2019

Exiguo Evaluation SW

EXIGUO EVALUATION SOFTWARE MANUAL

ARAZIM LTD.

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1 Overview

The Exiguo navigation platform is supplied with an Evaluation software (Windows OS) that can assist the user to evaluate the Exiguo platform and get a fast impression about the platform capabilities.
In this manual we will describe the various actions that can be done by the PC-Software that accompanies the family of Exiguo devices (VG, AHRS, INS & INS Dual Antenna).
Some of the actions, described, will help the user do the following:

a) Configure communication ports for both HOST and GPS.
b) View the data received in numeric view as well as in graphic.
c) View all system actions, requests & replies using the debug viewer.
d) Choose which message to view in a running system.
e) Record incoming messages and export them as text files.
f) Enter configuration mode and configure the system to:
   emit various messages at different rates, enable math filters, change IMU gyro & accelerometer ranges etc. …
g) Enter calibration mode and calibrate the system using both magnetic and static calibrations.
h) Reset system configuration and go back to factory-settings.

2 Communications

The Exiguo navigation platforms are supplied by default with RS232 serial port communication. The current evaluation software is designed to work with the RS232 serial communication port.

As can be seen in Figure 1, the software is equipped with two RS232 communication channels: one that connect to the Exiguo main communication channel (marked with red rectangle in: Figure 1), and a second one which is reserved for a future use (direct connection with Exiguo internal GPS).

In order to use either of them, user must first define the communication settings:

- Press the configuration button located in the tool-buttons (see: Figure 1 - Port configuration button)

Figure 1 - Port configuration button

- Once pressed, a communication port configuration window will pop-up. (see: Figure 2)

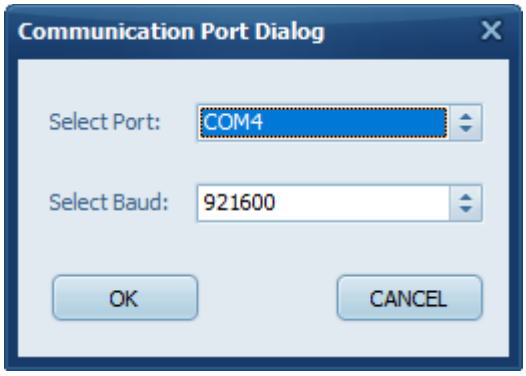


Figure 2 - Port settings dialogue

- Choose the Communication channel according to your computer connection and choose the correct baud-rate according to the Exiguo baud-rate configuration (default baud-rate is: 921600), and finally press OK button.
- After setting the communication channel, you should open the communication channel for transmit and receive by pressing the button marked in red rectangle. (see: Figure 3)

Figure 3 - Comport open button

When clicking the open comport button a few actions are performed:

a. Comport is opened and the button that closes is enabled.
b. A request for system type is sent to the Exiguo platform.
c. Once the request is received, the device type can be viewed at the status-bar (see: Figure 4).

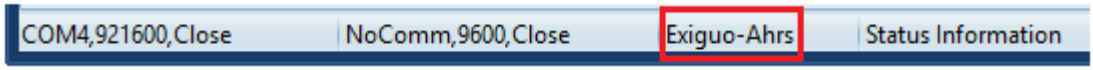


Figure 4 - Device-type status-bar tab

Note:

If the Exiguo platform is not connected or not powered, an answer for the query, regarding the device type, won't be received and the communication port will be closed automatically.

3 Monitoring Incoming Data

The incoming data can be viewed in 2 ways: Numeric or Graphic. Accompanying the data are a group of flags comprised of BITs (Built-In Tests) and status-flags which help us monitor (in a binary way) the functionality of the system, in real-time, as well as give us insight regarding whether or not the internal devices are working properly.

3.1 Numeric Data View

The numeric view (which is the default view) shows the values of every message we choose to review (provided the device was configured to emit that message). The numeric Data View includes a panel on the left side (see: Figure 5 - Numeric data-view panel) which holds the list of all available messages arranged in groups according to messages types. The groups can be expanded to reveal the group messages or collapsed to hide the group messages.
Choosing a message to view requires the user to click on the relevant message type button.
Depending on the Exiguo platform that is connected, some of the messages may not be relevant and therefor will not work when pressing that message type. For example GPS messages are irrelevant for Exiguo-VG platform.

Figure 5 - Numeric data-view panel

On the right bottom side of the application view, there is a group-box section, named: "Incoming Messages" (see: Figure 6). This view indicates the current active messages that the user can select to view.

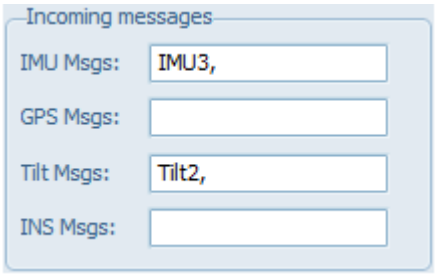
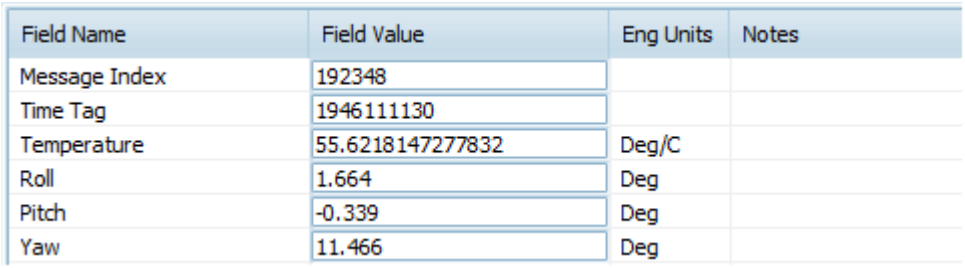


Figure 6 - Incoming messages view pane

Clicking on a message that is emitted, will show the fields of that message and its values at real-time (see: Figure 7).



Field Name	Field Value	Eng Units	Notes
Message Index	192348		
Time Tag	1946111130		
Temperature	55.6218147277832	Deg/C	
Roll	1.664	Deg	
Pitch	-0.339	Deg	
Yaw	11.466	Deg	

Figure 7 - Real-time values pane

3.2 Graphic Data View

To enter the graphic view, we have to press the “Messages Graphic View” tab. (see: Figure 8 - Messages graphic view)

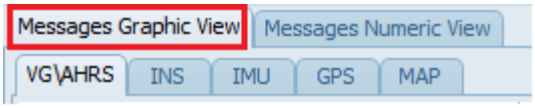


Figure 8 - Messages graphic view

Within the graphic view tab, there are 5 tabs: VG/AHRS, INS, IMU, GPS and MAP.

