

Spartacus Quick Start Guide Overview

The Spartacus GUI provides a simple way to set up and evaluate Sparton's line of navigation sensor modules, including:

- **DC-4E:** Navigation Sensor
- **GEDC-6E:** Gyro-Enhanced Navigation Sensor
- **AHRS-8:** Attitude Heading Reference System
- **IMU-10:** Inertial Measurement Unit
- **AHRS-M1:** Gyro-Enhanced Navigation Sensor
- **AHRS-M2:** Gyro-Enhanced, High Mag Accuracy Navigation Sensor

Spartacus System Setup

1. Ensure that all device interfaces are connected properly and the NDS-1/NDS-2 adapter board is connected to the PC.
2. **If running from ZIP:** Unzip the spartacus_v*.zip to a folder of your preference. Spartacus can be run directly from this folder, so installation in the traditional sense is not required. Specifically, administrator rights are not required to use this application.
If installing via EXE: Run spartacus_v_win_installer.exe. The setup wizard will walk you through the installation process. A folder will be created in whichever location you choose.
3. Open the spartacus.exe file that is located inside of the folder that was just created.
4. After the application opens, click on Spartacus Settings -> Serial Port Settings
5. You will be presented with a serial connection dialog (see Figure 1).

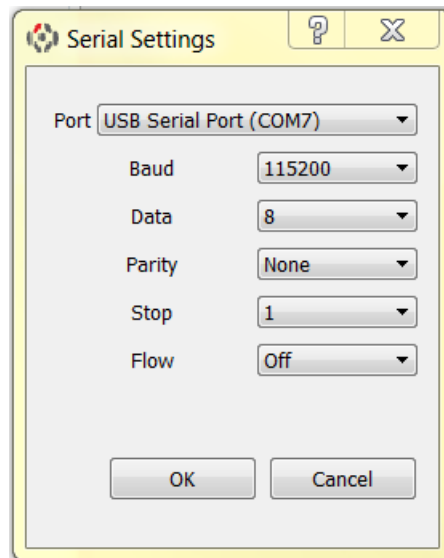


Figure 1: Serial Connection Dialog



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6. Ensure that the device's COM port is selected and click "OK."
 - a. The device's COM port may be identified using the Device Manager
7. In order to enable the various data views, select View → Data Tabs → Select All (Figure 2).

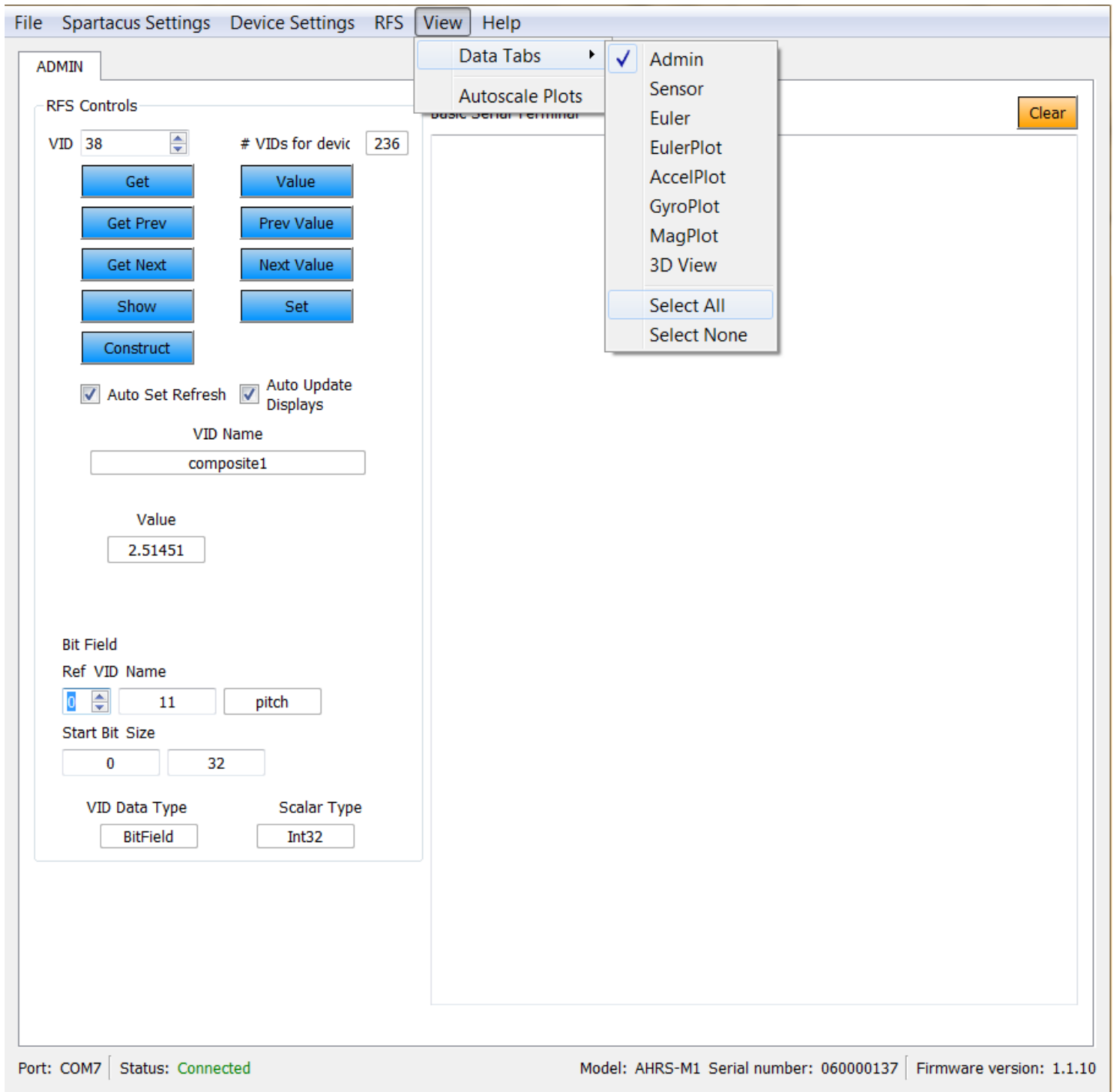


Figure 2: Enabling All Data Tabs

Guided Tour of the Spartacus Data Views

Not all tabs are available on all compass models. Please allow one second between tab changes to allow the device to be updated with the tab's data values.

Admin Tab

The Admin tab allows users to evaluate and manipulate the device VIDs using the Remote Function Select (RFS) Controls or Basic Terminal Window. RFS is a binary interface protocol used by Sparton's navigational and inertial sensors to communicate with hosts.

