ALIGN® Family of Heading Solutions

ALIGN Heading™ and ALIGN Relative Positioning™

1 Overview

This application note provides an overview of NovAtel's ALIGN family of heading solutions, including the ALIGN Heading and ALIGN Relative Positioning models. Receiver hardware setup and software configurations are also discussed.

Heading information can be logged from NovAtel's OEMV® receivers at a maximum rate of 10 Hz, or at a maximum of 20 Hz on OEM6™ receivers. The Master receiver position accuracy can be enhanced by adding OmniSTAR corrections or SBAS tracking, or by adding an optional RTK static base station.

2 ALIGN Models

There are two available ALIGN models:

ALIGN Heading provides angular heading and pitch measurements. The following logs are available at any free port:

Logs	Description
MASTERPOS	Position of the ALIGN Master
HEADING	Heading and pitch angles
HEADING2	Heading and pitch angles with ROVERID
GPHDT	NMEA heading angle
ALIGNDOP	DOP of heading computation

Table 1: ALIGN Heading Logs

ALIGN Relative Positioning provides angular heading and pitch measurements, precise relative positioning measurement and relative baseline information with centimetre level accuracy. The following logs are available at any free port:

Logs	Description
MASTERPOS	Position of the ALIGN Master
ROVERPOS	Position of ALIGN Rover relative to the Master
ALIGNBSLNXYZ	ECEF vector between Rover and Master
ALIGNBSLNENU	Easting. Northing. Altitude vector between Rover and Master
HEADING	Heading and pitch angles
HEADING2	Heading and pitch angles with ROVERID
GPHDT	NMEA heading angle
ALIGNDOP	DOP of heading computation

Table 2: ALIGN Relative Positioning Logs

2.1 ALIGN Setup (For both models)

ALIGN functionality requires one receiver to operate as a Master receiver to send information to a Rover receiver.

Any OEMV or OEM6 receiver model with a minimum of L1 & GLONASS tracking capability can act as a Master receiver. Receiver features may be limited if basic Position Velocity Time (PVT) only models are used (i.e., N1G). See Appendix A for more information.

A typical ALIGN setup includes:

- Two NovAtel OEMV receivers[1] or
- Two NovAtel OEM6 receivers [1] or
- A combination of OEMV and OEM6[1]
- Two GPS+GLONASS capable antennas
- Data communication link between both receivers[2]. Communication examples include a radio, modem or serial cable.

[1] Running ALIGN enabled receiver model and firmware version.

[2] For data rates of 10 Hz or higher, set the communication rate at 230400 bits per second between the two receivers.

3 Use Cases

A variety of symbols are used in this application note to depict ALIGN output symbols. The Meaning of each symbol is given below.

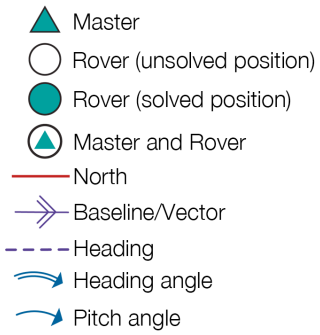

Table 3: Use Case Legend

3.1 **Use Case 1:** Fixed Antenna Distance between Master and Rover Receivers on One Platform (ALIGN Heading)

This use case requires one Master and one Rover receiver. Figure 1 provides an example where the Master and Rover receivers are located on the same vehicle, and the two antennas are located at a fixed distance from one another. Relative heading and pitch are computed with respect to the Master receiver.