3.2.1 VG/AHRS Data

The VG & AHRS data have Roll-Pitch-Yaw and temperature in numeric data coupled with the Roll-Pitch-Yaw graphs (see: Figure 9, Figure 10).

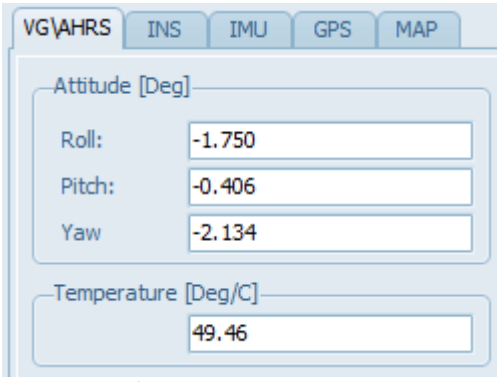


Figure 9 - VG/AHRS tab's numeric data

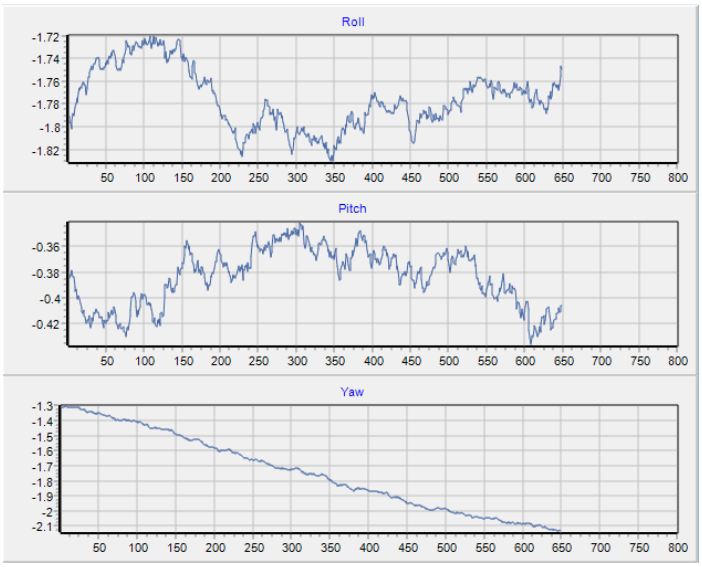


Figure 10 - VG/AHRS tab's graphic data

3.2.2 INS Data

The INS graphic view is used for both: INS and INS dual antennas. Both platforms includes the same list of data fields, but each system displays the location value differently.

As in the VG/AHRS graphic window, this window has numeric data as well. This data has the usual Roll-Pitch-Yaw along with GPS Position, GPS velocity, GPS date and time and, of course, observation information about the GNSS receiver satellites: GPS, Glonass & Baidu (see: Figure 11, Figure 12).

The graphic part of the window, has 4 graphic charts (see: Figure 13).

a. Graph for Roll & Pitch.
b. Graph for yaw / heading.
c. Graph for GPS height.
d. Graph for GPS location (latitude – longitude)

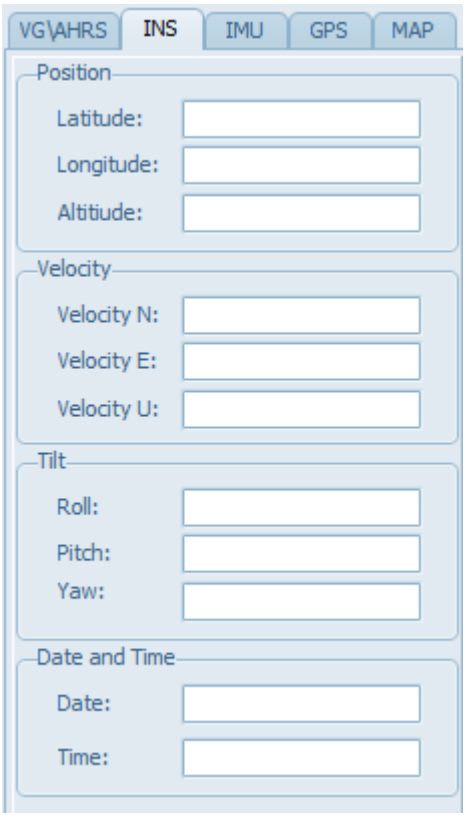


Figure 11 - INS tab's numeric data

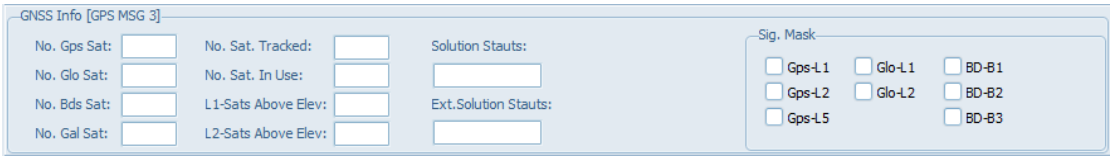


Figure 12 - INS tab's GPS numeric data

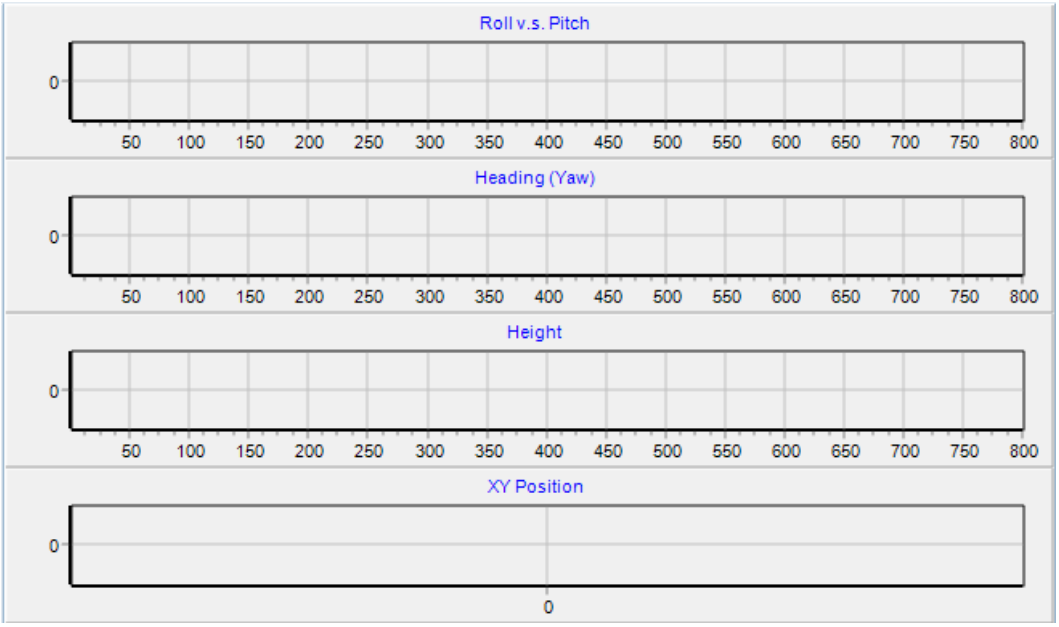


Figure 13 - INS tab's graphic data

3.2.3 IMU Data

In the IMU tab we can see the sensors information. Depends on the message selected 6DOF or 9DOF information is exhibited.
This graphic window has numeric equivalents as well (see: Figure 14 - IMU tab's numeric data).
This window preserve the option to exhibit information on additional sensors that will be supported by the Exiguo platform in the coming future, like: temperature, barometer and odometer.