The screenshot shows the 'ADMIN' tab selected in the top navigation bar. The 'RFS Controls' panel on the left contains the following elements:

- VID: 0 (with up/down arrows)
- # VIDs for device: 236
- Buttons: Get, Value, Get Prev, Prev Value, Get Next, Next Value, Show, Set, Construct
- Checkboxes: ☒ Auto Set Refresh, ☒ Auto Update Displays
- VID Name: [Empty text box]
- Lower Limit: [Empty text box]
- Upper Limit: [Empty text box]
- VID Data Type: [Empty text box]
- Scalar Type: [Empty text box]

The 'Basic Serial Terminal' window on the right is empty, with a 'Clear' button in the top right corner.

Figure 3: Admin Tab

This tab uses static control buttons to navigate the device's Variable IDentifiers (VID) while getting and setting values. It also holds the serial terminal window from which the user can communicate with the device using supported text commands. The control buttons can be seen in Figure 4 and are explained in Table 1.



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Figure 4: Admin Tab Controls

Table 1: Admin Tab Control Details

Number	Name	Function
1	Get	Fetches current data for selected VID.
2	Get Prev	Decrements VID and fetches its current data.
3	Get Next	Increments VID and fetches its current data.
4	Show	Shows information for selected VID.
5	Construct	
6	Value	Fetches current value for of selected VID.
7	Prev Value	Decrements VID and fetches current value.
8	Next Value	Increments VID and fetches current value.
9	Set	Sets data for selected VID within device memory.

The terminal window can also be used to communicate with the connected device. There are three methods which a user can input commands into the terminal window.

- Type commands directly into the terminal window. The commands must be entered a single line at a time, followed by enter.
- Commands copied from an outside program can be pasted into the terminal window by selecting *right-click* → *paste* within the terminal window. Each line will execute automatically.
- A text file can be dragged and dropped into the terminal window. Each line will execute automatically.

Sensor Tab

This tab shows some of the raw and processed sensor values in numerical format.

ADMIN	SENSOR	EULER	EULERPLOT	ACCELPLOT	GYROPLOT	MAGPLOT	3DVIEW
Magnetometer							
magr (counts)		magp (milligauss)					
X	-1848	X	194.478				
Y	-1972	Y	59.9377				
Z	-968	Z	358.201				
		Vector Amplitude	411.974				
Gyro							
gyror (counts)		gyrop (°/s)					
X	89	X	+0.00120327				
Y	96	Y	-0.01093940				
Z	-42	Z	-0.00000624				
Accelerometer							
accelr (counts)		accelp (mG)					
X	321	X	-53.2877				
Y	-2689	Y	-321.911				
Z	7813	Z	948.075				

Figure 5: Sensor Tab



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Euler Tab

This tab shows a standard compass rose along with pitch and roll. In addition, the two variables Mag Error (VID: “magFieldCalErr” for AHRS-M1, “magErr” for all others) and Heading Error (VID: “yawErrEst” for AHRS-M1, “magErr2” for all others) are displayed.

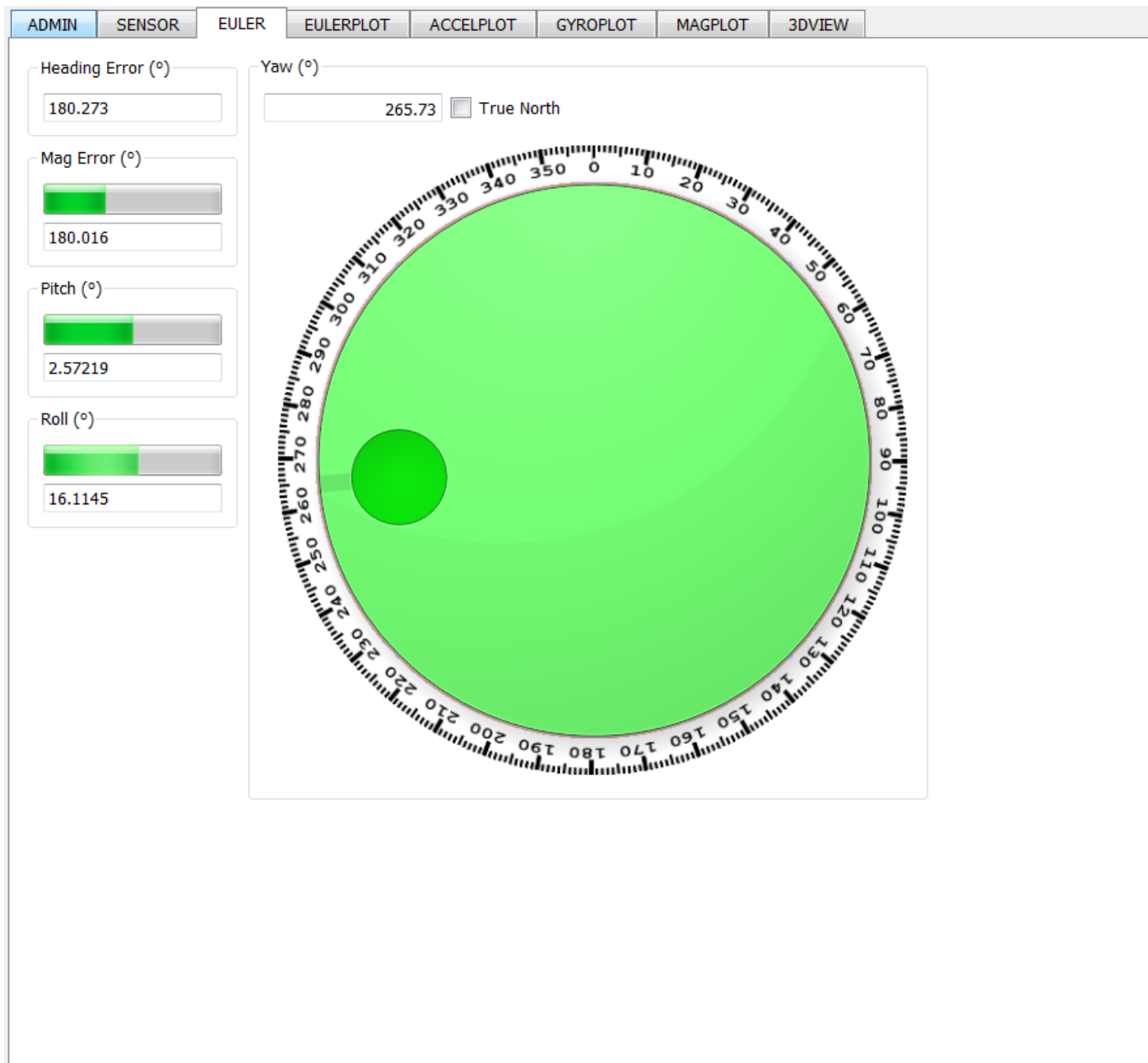


Figure 6: Euler Tab

Euler Plot Tab

This tab displays a real-time plot of pitch, roll, and yaw in degrees. NOTE: All plots can be automatically scaled by selecting View->Autoscale. Switching tabs sets ranges to their default values.