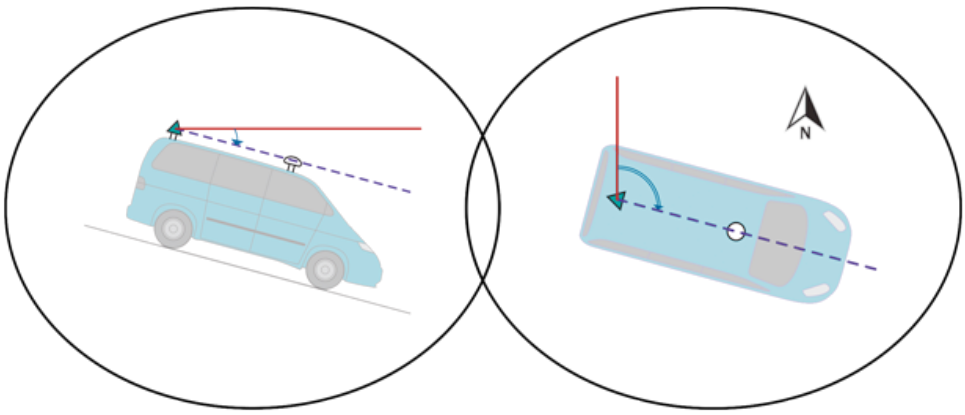

Figure 1: Heading from two receivers on one vehicle

In this setup, connect COM2 of the Rover receiver to one of the available COM ports on the Master receiver using a NULL modem cable. There are two possible ways to set up this use case. One uses ALIGN's plug and play functionality and another requires manual receiver configuration.

Plug and Play with Cable[3]:

1. Connect COM2 of the Rover receiver to an available COM port on the Master receiver using a NULL modem cable
2. Initiate ALIGN from the Rover receiver by entering the following command:
   ALIGNAUTOMATION ENABLE COM2 230400
3. To access heading data, ALIGN logs can be logged at either the ALIGN Master or Rover.

Manual Configuration with Cables:

You can also manually configure communication between the Master and Rover receivers.

1. Connect any COM port on the Master receiver (ie. COM2) to any COM port on the Rover receiver (ie. COM2) using a NULL modem cable
2. Issue the following commands to the Master:

   MOVINGBASESTATION ENABLE

   INTERFACEMODE COM2 NOVATEL RTCA OFF

   COM COM2 230400 N 8 1 N OFF ON

   LOG COM2 RTCAOBS3 ONTIME 0.1

   LOG COM2 RTCAREFEXT ONTIME 0.1
3. Issue the following commands to the Rover

   INTERFACEMODE COM2 RTCA NOVATEL OFF

   COM COM2 230400 N 8 1 N OFF ON

   LOG COM2 HEADINGEXTB ONNEW
4. To access heading data, ALIGN logs can be logged at either the ALIGN master or rover.

3.2 **Use Case 2:** Master and Rover Receivers on Separate Moving Platforms (ALIGN Relative Positioning)

This use case requires one Master and one Rover receiver. Figure 2 illustrates the Master receiver on the vessel and the Rover receiver located on the fighter jet. Relative heading, pitch, baseline length and Rover positions are computed with respect to the Master receiver.

[3] To use plug and play, the Master and Rover receivers must be running firmware versions 3.900/OEM060100RN0000 or higher.