All numeric label names have check-boxes next to them, checking or unchecking any of those checkboxes will cause the equivalent chart line to be visible or to be hide accordingly.
The checkboxes status have no influence on the visibility of the numeric value.

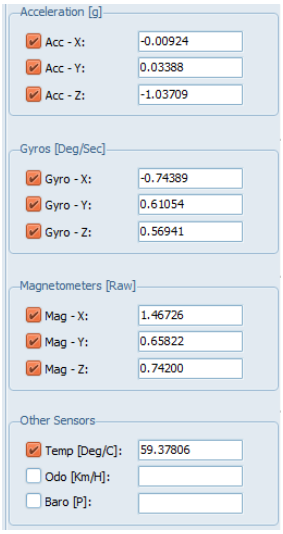


Figure 14 - IMU tab's numeric data

The graphic part of the window, has 4 graphic charts (see: Figure 15):

a. Graph for accelerometers x, y, z.
b. Graph for gyros x, y, z.
c. Graph for magnetometers x, y, z.
d. Graph for the rest of the existing sensors (and future ones).

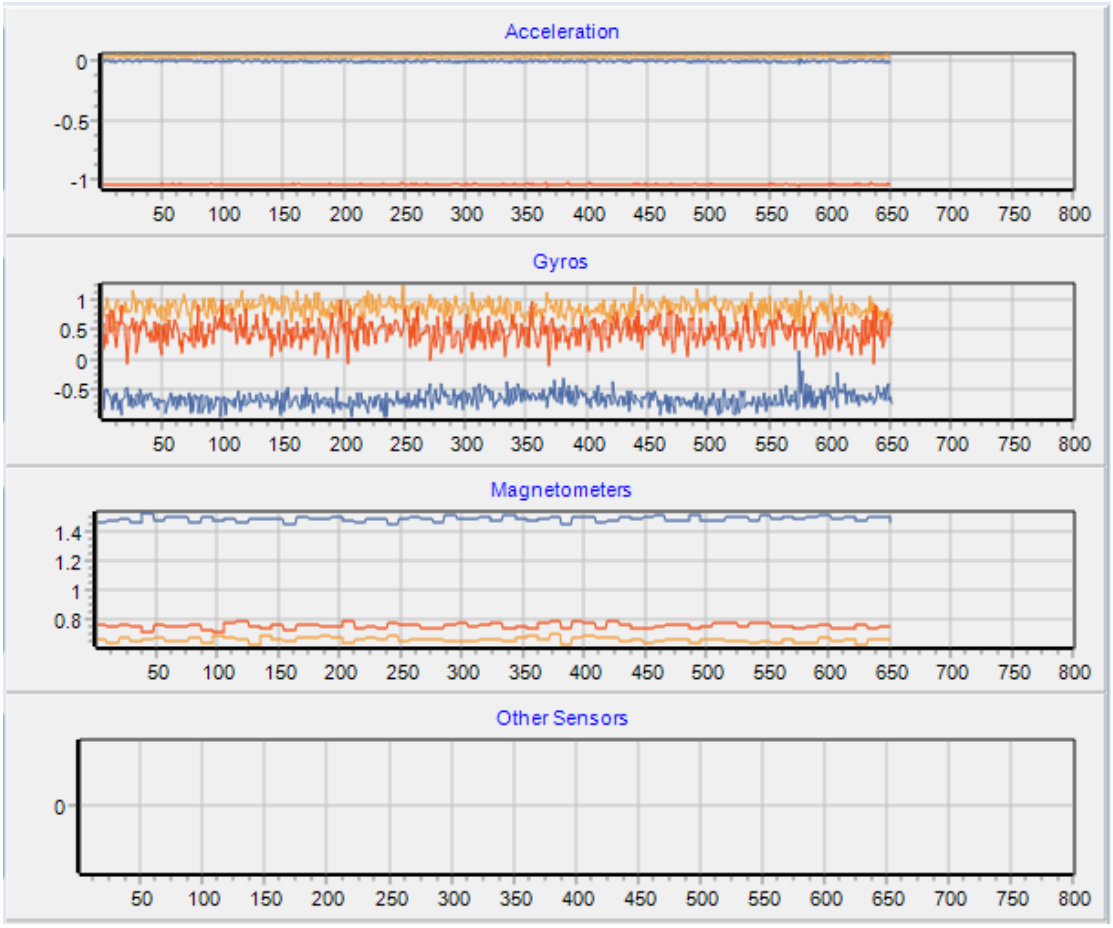


Figure 15 - IMU tab's graphic data

3.2.4 GNSS data

Currently, the GNSS data has no graphic elements to show. All it shows is numeric data, assembled into 6 groups (see: Figure 16 - GPS tab's numeric data), as well as information about satellites observation for: GPS, Glonass & Baidu (see: Figure 12 - INS tab's GPS numeric data).
The 6 groups are:

a. GPS Position
b. GPS Velocity.
c. Date and Time.
d. GPS Heading.
e. RTK base position.
f. Base to Rover.

The information that will be exhibited depends on the active messages selected.