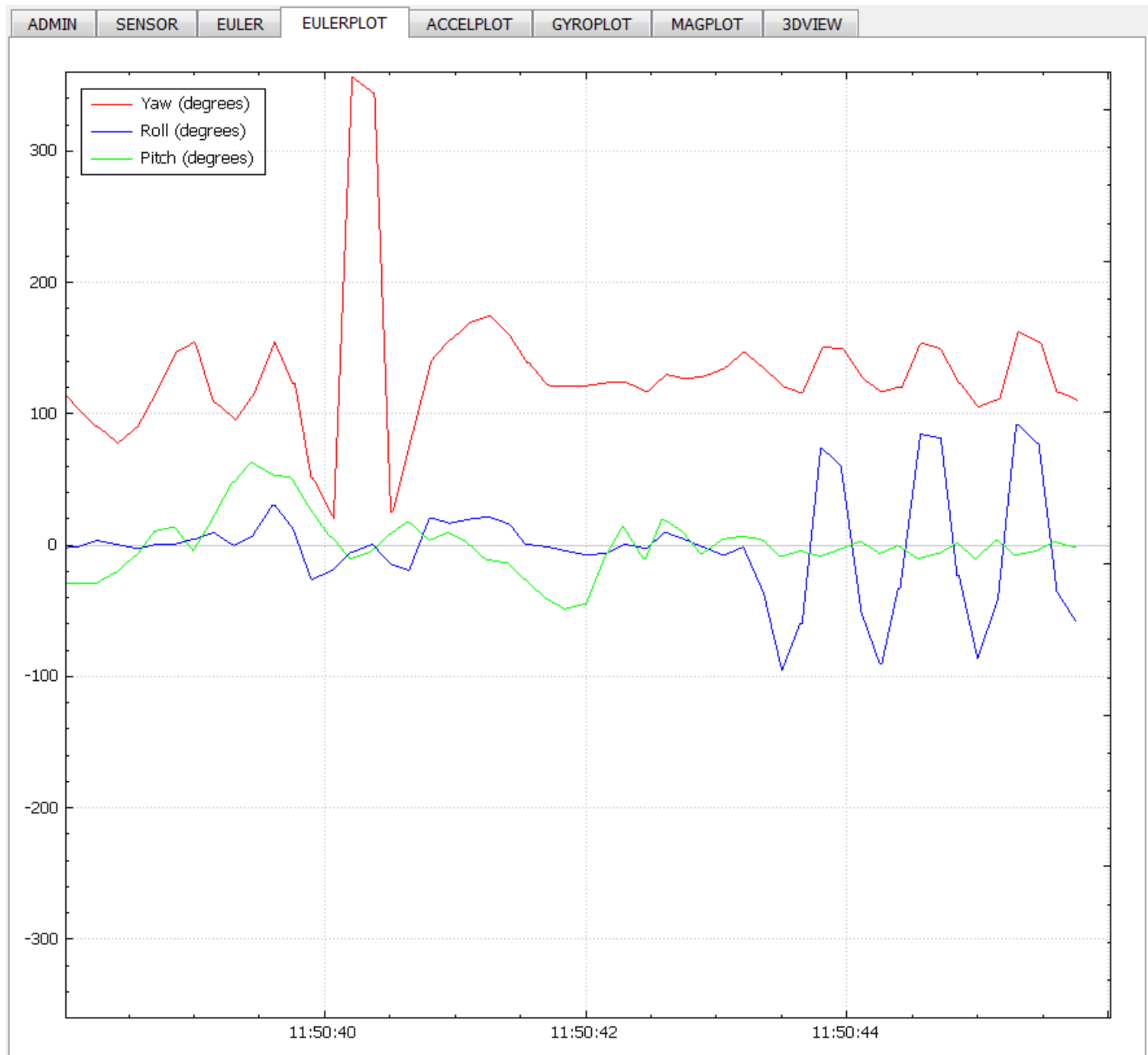


Figure 7: Euler Plot Tab



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Accelerometer Plot Tab

This tab displays a real-time plot of the XYZ accelerometer output in mg (for AHRS-8 and below) or m/s^2 (for IMU-10 and up).