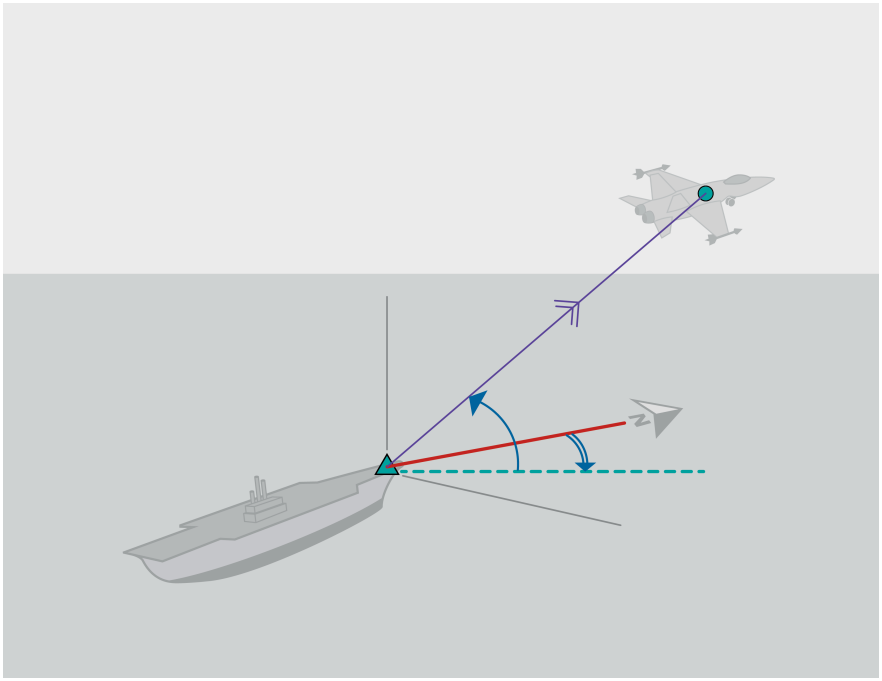

Figure 2: Heading from two receivers on separate platforms

There are two possible ways to set up this use case. One uses ALIGN's plug and play functionality and another requires manual receiver configuration.

Plug and Play with Wireless Data Link[3]:

1. Configure the wireless data links for two-way communication, using the same baud rate (i.e., 230400bps)
2. Connect one wireless data link to an available COM port on the Master receiver.
3. Configure the Master receiver COM port to communicate at the same baud rate as the wireless data link using the COM command:
   COM COM2 230400
4. Connect the other wireless data link to COM2 of the Rover receiver.
5. Initiate ALIGN from the Rover receiver by entering the following command:
   ALIGNAUTOMATION ENABLE COM2 230400
6. To access heading and relative positioning data, ALIGN logs can be logged at either the ALIGN Master or Rover.

Manual Configuration with Wireless Data Link:

1. Configure the wireless data links for two-way communication, using the same baud rate (i.e., 230400bps)
2. Connect one wireless data link to an available COM port on the Master receiver (i.e., COM2).
3. Configure the Master receiver to output RTCA corrections at the same baud rate as the wireless data link:

```
MOVINGBASESTATION ENABLE
INTERFACEMODE COM2 NOVATEL RTCA OFF
COM COM2 230400 N 8 1 N OFF ON
LOG COM2 RTCAOBS3 ONTIME 0.1
LOG COM2 RTCAREFEXT ONTIME 0.1
```

[3] To use plug and play, the Master and Rover receivers must be running firmware versions 3.900/OEM060100RN0000 or higher.

4. Connect the other wireless data link to an available COM port (i.e., COM2) on the Rover receiver.
5. Configure COM2 of the Rover receiver to receive corrections and output heading information at the same baud rate as the wireless data link:
   INTERFACEMODE COM2 RTCA NOVATEL OFF
   COM COM2 230400 N 8 1 N OFF ON
   LOG COM2 HEADINGEXTB ONNEW
6. To access heading and relative positioning data, ALIGN logs can be logged at either the ALIGN master or rover.

3.3 **Use Case 3:** Daisy-Chain ALIGN setup (ALIGN Heading)

This use case illustrates multiple Master and Rover receivers in a daisy chain type setup. There is one main Master receiver on one platform as a moving reference, with multiple Rovers on other platforms. Each Rover can act as the Master receiver for the next Rover receiver by transmitting ALIGN RTCA corrections to the next receiver.

Figure 3 illustrates the main Master receiver on a seismic research vessel. The Rover receivers are located in a series of buoys, with each Rover receiver acting as a Master for the next receiver. Relative heading and pitch are computed with respect to its linking Master receiver. The HEADING2 log is useful in this kind of configuration.