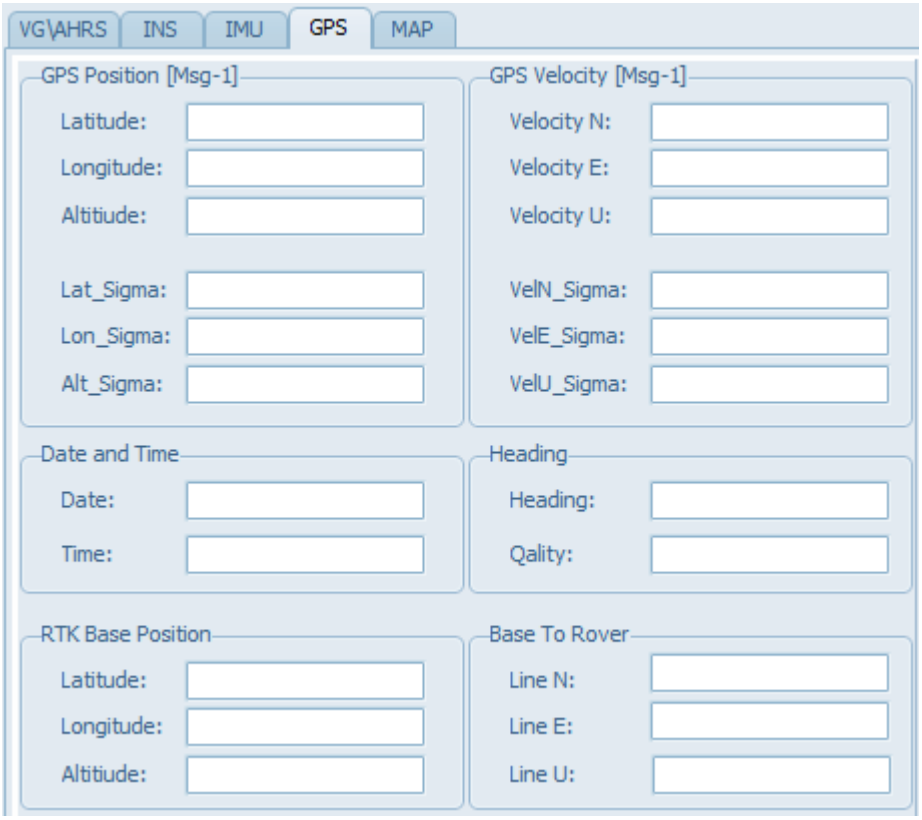


Figure 16 - GPS tab's numeric data

3.2.5 MAP

The map window was created to provide the user the ability to see his current position in real-time on the MAP.
The map element used for this is: Google-Maps, which means that in order for the MAP to be shown the user needs an Internet connection.

The left panel allows the user to control certain elements in the map and monitor others.
The left side panel (see: Figure 17) allows the user to control:

a. The language used by the map for locations, roads, junctions, etc. …
b. The map's center location (in the "Pan To" section).
c. Zooming in or out (in "Map View" section).
d. The type of map shown (in "Map View" section).
   Type can be: default, satellite, hybrid, terrain.
e. Showing or hiding the level of current traffic.

In the "Position Info" section, the user can also monitor the current latitude, longitude, altitude and heading of the person using that map.

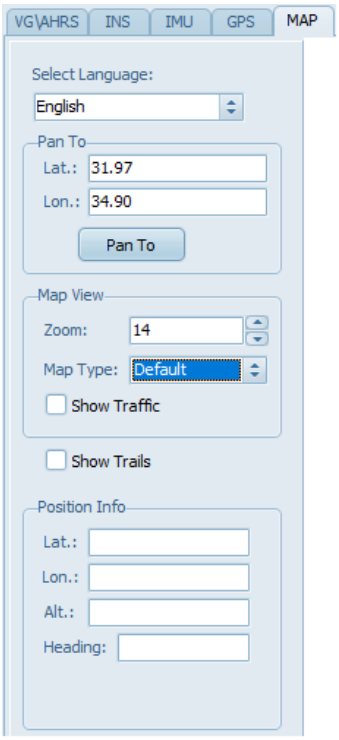


Figure 17 - MAP tab's user-controls pane

3.3 BITs and Status Flags

The main window holds on the right side a panel that has 5 sections which provide binary information (True or False) regarding statuses of elements in the system (see: Figure 18).
Some provide information in real-time, some provide information gathered only during startup time.
The 5 sections are:

a. Power-Up BIT.
b. Supply & Temperature.
c. GPS – BIT.
d. Continuous BIT – reserved for future statuses
e. UKF – Status.

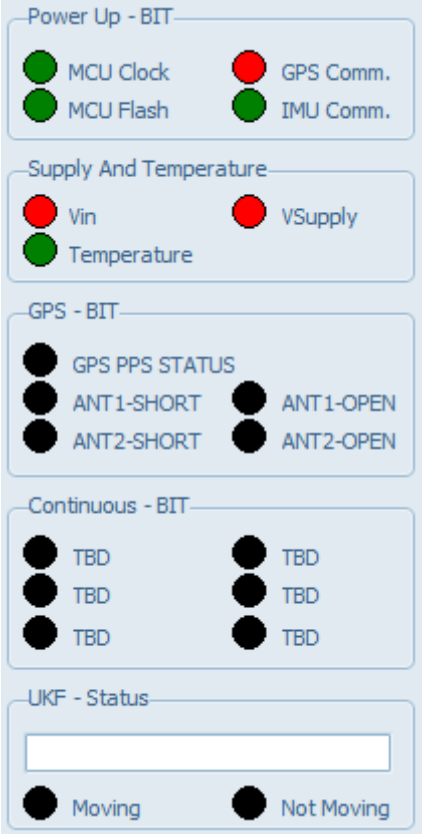


Figure 18 - System's BIT status pane

3.3.1 Power-Up BIT

This section informs the user only about BITs that occurred during start-up time.
This section has the following BITs:

a. MCU Clock – informs the user regarding the hardware initialization of the system.
   Green – hardware initialization completed well. Red – problem occurred during initialization.

b. MCU Flash – informs the user regarding the validity of the information existing in the flash and its integrity. All information in flash goes through a cyclic redundancy check (CRC16) for Integrity validity.
If the integrity check result is invalid and continues to be invalid after 3 tries, the BIT will inform the user about it.
Green – flash examination completed well, Red – there was a problem with the flash storage.
c. GNSS Communication – during start-up, the system checks the back and forth communication with the internal GNSS receiver.
If no communication exists the BIT will inform user about it.
Green – GPS communication is well, Red – problem occurred communicating with GPS.
d. IMU Communication – during start-up, the system checks the back and forth communication with the internal IMU.
If no communication exists the BIT will inform user about it.
Green – IMU communication is well, Red – problem occurred communicating with IMU.

3.3.2 Supply and Temperature

The system provides real-time information regarding power-supplies and temperature.
Two power supplies are monitored:

a. VSupply (VDD) – The internal working supply used for all internal electrical sub-systems.
b. VIN – The external power supply that is supplied as input to the Exiguo platform.

All 3 BITs respond to thresholds.
Each of the 3 mechanisms has 2 configurable thresholds: Min & Max.
If the mechanism values are within those thresholds the BIT monitor will show green.
Any deviation, either above maximum or below minimum, will cause the BIT, of the mechanism, to show red.