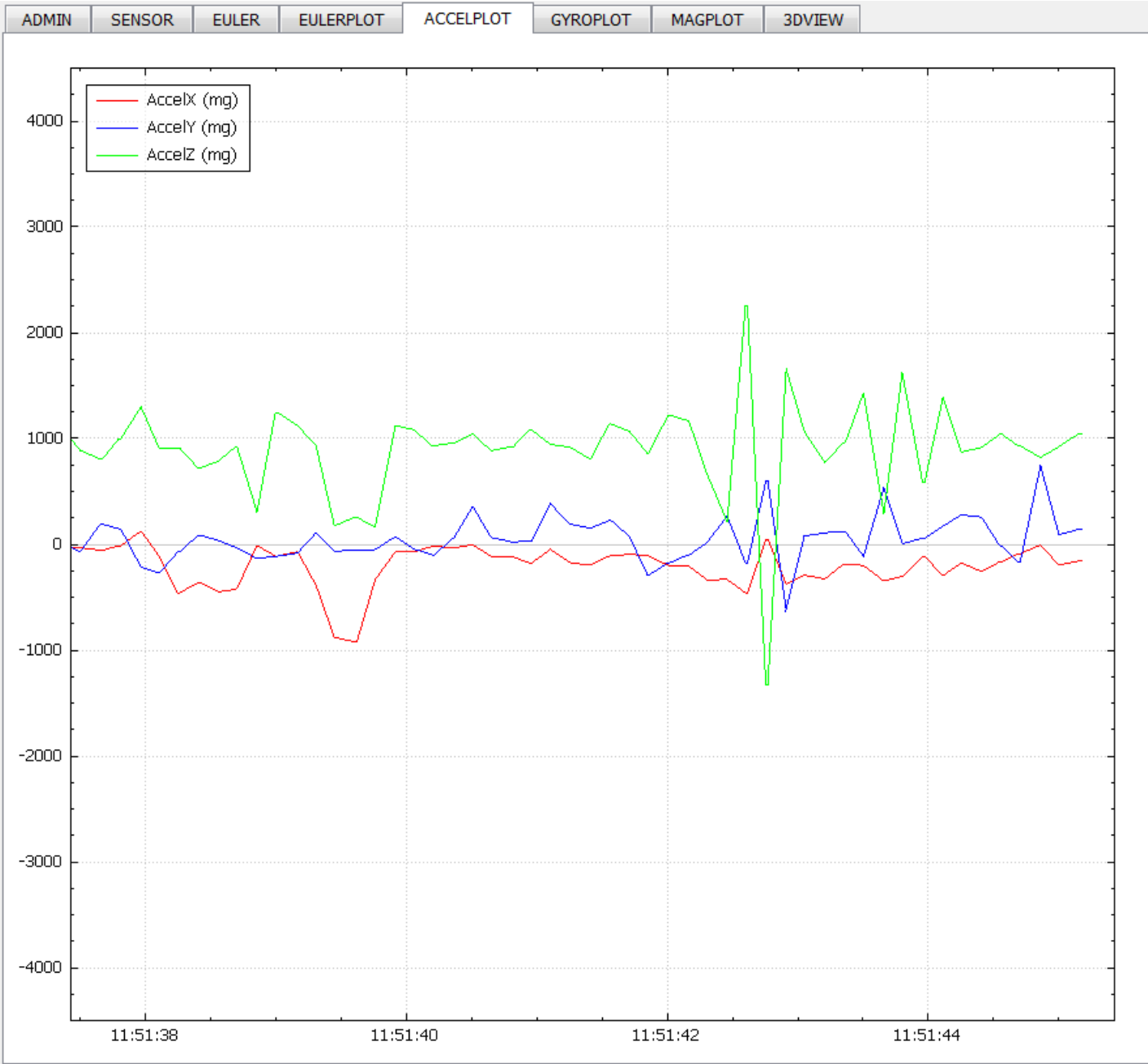


Figure 8: Accelerometer Plot Tab

Gyro Plot Tab

This tab displays a real-time plot of the XYZ gyro output in degrees per second.

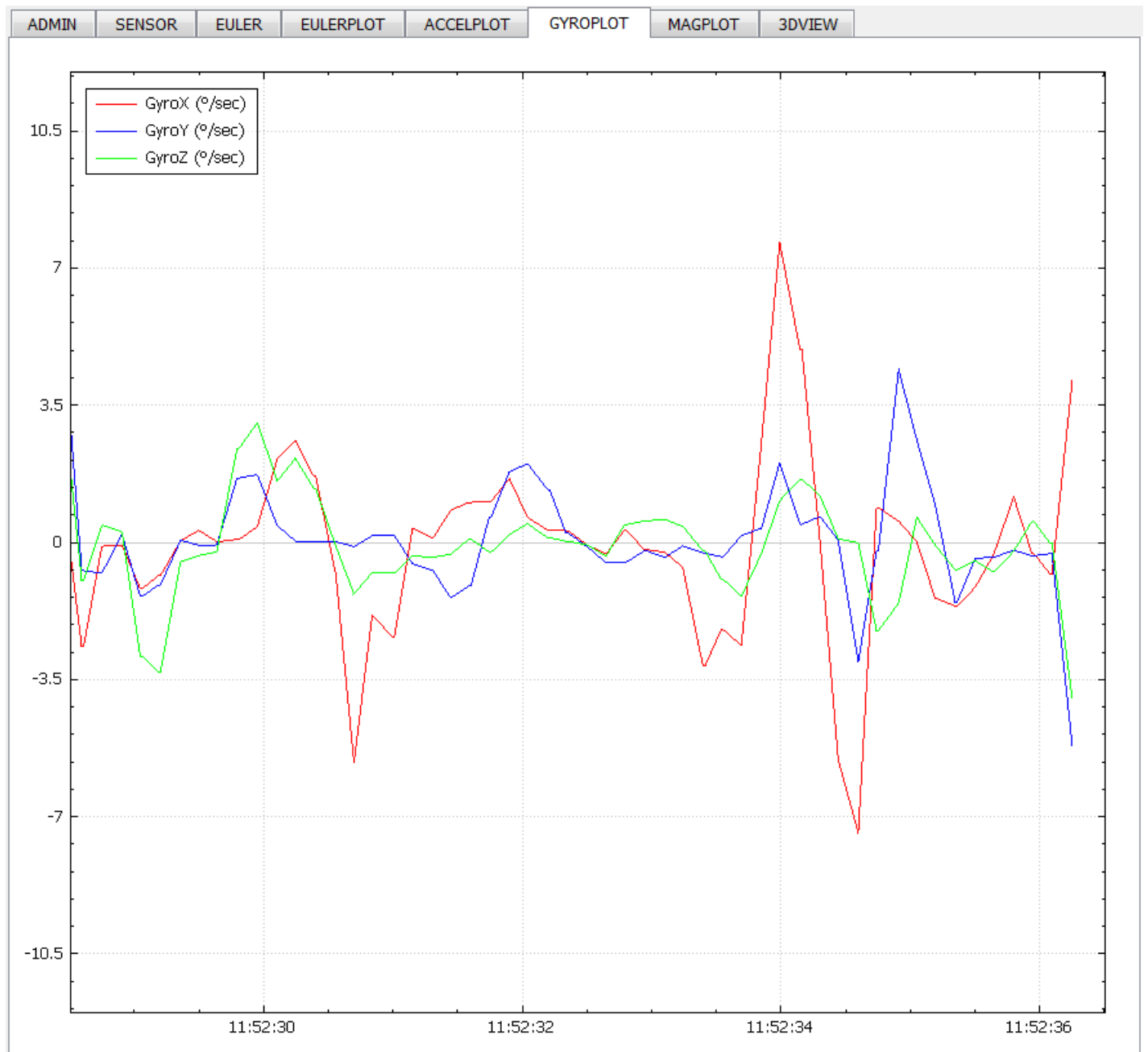


Figure 9: Gyro Plot Tab



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Magnetometer Plot Tab

This tab displays the XYZ magnetometer output is milligauss.

