Firmware 3.700 *ALIGN*™ Release With Y-Model Feature:

Overview and Setup Guide

1 Introduction

This application note provides an overview of the new ***ALIGN*** feature enhancements supported by the Y-model, as well as the receiver hardware setup and the software configuration.

Appendix A contains updated information on the commands and logs regarding the new ***ALIGN*** logs and commands.

2 New Y-Model Features

The Y-model can output positions of the Master and the Rover antennas at both the Master and Rover receivers; the corresponding logs are MASTERPOS and ROVERPOS (see Appendix A for details on logs). Section A.2 provides the necessary commands to configure and use the new features with this model.

> **Important Note**: **The ROVERPOS position and HEADING accuracy is relative to the MASTERPOS**. If the MASTERPOS is of RT-2 accuracy then the ROVERPOS and HEADING will be of RT-2 accuracy with respect to the Master receiver. The maximum ROVERPOS output rate is at 10Hz. The BESTPOS solution type at the ROVER is single point and has a 20Hz output rate.

3 About *ALIGN*

NovAtel's ***ALIGN*** technology generates distance and bearing information between a "Master" and "Rover" receiver. For the Y-model features, it can output position information of the Master and Rover antennas through the new MASTERPOS and ROVERPOS logs. ***ALIGN*** is useful for customers wanting to know the relative directional heading of a vessel/body, separation heading between two vessels/bodies, or heading information with moving base and pointing applications. Heading applications can be applied over various markets, including machine control, unmanned vehicles, marine, and agriculture.

Note: The Y-model currently supports a maximum 10Hz output rate for HEADING, MASTERPOS and ROVERPOS logs.

4 Minimum Equipment Required

The following is a minimum equipment list required for the heading setup:

- 2 x OEMV GPS receivers (OEMV family receiver models)

  Note: The Master and Rover receiver must have firmware version 3.700 and the ***ALIGN*** Y-model feature enabled Rover receiver model.

- 2 x GPS + GLONASS antenna (L-band functionality optional)
- Communication links (not supplied by NovAtel) between receivers. Examples include a radio, modem or serial cable.

  Note: You need to provide a data link between the two NovAtel receivers in order to receive corrections. For the HEADING, MASTERPOS, and ROVERPOS logs to be logged at a frequency of 10Hz, it is recommended to set the communication rate at 230400 bits per second between the two receivers.

5 *ALIGN* Accuracy Specifications

ALIGN offers the following accuracy specifications:

Table 1: *ALIGN* Fixed Heading RMS Accuracy

	0.5m Baseline	1m Baseline	2m Baseline	10m Baseline
Single Frequency – Fixed Heading Accuracy	1.6 degrees	0.8 degrees	0.4 degrees	0.08 degrees
Dual Frequency - Fixed Heading Accuracy	1.2 degrees	0.6 degrees	0.3 degrees	0.06 degrees

Note 1: The heading accuracy is not dependant on the position accuracy of the Master receiver; however heading accuracy over longer baseline lengths is dependent on environmental factors. It is important to note that a fixed heading is required to achieve the accuracy listed in Table 2.

Note 2: For Y-model users, the absolute accuracy of the ROVERPOS log depends on the absolute accuracy of the Master receiver. If MASTERPOS and HEADING log is of RTK accuracy, the ROVERPOS is also of RTK accuracy with respect to the Master receiver position.

6 Use Cases

6.1 User Case #1: Fixed Antenna Distance between Master and Rover Receivers on One Vehicle

The setup for this use case requires one Master and one Rover receiver mounted on the same platform. An optional RTK base station can also be setup to improve the position accuracy of the Master receiver.

Figure 1 illustrates a stationary base station broadcasting RTK corrections to the Master receiver on one vehicle. The Master and Rover receivers are located on the same vehicle and the two antenna locations are at a fixed distance from one another; relative heading is computed at the Rover end. To output HEADING, MASTERPOS and ROVERPOS on the Rover receiver, Master sends RTCAOBS2, RTCAREF and RTCAREFEXT message to Rover. On the Y-model Rover, the HEADINGEXTB message is broadcasted back to the Master receiver to output the same three logs at the Master receiver.