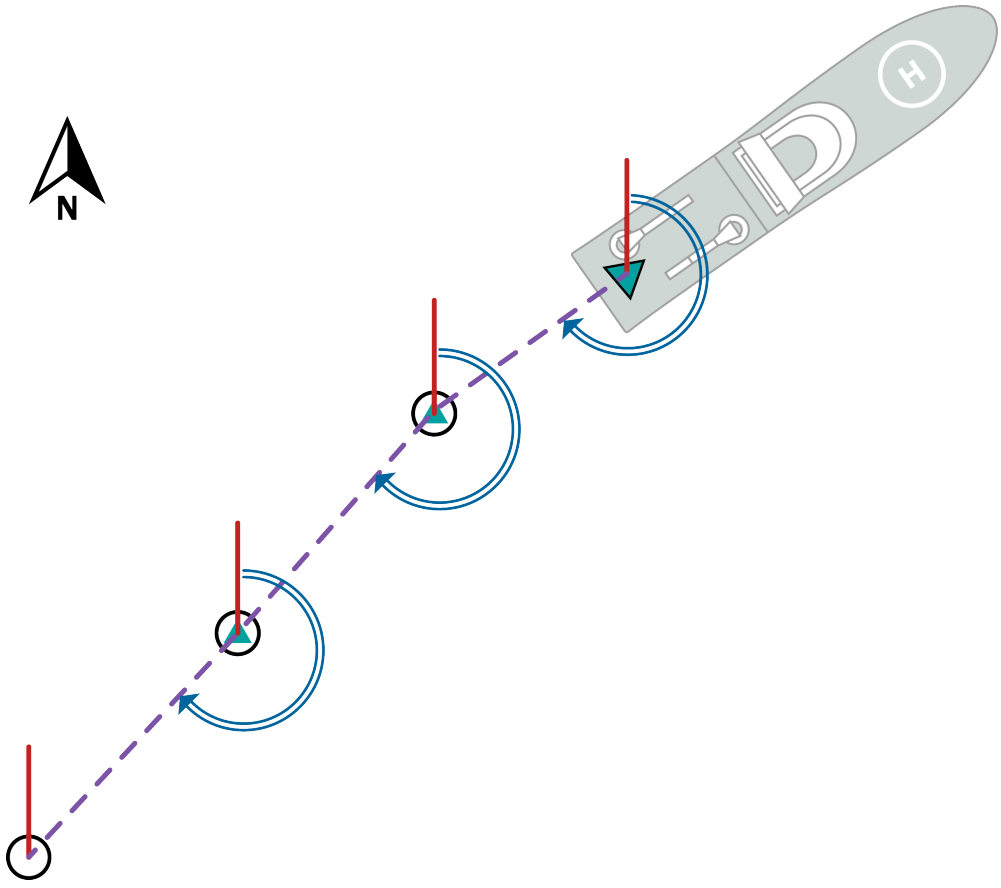

Figure 3: Use Case 3 – Daisy-Chain ALIGN setup

Plug and Play with Wireless Data Link[3]:

1. Configure the wireless data links between each master and rover pair for two-way communication, using the same baud rate (i.e., 230400bps)

2. Connect one wireless data link to an available COM (i.e., COM2) port on the first Master receiver.
3. Configure the Master receiver COM port to communicate at the same baud rate as the wireless data link using the COM command:

   COM COM2 230400
4. Connect the other wireless data link to COM2 of the Rover receiver.
5. Configure COM1 of the Rover receiver to send corrections to the next Rover station. Connect a wireless data link to COM1.
6. Set the Rover's COM1 baud rate to be the same as the wireless data link:

   COM COM1 230400
7. Configure COM2 of the next Rover receiver to receive corrections as described in Step 5
8. Repeat steps 4 through 8 until all receivers have been configured
9. Initiate ALIGN by entering the following command to each Rover receiver:

   ALIGNAUTOMATION ENABLE COM2 230400 10 OFF
10. To access heading and relative positioning data, ALIGN logs must be logged at each ALIGN rover.

