

ArNav Series

Software Update Log

Document



ARDICLABS

integrated sensing solutions

Ardic Teknoloji A.Ş.

April 2026

	ArNav Software Update Log	Document No	AL-CL-01
		Release Date	19.10.2023
		Revision No	00 (First Revision)
		Revision Date	-

Revision List

Firmware No	Date	Description
-	19.10.2023	Initial Release
1WWJS	26.10.2023	Filter Improvements
20000	30.11.2023	External Mag Support
20001	26.12.2023	Improvement when <i>InitAlignTime=0</i>
1WWJT-20002	30.01.2024	Barometer and magnetometer reading error fixed
2002B	11.11.2024	The barometer offset error has been corrected.
2002C	30.12.2024	The distortion in the IMU data that occurred after 4 hours of operation has been resolved.
2002D	26.02.2025	The orientation error that occurred at high speed has been fixed.
2002E	14.04.2025	The heading error in aerial vehicles has been corrected.
2002F	20.10.2025	GNSS position consistency check and IMU reinitialization feature have been added.
2002G	10.04.2026	A limiting feature has been added to the IMU data and heading angle values. The heading drift that occurred after the <i>SetHeading</i> command has been resolved.

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1. Software Update

1.1. P/N: ArNav M2GR-051293

Software No	Update No	Impact
ArNavM2GR051293_00A11702D11 0PPMA	First Revision	
ArNavM2GR051293_00A10101C01 1NN9T	0001	Recommendation
	0002	Recommendation
	0003	Critical
	0004	Recommendation
	0005	Critical
	0006	Recommendation
ArNavM2GR051293_00A10101C01 1NND5	0007	Critical
ArNavM2GR051293_00A10101C01 1WWJS	0008	Recommendation
	0009	Recommendation

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1.2. P/N: ArNav M2GR-051433

Software No	Update No	Impact
ArNavM2GR051433_00A10101C01 166NL	First Revision	-
ArNavM2GR051433_00A10101C01 1NNDC	0006	Recommendation
	0007	Critical
ArNavM2GR051433_00A10101C01 1WWJS	0008	Recommendation
	0009	Recommendation
ArNavM2GR051433_00A10901C01 20000	0010	Recommendation
ArNavM2GR051433_00A10901C01 20001	0011	Recommendation
ArNavM2GR051433_00A10101C01 1WWJT ArNavM2GR051433_00A10901C01 20002	0012	Critical
ArNavM2GR051433_00A10901C01 2002B	0013	Critical
ArNavM2GR051433_00A10901C01 2002C	0014	Critical
ArNavM2GR051433_00A10901C01 2002D	0015	Recommendation
ArNavM2GR051433_00A10901C01 2002E	0016	Recommendation
ArNavM2GR051433_00A10901C01 2002F	0017	Recommendation
ArNavM2GR051433_00A10901C01 2002G	0018	Recommendation

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1.3. P/N: ArNav M2HDR-051294

Software No	Update No	Impact
ArNavM2HDR051294_00A11702D11 077Z8	First Revision	
ArNavM2HDR051294_00A11702D11 1NN9O	0001	Recommendation
	0002	Recommendation
	0003	Critical
	0004	Recommendation
	0005	Critical
ArNavM2HDR051294_00A11702D11 1NND0	0006	Recommendation
	0007	Critical
ArNavM2HDR051294_00A11702D11 1WWJS	0008	Recommendation
	0009	Recommendation

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1.4. P/N: ArNav M2HDR-051434

Software No	Update No	Impact
ArNavM2HDR051434_00A11702D11 166NJ	First Revision	
ArNavM2HDR051434_00A11702D11 1NND9	0006	Recommendation
	0007	Critical
ArNavM2HDR051434_00A11702D11 1WWJS	0008	Recommendation
	0009	Recommendation
ArNavM2HDR051434_00A11F01D11 20000	0010	Recommendation
ArNavM2HDR051434_00A11F01D11 20001	0011	Recommendation
ArNavM2HDR051434_00A11702D11 1WWJT ArNavM2HDR051434_00A11F01D11 20002	0012	Critical
ArNavM2HDR051434_00A11F01D11 2002B	0013	Critical
ArNavM2GR051433_00A10901C01 2002C	0014	Critical
ArNavM2GR051433_00A10901C01 2002D	0015	Recommendation
ArNavM2GR051433_00A10901C01 2002E	0016	Recommendation
ArNavM2GR051433_00A10901C01 2002F	0017	Recommendation
ArNavM2GR051433_00A10901C01 2002G	0018	Recommendation