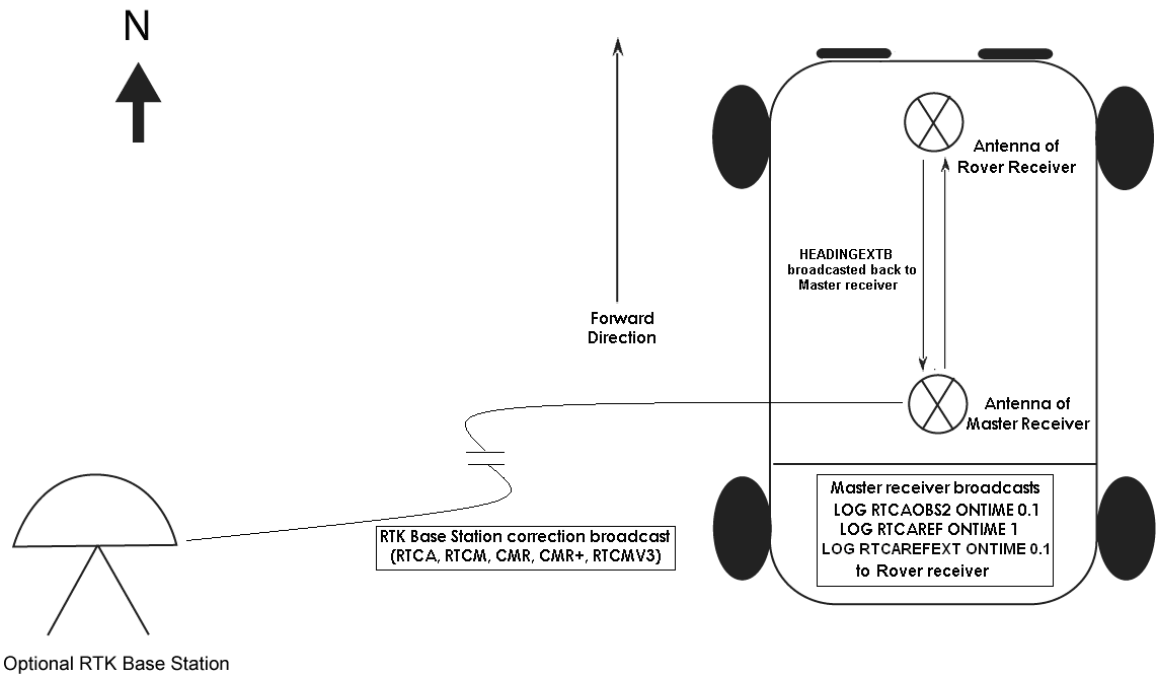

Figure 1: Use Case #1 – Bearing from two receivers on one vehicle

Table 2 provides the commands and logs set up for the Y-model feature in use case #1.

Table 2: Use Case #1 Sample Setup Logs for the Y-model Feature

Receiver requirement

	Master Receiver	Rover Receiver
Marketing Model	ALIGN Master	ALIGN Rover
Sample Engineering Model	L1GV	L1GYZ
Firmware Version	3.700	3.700

Features	HEADING log of the rover relative to the Master GPHDT - NMEA format of the HEADING log MASTERPOS log - position of the Master ROVERPOS log - Rover position relative to the Master	HEADING log of the rover relative to the Master GPHDT - NMEA format of the HEADING log MASTERPOS log - position of the Master output at the rover ROVERPOS log - position of the Rover relative to the Master at the Rover
Setup	movingbasestation enable com com2 230400 n 8 1 n off off interfacemode com2 novatel rtca off log com2 rtcaobs2 ontime 0.1 log com2 rtcarefext ontime 0.1 log com2 rtcaref ontime 1 log headinga onchanged (optional) log gphdt onchanged (optional) log masterposa onchanged (optional) log roverposa onchanged (optional)	com com2 230400 n 8 1 n off off interfacemode com2 rtca novatel off hdtoutthreshold 1.0 (optional - when request gphdt) log com2 headingextb onchanged log headinga onchanged log gphdt onchanged (optional) log masterposa onchanged (optional) log roverposa onchanged (optional)

