Kalman Filter Calibration

When using the IMU Kalman Filter, it is important to perform the full calibration procedure before meaningful testing commences. The calibration procedure is a series of specific manoeuvres that should be performed to help the Kalman filter characterise the outputs from the IMU.

If the calibration procedure is not performed, the Kalman filter will still function, but may not produce the high level of accuracy until dynamic manoeuvres in the X and Y plane have been performed (i.e. left and right hand turns, braking and accelerating). This should occur after a few minutes driving.

Recommended procedure

1. Park the vehicle in an open area, where the GPS antenna has clear view of the sky. Remain static and wait for the IMU to complete the 30 second stationary initialization. As this happens the VB3i front panel IMU LED will change from flashing orange to flashing green upon completion. If the vehicle moves before initialisation finishes, the 30 second process will restart once stationary again.

2. When the IMU LED is flashing green, drive forward to complete initialization of the IMU. Continue to an open area to perform calibration procedure.

3. Drive in a ‘figure of eight’ at least twice. These can be as little as 5 m in radius (almost full-lock in some vehicles), but 10 m is better. The vehicle should be travelling above 15 km/h during this procedure in order to generate sufficient forces for the calibration process.
4. Accelerating hard from standstill to 50 km/h or above, perform two brake stops with a decel force of at least 0.5 g.

When is the calibration required?

When carrying out high dynamic tests such as braking and ESC testing, this recommended process calibrates the Kalman filter as quickly as possible. When carrying out low dynamic tests such as driving on urban routes, or doing long term data collection, then this calibration is not as critical.

Re-running the calibration

The Kalman filter is constantly adapting its calibration depending on the information received from GPS and the IMU. Therefore, if the vehicle is left stationary for a long time, or the IMU is moved from its mounting position, then the calibration procedure should be repeated if further high dynamic testing is to be carried out.

The calibration should also be repeated after anything which causes the communication to break between IMU and VBOX, such as:

- Power cycle to either IMU or VBOX.  
  *Note: Using an [external power backup](https://racelogic.support/01VBOX_Automotive/01VBOX_data_loggers/VBOX_3i_Range/) stops the system shutting down under temporary power loss.*
- ‘VBOX Setup’ software is used to read IMU settings.
- ‘VBOX Tools’ OR ‘VBOX Setup’ software is used to read VBOX settings.
- Modes change using VBOX Manager.

[https://racelogic.support/01VBOX_Automotive/01VBOX_data_loggers/VBOX_3i_Range/](https://racelogic.support/01VBOX_Automotive/01VBOX_data_loggers/VBOX_3i_Range/)
• A GPS Coldstart is performed.

What happens if this isn’t done?

If this procedure cannot be carried out as above then the speed accuracy will be reduced, especially for the first few minutes until the Kalman Filter is able to calibrate itself. We strongly recommend that the Kalman Filter is calibrated when carrying out high dynamic tests.