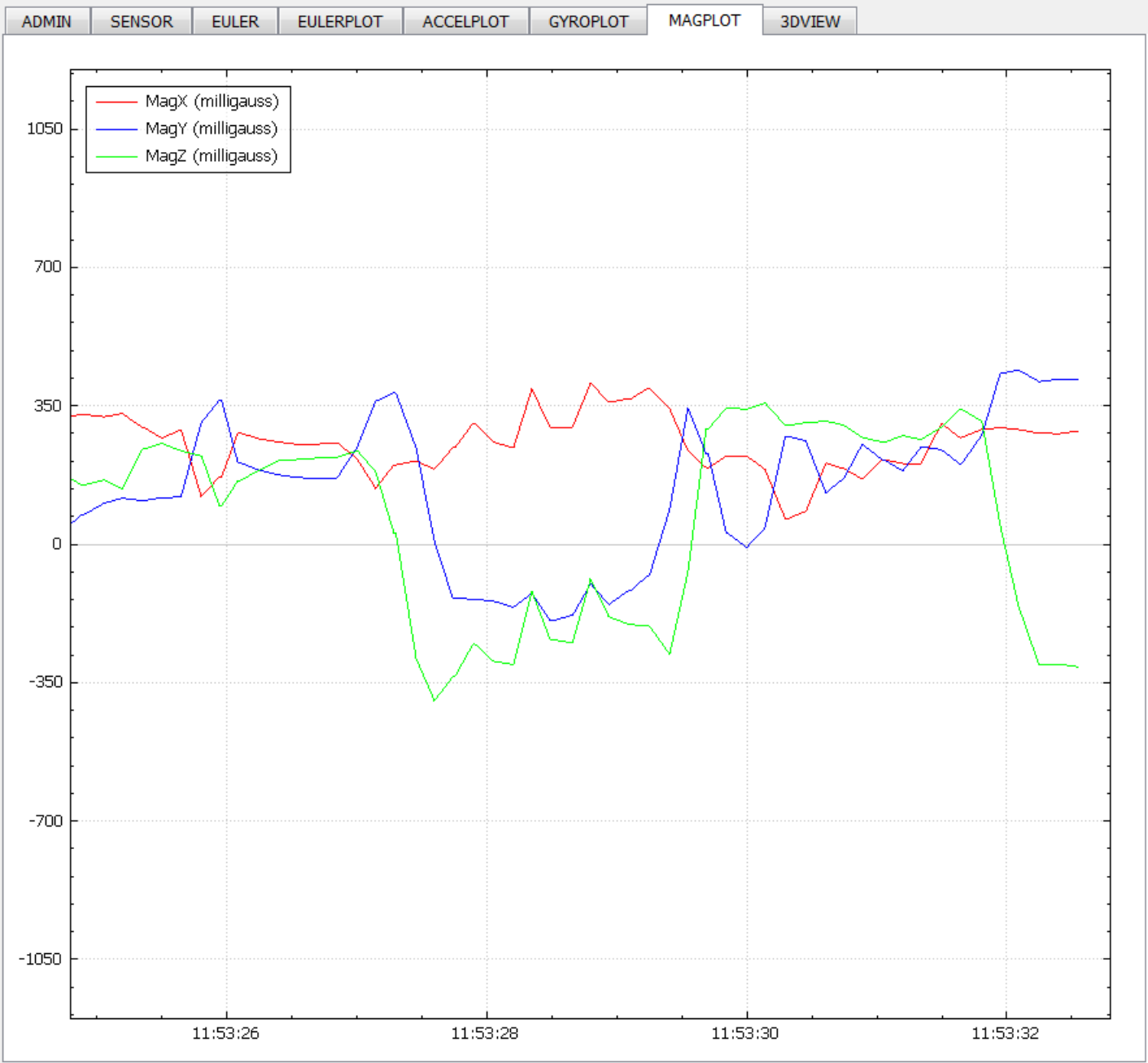


Figure 10: Magnetometer Plot Tab

3D View Tab

This tab gives a spatial representation of the device's orientation. This tab utilizes the device's quaternion output rather than Euler angles. Side 1 corresponds to the north face of the device.

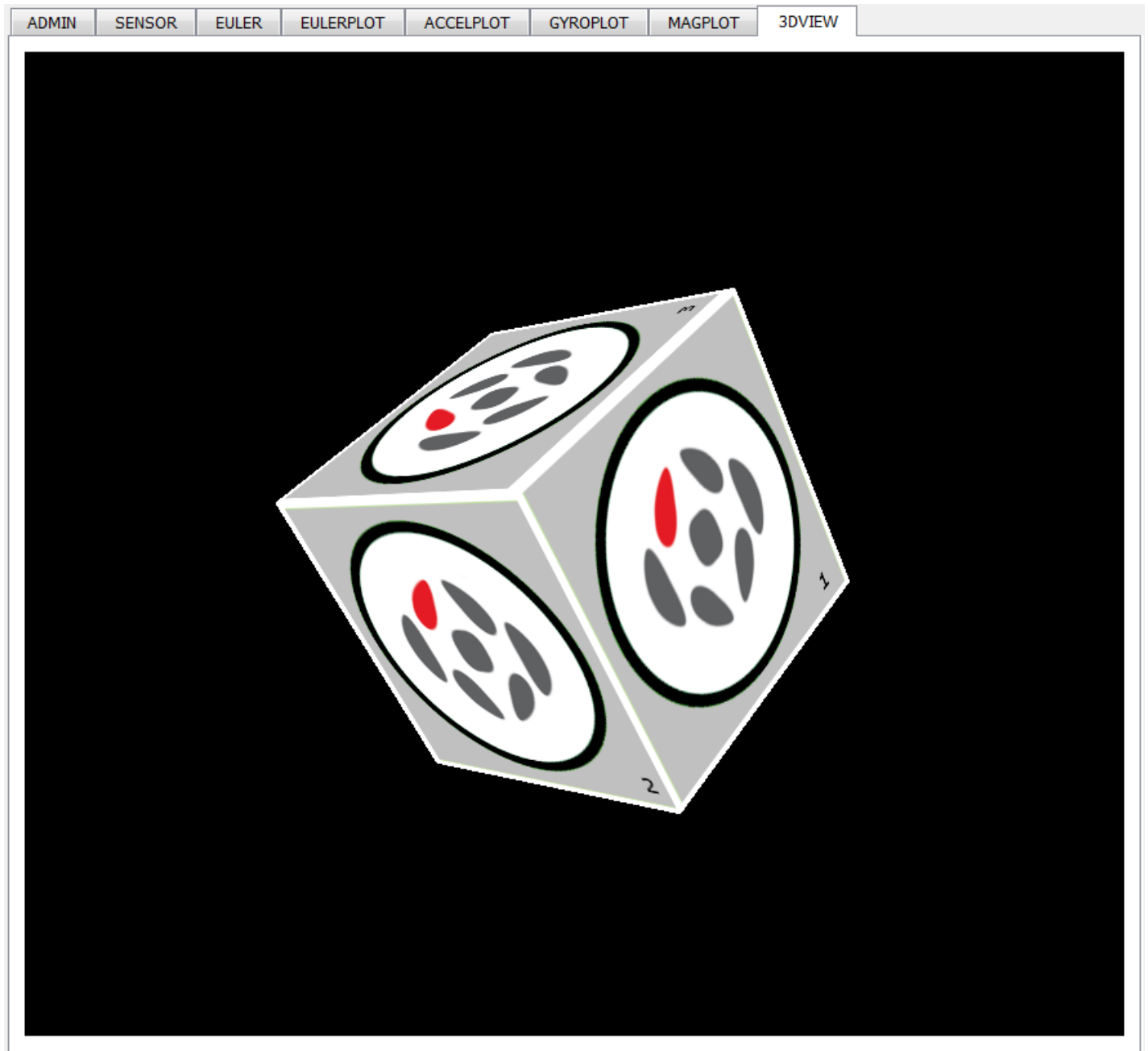


Figure 11: Spatial Representation of Device Orientation



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3D Calibration: Non AHRS-M1

In order to begin the 3D calibration process, select Devices Settings → In-Field Calibration → 3D Calibrate.