Note:
- Assuming that COM2 is used for data transmission between Master and Rover
- Due to the messages being transmitted between Master and Rover, the recommended baud rate for the com port is 230400

6.2 Use Case #2: Master and Rover Receivers on Separate Vehicles

The setup for this use case requires one Master and one Rover receiver. An optional base station can be setup to broadcast RTK corrections to the Master for a more accurate position solution at the Master. An example is provided in Figure 2 where an RTK base station is set up to transmit RTCA, RTCM, RTCMV3 or CMR correction to the Master. The Master receiver is setup on one vehicle as a moving reference with a Rover setup on another vehicle. The Master receiver transmits RTCA messages to the Rovers; relative heading is computed at the Rover end.

Figure 2 illustrates a stationary base station broadcasting RTK corrections to the Master receiver on one vehicle. The Rover receiver is located on another vehicle. Relative heading is computed and output at the Rover with respect to the Master receiver. On the Y-model Rover, the HEADINGEXTB message is broadcasted back to the Master receiver where the heading and position values can be logged as well.

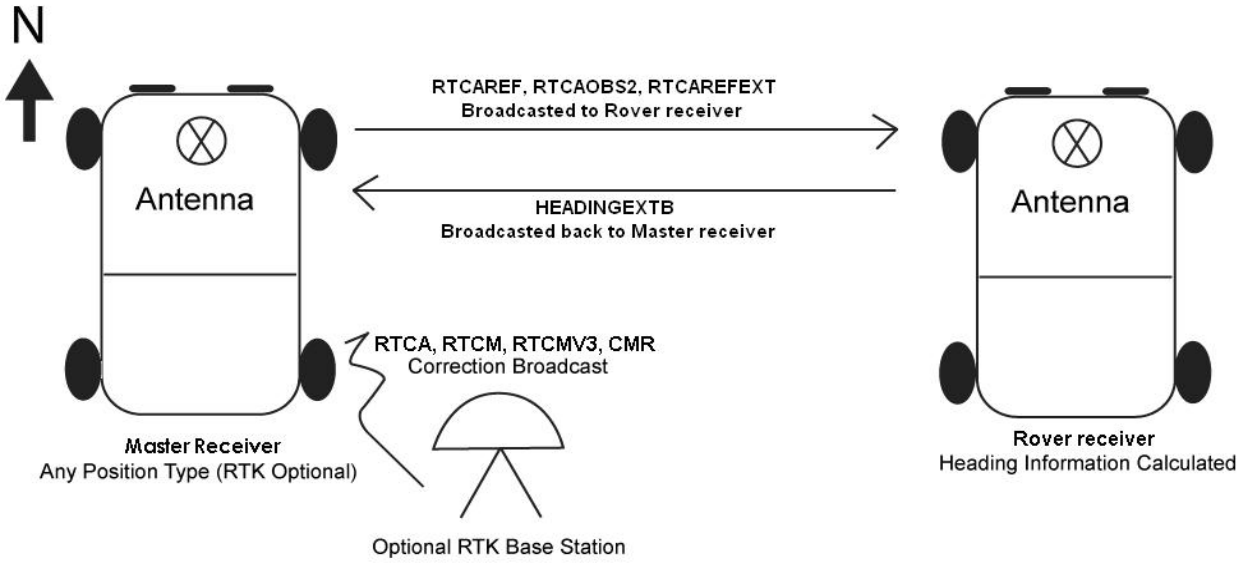

Figure 2: Use Case #2 – Bearing from two receivers on separate vehicles/vessel

Table 2 provides the commands and logs set up in use case #2.