3.3.3 GNSS - BIT

The system provides real-time information regarding two mechanisms: PPS & Antennas.
The GPS provides the following monitoring:

a. GPS PPS Status – when the GNSS receiver gets a location lock, it starts emitting PPS (Pulse Per Second). The Exiguo monitors the arrival of that pulse continuously. If a pulse was missing the flag will become Red, otherwise it should stay green.
b. ANT1-SHORT / ANT2-SHORT – information about the GNSS receiver connection with the antennas is acquired every second.
If antenna-1 or antenna-2 short-circuited – BIT will turn red, otherwise BIT will show green.
c. ANT1-OPEN / ANT2-OPEN - information about GNSS receiver connection with antennas is acquired every second.

If antenna-1 or antenna-2 was cut-off (connection is opened) – BIT will turn red, otherwise BIT will show green.

3.3.4 Continues BIT

Needs to Be Defined…

3.3.5 UKF-Status

One of the internal algorithm switches relates to the ability of the algorithm to recognize whether the platform is static or moving. This decision can be very hard in certain circumstances. The Exiguo provides its current decision status with every sample that it emits to the host computer.
In that section we exhibit if the system is moving or not moving and the exact condition recognized by the system.
If system is moving – BIT will show “Moving” as green, otherwise it’ll be black.
If system is stationary – BIT will show “Not Moving” as green, otherwise it’ll be black.

4 Record Incoming Data

The PC-Software not only allows the user to monitor the incoming data, but also to record it as binary file and then export the file to ASCII format.
For that purpose, the user is provided with a recording mechanism, in the form of 4 buttons, located on the toolbar (see: Figure 19 - System's recording controls).

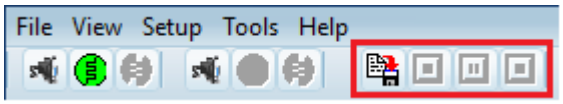


Figure 19 - System's recording controls

In order to save the incoming data and status messages we need to do the following:

a. We click the “Select Destination File” button.
   A “Save to File” dialogue will open.
   We choose a name for the file to be created and saved and click “Save”.
b. We make sure the system is running and then click the “Start Recording” button.
c. When done, we click the “Stop Recording” button.
d. From the menu, we click “File->Export”, and then choose the file we’ve just recorded.
e. We’ll be asked to provide a name for the exported file.
   Once the name is given, the file will be converted to ASCII.

5 Device Configuration

The PC software allows the users to configure the devices to:

Set a new RS-232 baud-rate, Emit various messages at different rates, set the work-mode as polling and not continues, etc. …

To open the configuration window, from the menu, we have to click "Setup->Device Configuration" (see: Figure 20 - Device configuration menu item).

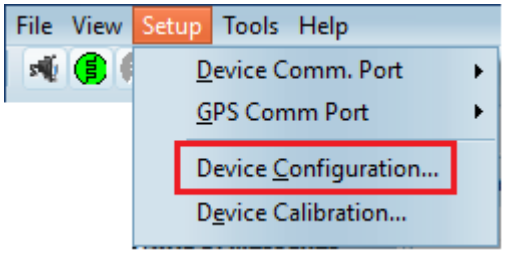


Figure 20 - Device configuration menu item

In the configuration window there are 2 groups of controls:

a. General Control
b. Device Information.

There are also 2 tabs containing fields of configuration parameters to read or write:

a. User Settings.
b. Factory Settings – for factory use only.

5.1 General Control

In this group, there are 7 buttons that control the functionality of the configuration (see: Figure 21 - Configuration's general-control pane)

a. Enter Config. – this button causes the system to enter the configuration mode. In that mode, device stops sending messages. The device will answer the "enter to configuration mode" with "ACK", informing that the request was received, followed by a status message, informing that system is in configuration mode.
b. Exit Config. – This button causes the system to exit configuration mode. Once exited, the device goes back to real-run mode.
   The device will answer the "exit configuration mode" with "ACK".
   This will be followed by a status message, informing that the system is in real-run mode.
   If requested, exiting configuration is also responsible for performing 2 actions: changing UART's baud-rate and system reboot.
   This is done that way since we need to send an ACK, to the users, informing them that their request, to either change the baud-rate or reboot, was received and will be performed once they exit the configuration state.
c. Read All Settings – This button reads all the configuration parameters (resident in ram memory) and places them in their right configuration window fields.

d. Write All Settings – This button takes all the values in the configuration window fields and writes them to the configuration parameters resident in ram.
e. Save Settings as Default – This button causes the current configuration parameters (resident in ram memory) to be burnt onto the flash memory.
   The “Ack” received, for the command sent, represents not only the reception of the request, but also the end of the writing onto flash, which is a relatively slow process.
   This means that the “Ack” might arrive rather late than normal. (up to 6 seconds).
f. Soft Reset – This button causes the system to go thru a “Hot Reset”.
   The “Ack” received for this command means that the command was received.
   The actual system reset, will be performed only when user exits the configuration mode.
g. Reset to Factory – This button causes all the current configuration parameters (resident in ram memory) to be assigned with their initial values, as configured by the factory.
   Please Note: This command DOES NOT burn the parameters onto flash automatically.
   Users must perform burning onto flash manually.

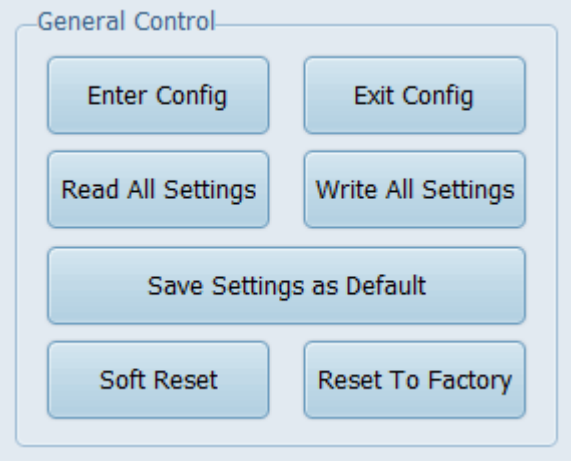


Figure 21 - Configuration's general-control pane

5.2 Device Information

In this group, there are 6 fields, who provide basic information about the current device (see:)

a. Name – To Be Defined.
b. Type – To Be Defined.
c. Version – To Be Defined.
d. HW Version – To Be Defined.
e. FW Version – To Be Defined.
f. Serial Num – To Be Defined.