You will be presented with the calibration quality screen if the device's firmware supports the quality variables (older firmware versions do not) (See Figure 12).

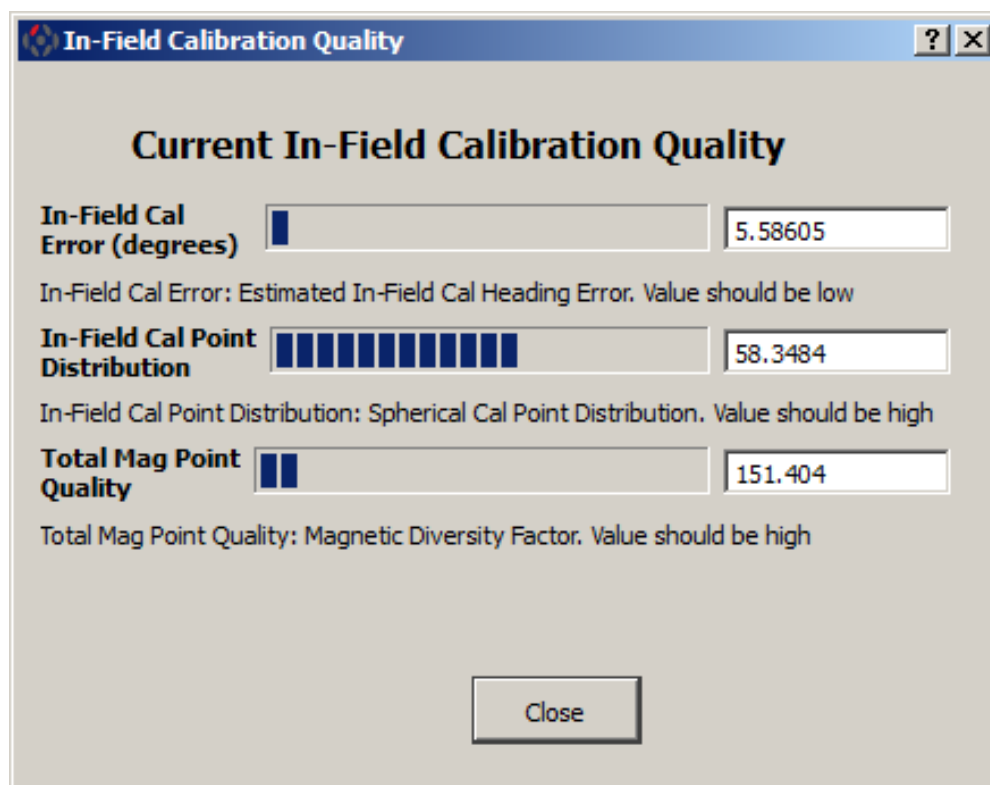
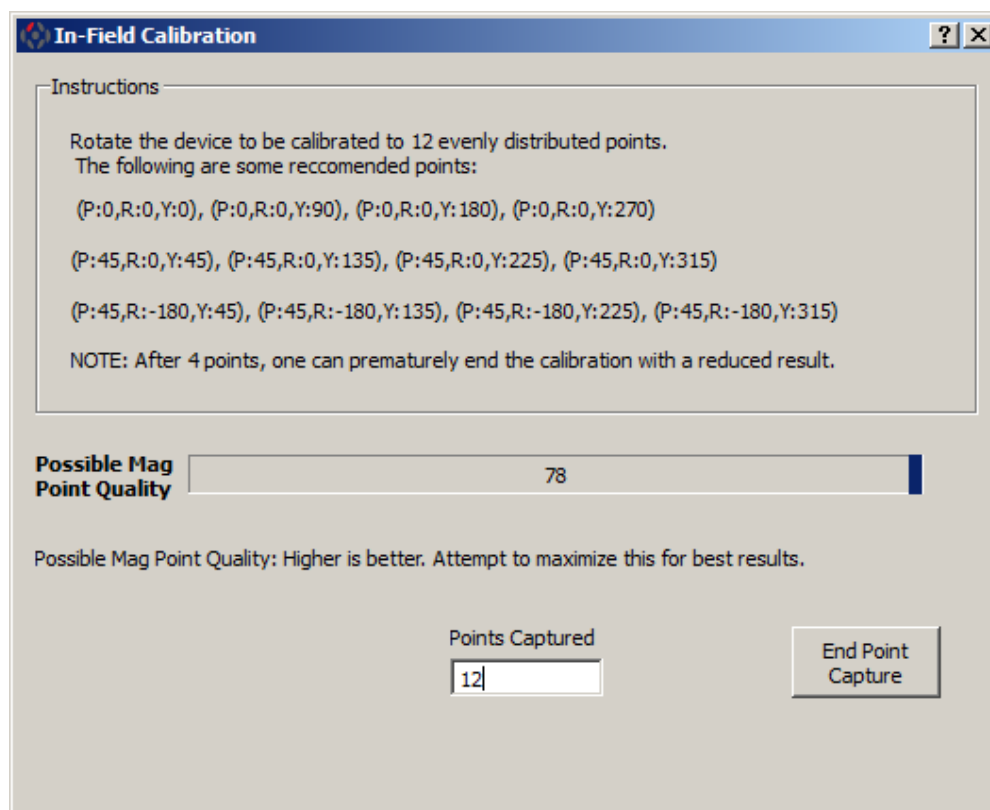


Figure 12: In-Field Calibration Quality

- The In-Field Calibration Error (VID: magFieldCalErr) is the device's current estimated heading error in degrees (this value should be low).
- The In-Field Calibration Point Distribution (VID: calPointDistribution) is a measure of how evenly distributed the last calibration point selection was on a spherical plane (this value should be high).
- The total magnetic point quality (VID: magPointQF) is a measure of how diverse the magnetometers readings were for the last calibration point selection (this value should be high).

Upon selecting “Yes,” the In-Field Calibration dialog appears (See Figure 13). Utilize the “Capture Point” button to begin capturing calibration points. As more points are captured, the “Possible Mag Point Quality” indicator (VID: possibleMagPointQF) can be used to maximize the calibration point magnetic diversity. Maximizing this indicator, by rotating the device in between capturing each calibration point, is essential to acquiring a superior in-field calibration.