Table 3: Use Case #2 Sample Setup Logs

Receiver requirement

	Master Receiver	Rover Receiver
Marketing Model	Master	AL1GN Rover
Sample Engineering Model	L1GV	L1GYZ
Firmware Version	3.700	3.700

Features	HEADING log GPHDT log MASTERPOS log ROVERPOS log	HEADING log GPHDT log MASTERPOS log ROVERPOS log
Setup	movingbasestation enable com com2 230400 n 8 1 n off off interfacemode com2 novatel rtca off log com2 rtcaobs2 ontime 0.1 log com2 rtcarefext ontime 0.1 log com2 rtcaref ontime 1 log headinga onchanged (optional) log gphdt onchanged (optional) log masterposa onchanged (optional) log roverposa onchanged (optional)	com com2 230400 n 8 1 n off off interfacemode com2 rtca novatel off hdtoutthreshold 1.0 (optional - when request gphdt) log com2 headingextb onchanged log headinga onchanged log gphdt onchanged (optional) log masterposa onchanged (optional) log roverposa onchanged (optional)

Note:

- Assuming that COM2 is used for data transmission between Master and Rover

- Due to the messages being transmitted between Master and Rover, the recommended baud rate for the com port is 230400

APPENDIX A

A.1 RTCA Background

Only RTCA differential corrections for the ***ALIGN*** feature are supported by using the RTCAOBS2 and RTCAREF message types. By sending both RTCAOBS2 and RTCAREF messages from the master receiver to the rover, this enables the heading log to be computed at the rover receiver. Both messages fall under NovAtel's proprietary RTCA Standard Type 7 binary-format messages.

Note: For further information on RTCA Standard messages, refer to the *Minimum Aviation System Performance Standards – DGNSS Instrument Approach System: Special Category I (SCAT-I),* Document No. RTCA/DO-217 (April 19, 1995); Appx A, Pg 21.

A.2 ***ALIGN*** Y-Model Commands and Logs

A.2.1 HDTOUTTHRESHOLD Control GPHDT Log Output Command

This command controls the output of the NMEA GPHDT heading log. It sets a heading standard deviation threshold. Only heading information with a standard deviation less than this threshold can be output into a GPHDT message.

Abbreviated ASCII Syntax: **Message ID: 1062**

HDTOUTTHRESHOLD thresh

Factory Default:

hdtoutthreshold 2.0

Field #	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	HDTOUT-THRESHOLD header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	thresh	0.0 - 180.0		Heading standard deviation threshold (degrees)	Float	4	H

A.2.2 MASTERPOS/ROVERPOS Log

These logs display the Master / Rover position.

You must have a Y-model capable Rover receiver to use these logs.

Note: The log can be output at YZ Model Rover only if it is receiving the RTCAREFEXT message from the Master. The log can be output at any Master if the Master is receiving HEADINGEXTA or HEADINGEXTB from the YZ Rover.

Message ID: **1051 (MASTERPOS)**

Message ID: **1052 (ROVERPOS)**

Log Type: **ASynch**

Recommended Input 1 (MASTERPOS):

log masterposa onchanged

Example 1:

#MASTERPOSA,COM1,0,21.5,FINESTEERING,1544,340322.000,00000008,5009,4655;
SOL_COMPUTED,NARROW_INT,51.11604599076,-114.03855412002,1055.7756,-
16.9000,WGS84,0.0090,0.0086,0.0143,"AAAA",0.0,0.0,13,13,13,12,0,0,0,0*a72e8d3f

Recommended Input 2 (ROVERPOS):

log roverposa onchanged

Example 2:

#ROVERPOSA,COM1,0,21.5,FINESTEERING,1544,340322.000,00000008,7453,4655;
SOL_COMPUTED,NARROW_INT,51.11605565964,-114.03854655975,1055.8559,-
16.9000,WGS84,0.0130,0.0122,0.0206,"RRRR",0.0,0.0,13,12,12,11,0,0,0,0*635b3a1c

Note: Asynchronous logs, such as MASTERPOS and ROVERPOS, should only be logged ONCHANGED. Otherwise, the most current data is not output when it is available. This is especially true of the ONTIME trigger, which may cause inaccurate time tags to result.