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2. Update No Descriptions

Update No	Description	Notes
0001	<i>TIME_UTC</i> and <i>LOCAL_GEOIDUNDULATION</i> messages have been added to Low Rate messages.	-
0002	The <i>LeverArm2</i> parameter has been deprecated in the system settings.	-
0003	The memory usage update has been made in the navigation filter.	-
0004	For system with low($<5^\circ$) beta, a north angle feed has been added for long, maneuver-free flights.	-
0005	Noise in the vertical channel velocity component has been reduced.	-
0006	<i>bodyCGLeverArm</i> has been activated.	-
0007	The initial parameters have been updated.	Software requires initialization.
0008	The mode transitions have been updated in the InitYawGNSS option.	-
0009	The system's INS mode filter measurements have been updated.	-
0010	The first version of the ArNavExtAid protocol has been added to the systems.	Beta-1 version for ArNavExtAid
0011	An improvement has been made in the orientation during the first 30 seconds after startup when <i>InitAlignTime=0</i> .	This update is valid for ArNavM2XX05143X products.
0012	In the case of GNSS loss and recovery, the rare issue of incorrect barometer and magnetometer readings has been fixed.	The detailed description given at section 3.1.
0013	The error where the barometer, after starting with an offset, would continue processing altitude values based on the unupdated offset when the GNSS connection was lost at different altitudes has been corrected.	The detailed description given at section 3.2.

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0014	The error in the IMU data that occurred when the system's operating time exceeded four hours has been resolved.	The detailed description given at section 3.3.			
0015	High-speed platform systems have resolved the heading distortion issue that occurred when the "Target Meas" setting was selected as "GNSS/INS HEADING."	The detailed description given at section 3.4.			
0016	The heading error that occurred in systems used in aerial vehicles when the "TargetMeas" setting was selected as either "GNSS/INS HEADING" or "GNSS/INS DOUBLE ANTENNA HEADING" has been corrected.	The detailed description given at section 3.5.			
0017	To monitor potential position and velocity degradations that may occur during GNSS band transitions and similar situations, a GNSS position consistency check feature has been added. In cases of short-term power interruptions, the issue of the IMU becoming unresponsive has been resolved by restarting the sensor.	The detailed description given at section 3.6.			
0018	IMU values have been limited. To monitor these limitations, the scope of the system status log message has been extended. The error in heading calculation above 180° has been corrected. When the heading is unavailable for a long period, the deviation in heading that occurred during GNSS/INS operation after setting the heading with the <i>SetHeading</i> command has been resolved.	The detailed description given at section 3.7.			

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3. Detailed Updates

3.1 0012: Incorrect Barometer and Magnetometer Data

The system continuously reads magnetometer and barometer data from the sensors and checks its consistency from the moment of startup. Once a stable GNSS signal is received, the system switches to GNSS/INS mode. If GNSS signal loss occurs, the system switches to INS mode.

During one of the flight tests, incorrect barometer and magnetometer data were observed. No degradation in position, speed, or orientation information was detected. Upon a detailed investigation, it was found that this error could occur, though rarely. When subjected to stress tests, it was observed that the likelihood of this error increases. Typically, this error can occur when the system switches rapidly between GNSS/INS mode, INS mode, and back to GNSS/INS mode. The system continuously checks the consistency of the magnetometer data and the status of the sensor. If any inconsistency is detected, it does not use the data. The barometer data is continuously checked to ensure it stays within a specific range. The primary cause of the degradation observed during the tests is an error that can occur during the process of checking the consistency of the magnetometer data and reading the sensor's status. The error is corrected after a soft-reset or hard-reset.

As a result;

Error Occurrence Condition:

- When GNSS/INS to INS and back to GNSS/INS transitions are repeated within less than 10 seconds, there is approximately a 10% chance of an error occurring.

Effects:

1- If the system is in GNSS/INS mode;

A- Barometer altitude, pressure, temperature, and magnetometer data show temporary degradation

B- Position, speed, and orientation data are not affected.

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2- If the system is in INS mode and "GNSS-BARO" is selected within "Target Measurement,"

A- Permanent degradation in position, speed, and orientation data

B- Temporary degradation in barometer altitude, pressure, temperature, and magnetometer data

3- If the system is in INS mode and "GNSS-BARO" is not selected within "Target Measurement,"

A- Position, speed, and orientation data are not affected.