The image shows a software dialog box titled "In-Field Calibration". It has a blue header bar with a question mark icon and a close button. The main content area is divided into sections. The first section, titled "Instructions", contains text: "Rotate the device to be calibrated to 12 evenly distributed points. The following are some recommended points:" followed by three lines of coordinate pairs: "(P:0,R:0,Y:0), (P:0,R:0,Y:90), (P:0,R:0,Y:180), (P:0,R:0,Y:270)", "(P:45,R:0,Y:45), (P:45,R:0,Y:135), (P:45,R:0,Y:225), (P:45,R:0,Y:315)", and "(P:45,R:-180,Y:45), (P:45,R:-180,Y:135), (P:45,R:-180,Y:225), (P:45,R:-180,Y:315)". Below this is a "NOTE: After 4 points, one can prematurely end the calibration with a reduced result." The second section, titled "Possible Mag Point Quality", features a horizontal progress bar with the number "78" in the center. Below the bar is the text "Possible Mag Point Quality: Higher is better. Attempt to maximize this for best results." The third section contains a label "Points Captured" above a text input field containing the number "12". To the right of this is a button labeled "End Point Capture".

In-Field Calibration

Instructions

Rotate the device to be calibrated to 12 evenly distributed points.
The following are some recommended points:

(P:0,R:0,Y:0), (P:0,R:0,Y:90), (P:0,R:0,Y:180), (P:0,R:0,Y:270)

(P:45,R:0,Y:45), (P:45,R:0,Y:135), (P:45,R:0,Y:225), (P:45,R:0,Y:315)

(P:45,R:-180,Y:45), (P:45,R:-180,Y:135), (P:45,R:-180,Y:225), (P:45,R:-180,Y:315)

NOTE: After 4 points, one can prematurely end the calibration with a reduced result.

Possible Mag Point Quality 78

Possible Mag Point Quality: Higher is better. Attempt to maximize this for best results.

Points Captured 12

End Point Capture

Figure 13: In-Field Calibration Dialog

It is recommended that 12 points are captured for the best calibration result. However, the process can be ended after 4 points with a degraded result.

After the final point is captured (or the process was ended before 12 points), the Calibration dialog will switch from the capture view to the convergence view (See Figure 12)

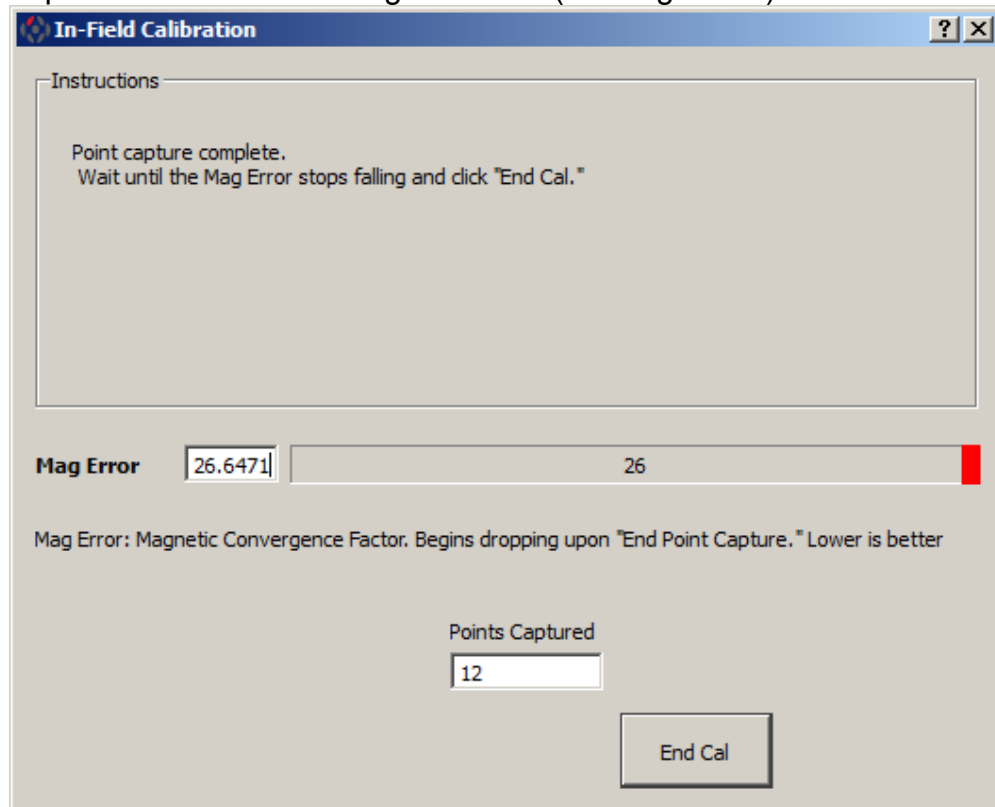


Figure 14: Convergence View

The Mag Error (VID: magErr) should decrease within the first few seconds (older firmware versions may take a few minutes) and stabilize. After the Mag Error has ceased dropping, the "End Cal" button commits the in-field calibration to the device.

The new calibration quality values will be displayed (See Figure 15) after the calibration process.