Field #	Field Type	Field Description	Binary Format	Binary Bytes	Binary Offset
1	MASTERPOS/ROVERPOS header	Log Header		H	0
2	sol stat	Solution Status	Enum	4	H
3	pos type	Position Type	Enum	4	H+4
4	lat	Master/Rover WGS84 Latitude in degrees	Double	8	H+8
5	long	Master/Rover WGS84 Longitude in degrees	Double	8	H+16
6	hgt	Master/Rover MSL Height in metres	Double	8	H+24
7	undulation	Undulation in metres	Float	4	H+32
8	datum id#	WGS84 (default)	Enum	4	H+36
9	lat σ	Latitude Std in metres	Float	4	H+40
10	long σ	Longitude Std in metres	Float	4	H+44
11	hgt σ	Height Std in metres	Float	4	H+48
12	stn id	Receiver ID (currently in ROVERPOS, it is defaulted at "RRRR") MASTERPOS ID can be set using the DGPSTXID command.	Char[4]	4	H+52
13	Reserved		Float	4	H+56
14	Reserved		Float	4	H+60
15	#SVs	Number of satellites tracked	Uchar	1	H+64
16	#solnSVs	Number of satellites in solution	Uchar	1	H+65
17	#obs	Number of satellites above elevation mask angle	Uchar	1	H+66
18	#multi	Number of satellites above elevation mask angle with L2	Uchar	1	H+67
19	Reserved		Uchar	1	H+68
20	Reserved		Uchar	1	H+69
21	Reserved		Uchar	1	H+70
22	Reserved		Uchar	1	H+71
23	xxxx	32-bit CRC (ASCII and Binary only)	HEX	1	H+72
24	[CR][LF]	Sentence Terminator (ASCII only)	-	-	-

A.2.3 GPHDT NMEA Heading Log

Actual vessel heading in degrees true (from true north).You can also set a standard deviation threshold for this log using the command HDTOUTTHRESHOLD.

You must have an ***ALIGN***-capable receiver to use this log.

Message ID: **1045**
Log Type: **ASynch**

Recommended Input:

log gphdt onchanged

Example:

```
$GPHDT,75.5554,T*45
```

Example 2 (Combined GPS and GLONASS, with NMEATALKER set to AUTO):

```
$GNHDT,75.5554,T*45
```

Field #	Structure	Field Description	Symbol	Example
1	$GPHDT	Log header		$GPHDT
2	heading	Heading in degrees	x.x	75.5554
3	True	Degrees True	T	T
4	*xx	Checksum	*hh	*36
5	[CR][LF]	Sentence terminator		[CR][LF]

A.2.4 HEADING Heading Information Log

The heading is the angle from True North of the base to rover vector in a clockwise direction.

Message ID: **971**
Log Type: **Asynch**

Recommended Input:

log headinga onchanged

ASCII Example:

```
#HEADINGA,COM1,0,77.0,FINESTEERING,1481,418557.000,00000000,3663,36137;
SOL_COMPUTED,L1_INT,5.913998127,75.566444397,-0.152066842,0.0,0.104981117,
0.222061798,"AAAA",13,10,10,0,0,00,0,11*481a5bab
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	HEADING header	Log header		H	0
2	sol stat	Solution status	Enum	4	H
3	pos type	Position type	Enum	4	H+4
4	length	Baseline length (0 to 3000 m)	Float	4	H+8
5	heading	Heading in degrees (0 to 359.999 degrees)	Float	4	H+12
6	pitch	Pitch (□90 degrees)	Float	4	H+16
7	Reserved		Float	4	H+20
8	hdg std dev	Heading standard deviation in degrees	Float	4	H+24
9	ptch std dev	Pitch standard deviation in degrees	Float	4	H+28
10	stn ID	Station ID string	Char[4]	4	H+32
11	#SVs	Number of observations tracked	Uchar	1	H+36
12	#solnSVs	Number of satellites in solution	Uchar	1	H+37
13	#obs	Number of satellites above the elevation mask angle	Uchar	1	H+38
14	#multi	Number of satellites above the mask angle with L2	Uchar	1	H+39
15	Reserved		Uchar	1	H+40
16	ext sol stat	Extended solution status	Uchar	1	H+41
17	Reserved		Uchar	1	H+42
18	sig mask	Signals used mask - if 0, signals used in solution are unknown	Uchar	1	H+43
19	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+44
20	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

7 Final Points

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

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