B- Temporary degradation in barometer altitude, pressure, temperature, and magnetometer data.

4- If the system is in AHRS mode, permanent degradation in orientation data

is observed.

Solution:

To ensure the ArNavM2HDR051434_00A11702D111**WWJS** software is maintained with minimal changes, the evaluation of magnetometer data has been reduced from two points to a single point, and the ArNavM2HDR051434_00A11702D111**WWJT** version has been released with the error corrected.

The error has been fixed in the ArNavM2HDR051434_00A11F01D11**20002** software.

Recommended Update:

It is recommended that critical systems, which are frequently exposed to GNSS signal loss, update their software.

3.2 0013: Barometer Offset Error

When "GNSS-BARO" is selected within the "Target Measurement" system, the offset value on the barometer is calculated once the GNSS connection is established after system startup. As long as the GNSS connection is available, this offset value is continuously updated by the system based on changes in altitude.

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When there is a loss of GNSS connection, altitude information continues to be provided through barometric altitude data, supporting height measurements even when GNSS is unavailable.

A software-related error has occurred in updating the offset value. This error arises when the difference between the altitude at which the initial barometric offset value is taken and the altitude at which the GNSS signal is lost exceeds approximately 1000 feet. As a result of this error, sudden altitude changes occur when the GNSS signal is lost and then reacquired.

As a result;

Error Occurrence Condition:

- When "GNSS-BARO" is selected within "Target Measurement," sudden changes occur in the altitude channel if the difference between the altitude at which the GNSS signal is received, transitioning to GNSS/INS mode, and the altitude at which the GNSS signal is lost exceeds 1000 feet.

Effects:

1- If the system is in GNSS/INS mode and "GNSS BARO" is selected in the "Target Measurement" option, a persistent altitude change is observed in the event of a GNSS disconnection.

Solution:

This error in the ArNavM2HDR051434_00A11702D11**20002** and ArNavM2GR051433_00A10901C01**20002** software versions is addressed with a new release. The error has been fixed in the ArNavM2HDR051434_00A11F01D11**2002B** and ArNavM2GR051433_00A10901C01**2002B** software versions.

Recommended Update:

It is recommended that critical systems, which are frequently exposed to GNSS signal loss, update their software.

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3.3 0014: IMU Error

Persistent distortions in the IMU data have been observed in the ArNav M2HDR-051434 and ArNav M2GR-051433 systems operating for four hours or longer. This issue has been identified as software-related, with an error detected in the synchronization of the IMU sensor. As a result of this error, the system cannot reliably read IMU data during extended operating periods.

As a result;

Error Occurrence Condition:

- IMU sensor data corruption in ArNav systems operating for four hours or more.

Effects:

1- Corruption of the data read from the IMU sensor.

Solution:

This error in the ArNavM2HDR051434_00A11702D11**2002B** and ArNavM2GR051433_00A10901C01**2002B** software versions is addressed with a new release. The error has been fixed in the ArNavM2HDR051434_00A11F01D11**2002C** and ArNavM2GR051433_00A10901C01**2002C** software versions.

Recommended Update:

It is recommended that all the systems be updated.

3.4 0015: Heading Error

Heading distortions have been observed in the ArNav M2HDR-051434 and ArNav M2GR-051433 systems when the "TargetMeas" setting was selected as "GNSS/INS HEADING" and the systems were exposed to high maneuvers.

The "MiscGNSSHeadingAidRateThresh" setting has been enabled.

As a result;

Error Occurrence Condition:

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-Heading distortion under high maneuvering conditions when the "TargetMeas" setting is selected as "GNSS/INS HEADING."

Effects:

-Heading distortion of up to 3°.

Solution:

This error in the ArNavM2HDR051434_00A11702D11**2002C** and ArNavM2GR051433_00A10901C01**2002C** software versions is addressed with a new release. The error has been fixed in the ArNavM2HDR051434_00A11F01D11**2002D** and ArNavM2GR051433_00A10901C01**2002D** software versions. For the ArNavM2GR051433_00A10901C01**2002D** and ArNavM2HDR051434_00A11F01D11**2002D** firmware, the ArView application version should be 0.49b.

Recomended Update:

It is recommended that ArNav M2 systems with firmware versions 2002C and earlier be updated to the 2002D firmware. For this update, the ArView 0.49b application should be used.