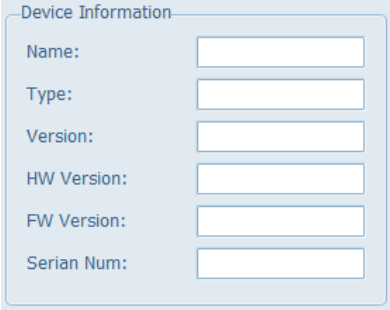


Figure 22 - Unit's device information

5.3 User Settings

In the “user settings” part of the configuration window (see: Figure 23), we can configure some of the behavior of the device in terms of: communication with unit, behavior of the IMU and, partial behavior of the math and all the messages that the unit has to offer.
The “user settings” are comprised of 4 groups:

a. General Settings.
b. IMU Settings.
c. UKF Settings.
d. Messages Out.

Param Name	Current Value	New Value
General Settings		
Comm Type	RS-232	RS-232
Comm Channel	1	1
Comm Speed	921600	921600
Operation Mode	Start Immidiate	Start Immidiate
Sample Mode	Continues	Continues
IMU Settings		
IMU Sample Rate [Hz]	100	100
Acceleration Range	2g	2g
Gyros Range	250 Deg/Sec	250 Deg/Sec
UKF Settings		
IMU Orientation	1	1
Static Samples	2000	2000
Enable Filter	Disabled	Disabled
Messages Out		
IMU_1 - RAW	0	0
IMU_2 - 6DOF	0	0
IMU_3 - 9DOF	0	0
IMU_4 - Misc Sensors	0	0
GPS_1	0	0
GPS_2	0	0
GPS_3	0	0
GPS_4	0	0
Tilt [R,P]	25	25
Tilt [R,P,Y]	0	0
Tilt [Quater]	0	0

Figure 23 – Configuration's user-settings pane

5.3.1 General Settings

In this group we have the following fields to configure:

a. Comm type – This refers to the type of the physical communication lines that the unit has with the "outside world" or HOST.
It can be: RS-232, UART, LAN, etc. … - **At the moment only the RS232 is supported.**

b. Comm Channel – In every system, each type of communication may have more than one channel.
This field shows the channel-id (index) of the communication type we're configuring – **At the Moment only a single Channel is supported**

c. Comm Speed – This field configures the speed / baud-rate of the selected channel of communication.
The speeds, to choose from, will change according to the type of communication we are configuring.

d. Operation Mode – During the initialization of every unit, the unit must obtain a static-calibration before running.
This calibration could be achieved by either go thru a bias-estimation process or load an old calibration from flash.
User may choose one of the two options:
1) Start Immediate – Load an old calibration from flash.
2) Do Static on Power-Up – perform a static calibration at boot.

e. Sample Mode – The unit allows users to either receive the messages they requested in continues way, according to the rate each message was configured with or receive all the messages requested, by requesting them manually.
User may choose one of the two options:
1) Continues – Messages arrive to HOST according to their preconfigured rate.
2) Polling – the user will need to send a sample request for a specific message manually.

5.3.2 IMU Settings

The following values allow us to configure the behavior of the IMU that the system is based on.
In this group we have the following fields to configure:

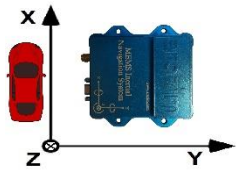
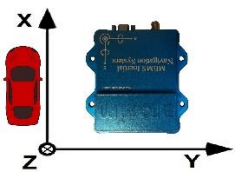
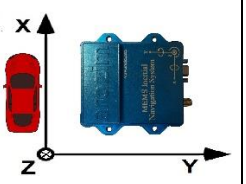
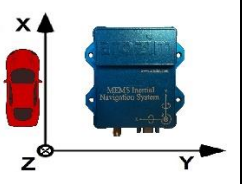
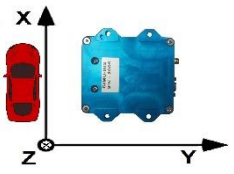
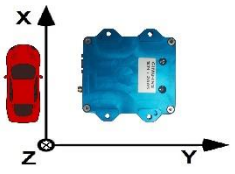
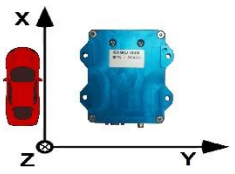
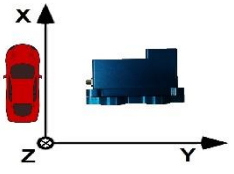
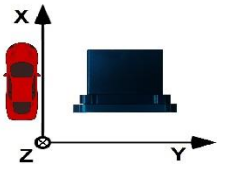
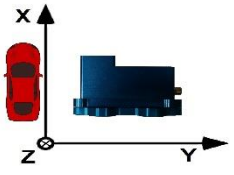
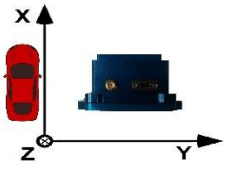
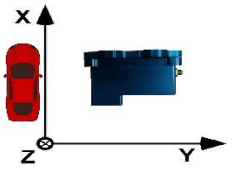
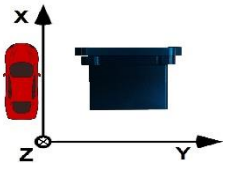
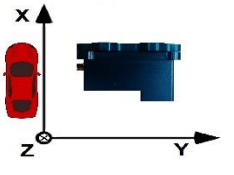
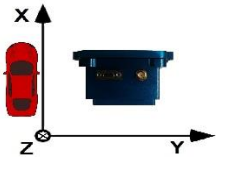
a. IMU Sample Rate (Hz) – This field allows the users to determine the sampling rate of the IMU used in the system.
Important to know, that many times this figure will either have very limited choices or be blocked completely.
b. Acceleration Range – This field allows the users to determine the range of the accelerometer used in the IMU.
There are only 4 options to choose from: 2g, 4g, 8g , 16g.
c. Gyros Range – This field allows the users to determine the range of the gyros used in the IMU.
There are only 4 options to choose from:
250, 500, 1000 and 2000 Deg/Sec.

5.3.3 UKF Settings

The following values allow us to configure the behavior of the math used in the algorithm of the system.
In this group we have the following fields to configure:

a. IMU Orientation – This field allows users to inform the system the angle of the IMU installation on a platform. There are 16 different states to choose from (see: Table 5-1).
b. Static Samples – This field allows the users to determine the number of samples they wish to provide the static calibration mathematical calculations.
This value is valid between: 1000-9000.
c. Enable Filter – This field allows the users to determine whether the math calculations use the “IIR filter” or not.
This filter, when enabled, smoothens the IMU incoming values, which, in turn produces better roll-pitch-yaw output.