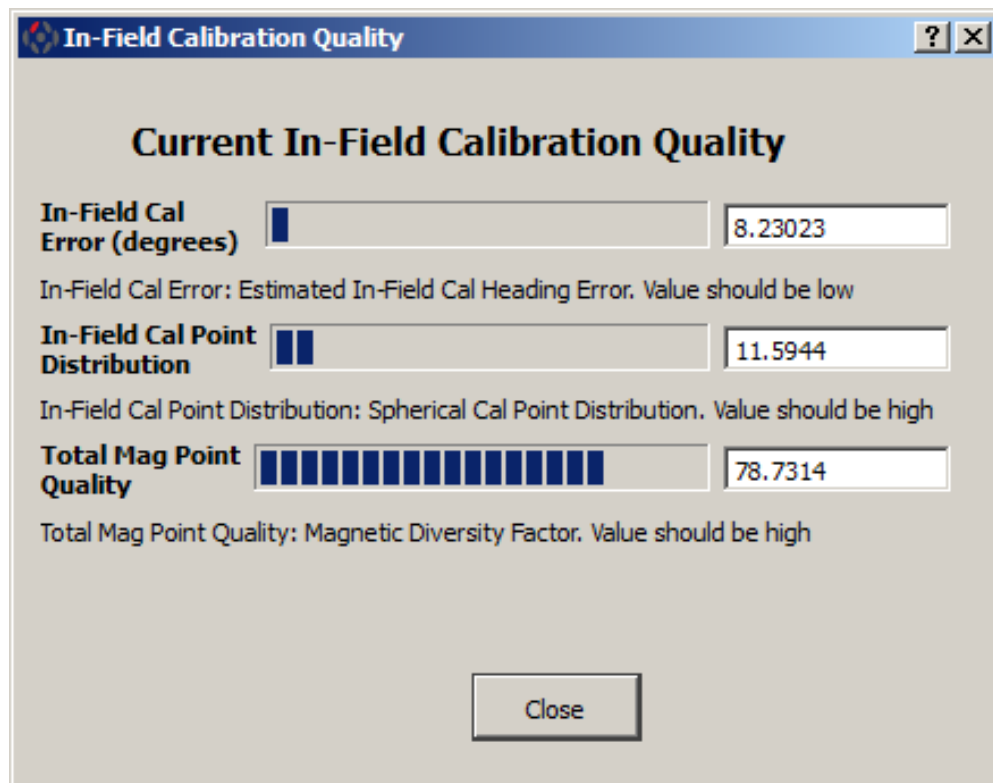


Figure 15: In-Field Calibration Quality After Completed In-Field Calibration

NOTE: If the original factory calibration is desired over the in-field calibration, select Device Settings → In-Field Calibration → Restore Factory Cal.

3D Calibration: AHRS-M1/AHRS-M2

In order to begin the calibration process using the AHRS-M1/M2, select Device Settings → In-Field Calibration → Calibrate AHRS-M1 (Figure 16).

The screenshot shows the Spartacus Settings application interface. The top menu bar includes 'File', 'Spartacus Settings', 'Device Settings', 'RFS', 'View', and 'Help'. The 'Device Settings' menu is open, showing options: 'Sensor Config', 'Orientation', and 'In-Field Calibration'. The 'In-Field Calibration' option is selected, and a sub-dialog 'Calibrate AHRS-M1' is visible. The main window has a left sidebar with 'ADMIN' and 'RFS Controls' tabs. Under 'RFS Controls', there is a 'VID' dropdown set to '0', a '# VIDs for device' field set to '236', and buttons for 'Get', 'Value', 'Get Prev', 'Prev Value', 'Get Next', 'Next Value', 'Show', 'Set', and 'Construct'. Below these are checkboxes for 'Auto Set Refresh' and 'Auto Update Displays', both checked. There are also input fields for 'VID Name', 'Lower Limit', 'Upper Limit', 'VID Data Type', and 'Scalar Type'. A 'Clear' button is located in the top right corner of the main window. At the bottom, a status bar shows 'Port: COM7', 'Status: Connected', 'Model: AHRS-M1', 'Serial number: [redacted]', and 'Firmware version: 1.1.10'.

Figure 16: Opening AHRS-M1 Calibration Dialog

You will be presented with the AHRS-M1 Calibration Controls dialog which floats over the Spartacus window and shares priority. The “Yaw Error Estimate” and Absolute Yaw Error” line edit boxes should begin updating in real time. The dialog can be seen in Figure 17.

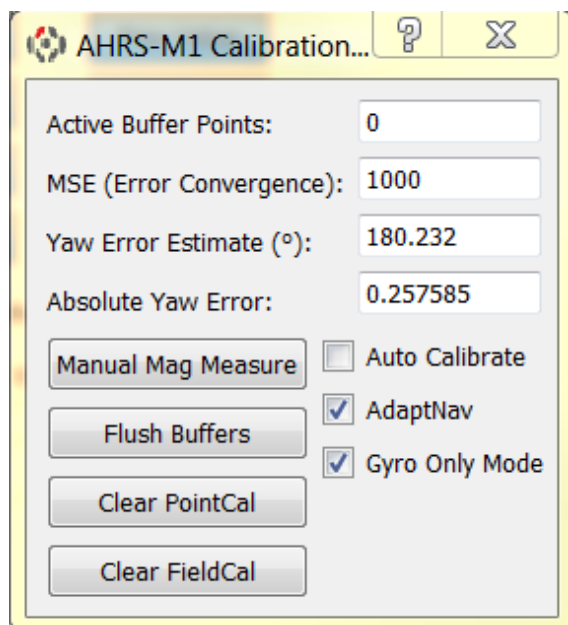


Figure 17: AHRS-M1 Calibration Controls

The VID values displayed in the AHRS-M1 Calibration Control dialog are

- **Active Buffer Points:** The total number of captured calibration points. Four or more are needed to begin the calibration process of the AHRS-M1.
- **MSE (Error Convergence):** Monitors calibration process' error convergence. Four or more active buffer points must have been captured before this is calculated. The closer it is to zero, the greater the accuracy.
- **Yaw Error Estimate (°):** The estimated heading error of the AHRS-M1 (in degrees).
- **Absolute Yaw Error:** Error difference between the measured yaw and the estimated yaw.

The controls displayed in the AHRS-M1 Calibration Control dialog are

- **Manual Mag Measure:** Manually captures a calibration point.
- **Flush Buffers:** Clears all captured calibration points.
- **Clear PointCal:** Clears the point calibration buffer.
- **Clear FieldCal:** Defaults calibration to PointCal values.
- **Auto Calibrate:** Toggles automatic field calibration.
- **AdaptNav:** Toggles AdaptNav III.
- **Gyro Only Mode:** Toggles Gyro Only Mode.



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There are two methods to calibrating the AHRS-M1: Point Calibration and Field Calibration:

- **Point Calibration:** Involves obtaining magnetic measurements by manually manipulating the AHRS-M1 into different positions and clicking the “Manual Mag Measure” button. The idea is to obtain as many magnetically diverse points as possible (12 is recommended). Once the user has obtained at least four points, the MSE will begin to decrease. The closer the MSE is to zero, the greater the accuracy of the yaw measurements. The recommended positions for manual measurements can be seen in Table 2.

Table 2: Recommended Manual Measurement Points

Point	Pitch(°)	Roll(°)	Yaw(°)
1	0	0	0
2	0	0	90
3	0	0	180
4	0	0	270
5	45	0	45
6	45	0	135
7	45	0	225
8	45	0	315
9	45	180	45
10	45	180	135
11	45	180	225
12	45	180	315

- **Field Calibration:** Involves obtaining magnetic measurements by manually manipulating the AHRS-M1 into different positions while auto calibration is enabled. The AHRS-M1 will gather calibration points automatically as its position is changed. While precision is not a factor when manipulating the AHRS-M1, it is still recommended to aim for points similar to those listed in Table 2. Once a minimum of four points have been captured, the MSE will begin to decrease. The closer MSE is to zero, the greater the accuracy of the yaw measurements. The recommended number of captured points is 12.