3.5 0016: Heading Error Occured in Aerial Vehicles

In ArNavM2 systems used in aerial vehicles, heading distortions were observed when the "TargetMeas" setting was configured as either "GNSS/INS HEADING" or "GNSS/INS DOUBLE ANTENNA HEADING" under conditions of high roll/pitch angles. The source of the error was identified as the estimation of the north angle, and it has been corrected.

As a result;

Error Occurence Condition:

- ArNavM2 systems integrated into aerial vehicles with the "TargetMeas" setting configured as either "GNSS/INS HEADING" or "GNSS/INS DOUBLE ANTENNA HEADING".

Effects:

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- Heading distortion .

Solution:

This error in the ArNavM2HDR051434_00A11702D11**2002D** and ArNavM2GR051433_00A10901C01**2002D** software versions is addressed with a new release. The error has been fixed in the ArNavM2HDR051434_00A11F01D11**2002E** and ArNavM2GR051433_00A10901C01**2002E** software versions.

Recomended Update:

It is recommended that ArNav M2 systems with firmware versions 2002D and earlier be updated to the 2002E firmware.

3.6 0017: GNSS Position Consistency Check and IMU Reinitialization

During GNSS band transitions, degradations of up to 3 m/s in vertical velocity have been observed. To prevent this and similar issues, a consistency check feature has been added to the GNSS position solution.

It has been observed that the IMU sensor needs to be restarted when the system is powered with noisy or intermittent voltage. During this restart period, the system continues to generate angle, position, and velocity information using the last measured acceleration and rotation values; however, the outputs are marked as invalid. After approximately one second, the system recovers and begins displaying valid values again.

As a result;

Error Occurence Condition:

- GNSS position consistency is weak
- GNSS band transitions
- Short term IMU power interruptions

Effects:

- Degradations in position

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- Degradations in vertical velocity
- IMU measurement values remaining constant

Solution:

This error in the ArNavM2HDR051434_00A11702D11**2002E** and ArNavM2GR051433_00A10901C01**2002E** software versions is addressed with a new release. The error has been fixed in the ArNavM2HDR051434_00A11F01D11**2002F** and ArNavM2GR051433_00A10901C01**2002F** software versions.

Recommended Update:

It is recommended that ArNav M2 systems with firmware versions 2002E and earlier be updated to the 2002F firmware.

3.7 0017: IMU - Heading Limitation and Heading Drift

A – Limits have been defined for IMU data. For products with part numbers M2GR051433(A) and M2HDR051434(A), these limits are set to $\pm 40g$ for the accelerometer and $\pm 500^\circ/s$ for the gyroscope. When a measurement exceeding these limits is calculated or an invalid measurement occurs, the corresponding error information is added to the IMU status bits in the system_status_log message. In this context, the following status bits have been defined:

- accOutOfRange
- gyroOutOfRange
- accInvalidMeasurement
- gyroInvalidMeasurement

In this way, invalid measurements can be detected by the system and reported to the user. Detailed explanations can be found in the ArNav M2 Series User Manual. Additionally, precautions have been taken for other float and double data within the system to preserve navigation calculations.

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B – In heading measurements, values exceeding 180°, such as 180.0004°, were observed. To prevent this issue, the heading value has been limited to the range of ± 3.1415925 rad ($\pm 179.999991^\circ$).

C – When the system determines the heading using the *SetHeading* command, the resulting heading error was previously accumulated with the error generated in VRU mode. This caused the system to produce larger heading errors in a short time. In other words, when the system transitioned to GNSS/INS mode with *SetHeading*, faster degradation in heading was observed compared to the waiting duration in VRU mode. With this update, the heading measurement error after *SetHeading* has been corrected.

As a result;

Error Occurrence Condition:

- During 180° transitions
- When the heading is determined using the *SetHeading* command after the system has been operating in VRU mode for a long period

Effects:

- Decreased accuracy in the computed navigation solutions
- Heading drift of 0.0004 degrees
- Higher than normal deviation in heading

Solution:

This error in the ArNavM2HDR051434_00A11702D11**2002F** and ArNavM2GR051433_00A10901C01**2002F** software versions is addressed with a new release. The error has been fixed in the ArNavM2HDR051434_00A11F01D11**2002G** and ArNavM2GR051433_00A10901C01**2002G** software versions.

Recommended Update:

It is recommended that ArNav M2 systems with firmware versions 2002F and earlier be updated to the 2002G firmware.