNSS_Proocol_Specification

Table 2: Terms and Abbreviations

Abbreviation	Description
BDS	BeiDou Navigation Satellite System
ENU	East North Up
Galileo	Galileo Satellite Navigation System (EU)
GLONASS	Global Navigation Satellite System (Russia)
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
NAVIC/IRNSS	Indian Regional Navigation Satellite System
QZSS	Quasi-Zenith Satellite System
RMC	Recommended Minimum Specific GNSS Data