Manual Configuration with Wireless Data Link:

1. Configure the wireless data links between each master and rover pair for two-way communication, using the same baud rate (i.e., 230400bps)
2. Connect one wireless data link to an available COM port (i.e., COM2) on the first Master receiver.
3. Configure the Master receiver COM port to output corrections at the same baud rate as the wireless data link:
   MOVINGBASESTATION ENABLE
   INTERFACEMODE COM2 NOVATEL RTCA OFF
   COM COM2 230400 N 8 1 N OFF ON
   LOG COM2 RTCAOBS3 ONTIME 0.1
   LOG COM2 RTCAREFEXT ONTIME 0.1
4. Connect the other wireless data link to COM2 of the Rover receiver.
5. Configure COM2 of the Rover receiver to receive corrections at the same baud rate as the wireless data link:
   INTERFACEMODE COM2 RTCA NOVATEL OFF
   COM COM2 230400 N 8 1 N OFF ON
6. Configure COM1 of the Rover receiver to send corrections to the next Rover station. Connect a wireless data link to COM1.
7. Set the Rover's COM1 to output corrections at the same baud rate as the wireless data link:
   MOVINGBASESTATION ENABLE
   INTERFACEMODE COM1 NOVATEL RTCA OFF
   COM COM1 230400 N 8 1 N OFF ON
   LOG COM1 RTCAOBS3 ONTIME 0.1
   LOG COM1 RTCAREFEXT ONTIME 0.1
8. Configure COM2 of the next Rover receiver to receive corrections as described in Steps 4 and 5.
9. Repeat steps 4 through 8 until all receivers have been configured
10. To access heading data, ALIGN logs must be logged at each ALIGN Rover.

[3] To use plug and play, the Master and Rover receivers must be running firmware versions 3.900/OEM060100RN0000 or higher.

3.4 Use Case 4: Single Master with Multiple Rovers ALIGN setup (ALIGN Relative Positioning)

This use case demonstrates one ALIGN Master and multiple Rover receivers. There is one main Master receiver set up on one platform as a moving reference, with multiple Rovers set up on other platforms.

Figure 4 illustrates the main Master receiver on a seismic research vessel. The Rover receivers are located in a series of buoys. Relative heading, pitch, baseline length and Rover positions are computed with respect to the Master receiver.

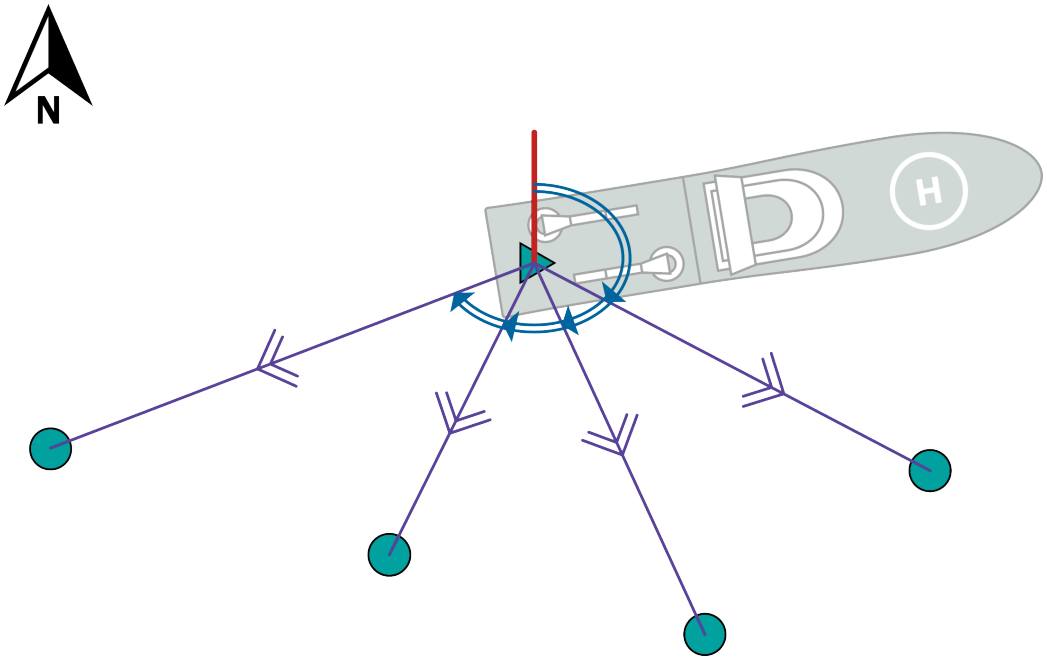

Figure 4: Single Master with Multiple Rovers ALIGN setup

Manual Configuration with Wireless Data Link:

1. Configure the wireless data links for two-way communication, using the same baud rate (i.e., 230400bps)
2. Connect one wireless data link to an available COM port on the Master receiver (i.e., COM2).
3. Configure the Master receiver to output RTCA corrections at the same baud rate as the wireless data link:
   MOVINGBASESTATION ENABLE
   INTERFACEMODE COM2 NOVATEL RTCA OFF
   COM COM2 230400 N 8 1 N OFF ON
   LOG COM2 RTCAOBS3 ONTIME 0.1
   LOG COM2 RTCAREFEXT ONTIME 0.1
4. Connect the other wireless data link to an available COM port on the Rover receiver.
5. Configure COM2 of the Rover receiver to receive corrections and output heading information at the same baud rate as the wireless data link:
   INTERFACEMODE COM2 RTCA NOVATEL OFF
   COM COM2 230400 N 8 1 N OFF ON
6. Repeat Steps 4 and 5 until all Rover receivers are configured
7. To access heading and relative positioning data, ALIGN logs must be logged at each ALIGN rover.

4 Appendix A Model Compatibility Chart [4] [5]

Master Receiver Model	Rover Receiver Model	Master *ALIGN* Logs	Rover *ALIGN* Logs
PVT Only Models (ie. NIG, OEM6-G2S-00G-0TN)	Heading Only Models (ie. Z1GZ, Z12GZ)	MASTERPOS, HEADING, HEADING2, GPHDT,	MASTERPOS, HEADING, HEADING2, GPHDT, ALIGNDOP
PVT Only Models (ie. N1G)	Heading with Raw Data (ie. L1GZ, L12GZ)	MASTERPOS, HEADING, HEADING2, GPHDT	MASTERPOS, HEADING, HEADING2, GPHDT, ALIGNDOP, RANGE
PVT Only Models (ie. N1G)	Relative Positioning with Raw Data (ie. L1GYZ, L12GYZ)	MASTERPOS, ROVERPOS, HEADING, HEADING2, GPHDT, ALIGNBSLNXYZ, ALIGNBSLNENU	MASTERPOS, ROVERPOS, HEADING, HEADING2, GPHDT, ALIGNBSLNXYZ, ALIGNBSLNENU, ALIGNDOP, RANGE
Raw data Models (ie. L12LV, L12LGRV)	Heading Only Models (ie. Z1GZ, Z12GZ)	MASTERPOS, HEADING, HEADING2 GPHDT, RANGE	MASTERPOS, HEADING, HEADING2, GPHDT, ALIGNDOP
Raw data Models (ie. L12LV, L12LGRV)	Heading with Raw Data (ie. L1GZ, L12GZ)	MASTERPOS, HEADING, HEADING2, GPHDT, RANGE	MASTERPOS, HEADING, HEADING2, GPHDT, ALIGNDOP, RANGE
Raw data Models (ie. L12LV, L12LGRV)	Relative Positioning with Raw Data (ie. L1GYZ, L12GYZ)	MASTERPOS, ROVERPOS, HEADING, HEADING2, GPHDT, ALIGNBSLNXYZ, ALIGNBSLNENU, RANGE	MASTERPOS, ROVERPOS, HEADING, HEADING2, GPHDT, ALIGNBSLNXYZ, ALIGNBSLNENU, ALIGNDOP, RANGE

[4] Refer to the NovAtel product model list for complete list of ALIGN capable receivers and models.

[5] Refer to Table 1 and Table 2 for ALIGN-related commands and logs description. Full explanation of the commands and logs can be located in the *OEMV/OEM6 Family Firmware Reference Manual.*

5 Final Points

If you require any further information regarding the topics covered within this application, contact:

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