Table 5-1: Optional parameters values for Setting IMU orientation on a platform

0 	1 	2 	3 
4 	5 	6 	7 
8 	9 	10 	11 
12 	13 	14 	15 

5.3.4 Messages Out

The unit allows the users to determine the type of messages they wish to receive.
It is possible to receive multiple messages at once.
Clicking on the value field, of each message, will give the users the ability to determine the rate of the message. Choosing “0” will disable the message.

The type of messages displayed to the user, are Exiguo platform dependent, which means, the user will be able to configure only messages that are supported by the connected Exiguo platform.
The table below exhibits the available data messages and their availability on different Exiguo platforms.

Table 5-2: List of Data Messages with relation to Exiguo platform type

Message Index	Message Name	Platforms
0x20	IMU1-Raw Data	All Platforms
0x21	IMU2-6DOF	All Platforms
0x22	IMU3-9DOF	All Platforms
0x23	IMU4-Misc.	Not active at the moment
0x30	GPS1-LLA	AHRS, INS, INS2ANT
0x31	GPS2-ECEF	AHRS, INS, INS2ANT
0x32	GPS3-Statistic	AHRS, INS, INS2ANT
0x33	GPS4-RTK	To be implemented soon
0x34	GPS5-Sat. Info	To be implemented soon
0x40	Tilt1 – [R,P]	All Platforms
0x41	Tilt2 – [R,P,Y]	All Platforms
0x42	Tilt3 – [Quarter]	All Platforms
0x43	Tilt4 – [DCM]	All Platforms
0x50	INS1 – Tilt & Pos.	INS, INS2ANT
0x51	INS2 – Tilt, Pos. & Vel.	INS, INS2ANT

5.3.5 Save / Load Settings from File

The settings pane, allows the users to save the current settings onto or load previous settings from a file (see: Figure 24).

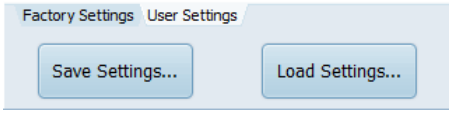


Figure 24 – The save & load buttons of configuration's user-settings

If users wish to save the current settings, the steps are:

1) Click the "Save Settings" button.
2) Choose a name and a path to save the file to.
3) Click the "Save" button.

If users wish to load a previously saved settings, the steps are:

1) Click the "Load Settings" button.
2) Choose a name and a path of the file to be loaded.
3) Click the "Open" button.

5.4 Factory Settings

In the "Factory Settings" section of the configuration pane, we can configure some of the factory settings of the system.
Next to each section in the pane exits two buttons: "W" for write to RAM, and "R" for read from RAM.

The values we're able to configure are:

a. Unit's serial number.
b. Misalignment correction parameters.
c. Alarms.
d. Debug Messages.

5.4.1 Serial Number

The user can change the serial number (see: Figure 25), by writing a new serial number in the text box and clicking the "W" button.
Of course, for reading the unit's serial number user needs to click the "R" button.

Figure 25 – Configuration's serial number text box.

5.4.2 Misalignment Correction

The user can read/write the misalignment the coefficients. (see: Figure 26).
For reading a single matrix or offset, users can do so by clicking the "R" button next to them.
Same is true for writing, using the "W" button.

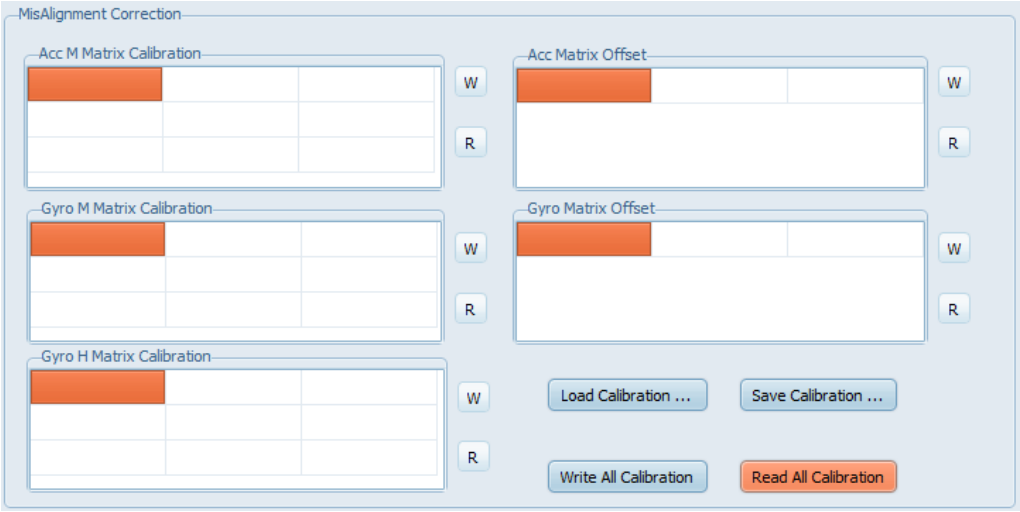


Figure 26 – Configuration's misalignment coefficients pane

The users are also able to read / write all the coefficients at once.
This is done by clicking the "Read All Calibration" / "Write All Calibration" buttons respectively.
Just like the "User Settings", the users are able to save all the values onto file or load old values from file.

Please note: it is impossible to change the misalignment coefficients of the unit. The way around it is to save the values onto file, then use a text-editor to edit the file manually and then load it with the new values.

5.4.3 Alarms

The users are able to set the alarm thresholds of 3 elements in the unit (see: Figure 27):

a. Temperature.
b. V in
c. VDD.

To change the values, the users have to place new values in the Min/Max fields of every element and then click “W” for writing it to RAM configuration.
To read the values, of a specific element, from RAM configuration, users have to click the “R” button.
Each element has checkboxes for enabling / disabling message-notifications for any value that deviates from the threshold given.
When a value is out of range, notifications will be emitted once a second until the value goes back to being within the min-max range again.
Please note: The checkboxes are for the notification messages only. Checkboxes have no effect on the BIT notifications in the application’s main window.

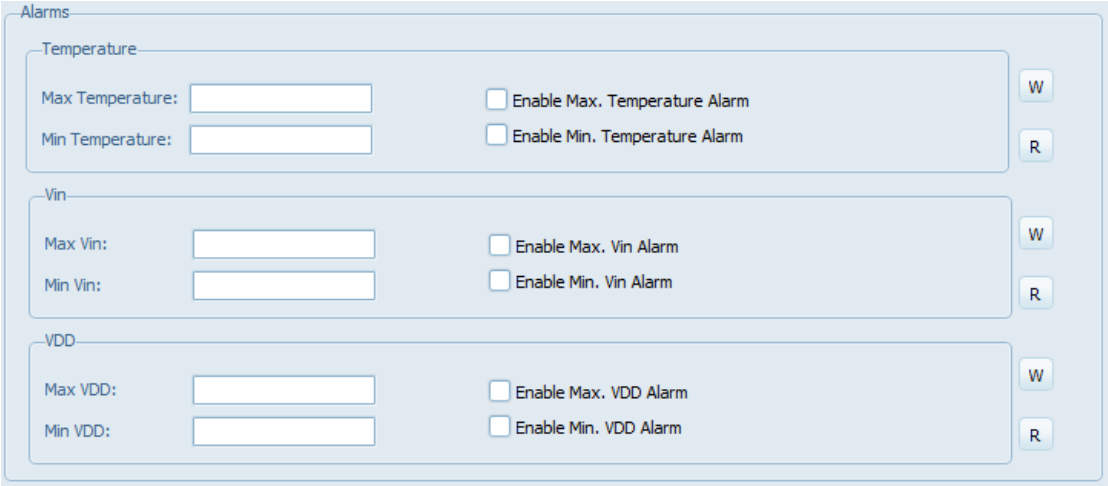


Figure 27 – Configuration’s alarm settings pane.

5.4.4 Debug Messages

The users have the ability to receive a special debug-message from the unit (see: Figure 28).
This message carries all the values that are used by the mathematical “Kalman filter”.
This message has no rate value to be configured, since it is emitted at the rate of the IMU itself.
The section has all the debug messages that the system can support, but will enable only the one suitable for the unit type being configured.

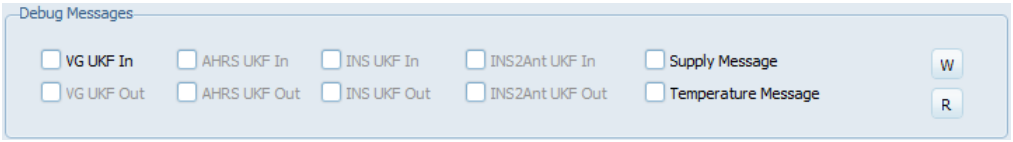


Figure 28 – Configuration's debug-message settings pane

6 Device Calibration

The PC software provides the users with the ability to perform 2 types of calibrations:

a. Static Calibration (Bias estimation calculation).
b. Magnetic Calibration.

To open the calibration window, from the menu, we have to click "Setup->Device Configuration" (see: Figure 29).

In the calibration window there are 3 groups of controls:

a. General Control
b. Static Calibration (Bias Estimation)
c. 2D Hard Iron Calibration

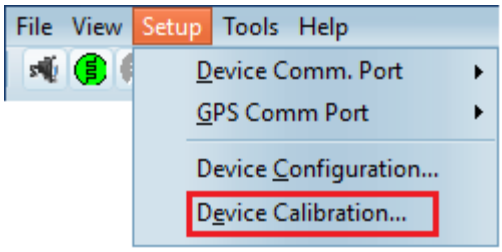


Figure 29 – Device calibration's menu item.

6.1 General Control

In this group there are 4 buttons (see: Figure 30) that do the following:

a. Enter Calibration – Clicking this button will cause the unit to: 1) Send an "Ack" message informing that the message was received.
   2) Stop the data messages from being sent to the HOST.
   3) Set the unit's state machine as "In Calibration".
   4) Send the HOST an "In Calibration" status message.
b. Exit Calibration – Clicking this button will cause the unit to:
   1) Send an "Ack" message informing us that the message was received.
   2) Set the unit's state machine as "In Real-Run".
   3) Send the HOST an "In Real-Run" status message.
   4) Have the system go thru reboot, if unit's calibration was changed, either by performing a calibration or loading calibration values.
c. Save Calibration – Clicking this button will cause the unit to save the new calibration onto flash.
   The "Ack" received, for the command sent, represents not only the reception of the request, but also the end of the writing onto flash, which is a relatively slow process.
   This means that the "Ack" might arrive rather late than normal (up to 6 seconds).
d. Reset to Factory Calibration – In cases where either of the calibrations is bad, and there is no way to perform a calibration, there

is a way to bring back the initial (factory) calibration values.
Please Note: This command DOES NOT burn the parameters onto flash automatically.
Users must click the “Save Calibration” button to burn the new values onto flash.

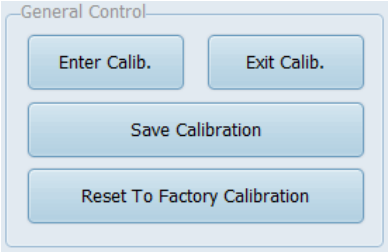


Figure 30 – Calibration’s general-control pane

6.2 Static Calibration (Bias Estimation)

6.2.1 Static Calibration Overview

In order to compensate for the Sensors Biases, we use a compensation algorithm. By default, each of the navigation systems are defined to do the bias estimation calculation immediately after power up. When this option is active, the system holds the calibration in memory registers until the next power cycle.

If the user choose to disable the bias estimation on power up, he still has the ability to do the bias estimation calculation manually on request, by sending the start Bias Estimation instruction.

Sending the Start Bias Estimation instruction, enforce the system to start immediately to collect measurements for the Bias Estimation calculation. The measurement collection will end and calculation will start when the amount of measurement collected are equal to the predefined amount of samples defined for the Bias Estimation on power up or when the Stop bias estimation command is received by the system.

If the Bias Estimation calculation is finished successfully, the user needs to save the new calibration values using the "Burn to Flash" instruction.

The user also has the option to read the calibration values by using two commands: Get Bias Est. Cal & Get Bias Est. Ext. Cal. The user can save the results on the host controller and write them back when it is needed, by using the complementary commands: Set Bias Est. Cal. & Set Bias Est. Ext. Cal.

During the calibration process, the navigation system will send status messages:

1. smStartStaticCal – When command "Start Bias Est.Cal." has been received.
2. smInStaticCal – indicating the percent of measurement processed (relative to the register indicating the amount of messages to process).
3. smDoneStaticCal – When the Bias Estimation calibration ended successfully.
4. smStaticCalError – When the Bias Estimation calibration ended unsuccessfully.

The Bias Estimation is used in all platforms.

6.2.2 Producing Calibration

In the static-calibration group of controls (see: Figure 31), the users can perform a static calibration.
The way to perform a static calibration is the following:

a. Place the unit in a steady, fixed place.
   Please Note: It is important that the unit does not move during the calibration, otherwise the calibration accuracy will be compromised.
b. Click the “Start” button and wait for the system to finish the calibration.
   Once the preconfigured number of samples is gathered by the system, the calibration will stop automatically.
   During the gathering of the samples, the “Status” text-control will inform us of the percentage of samples gathered.
   If the “Status” text-control results in “Ending Bias Estimation”, that means the calibration went well, any other result means the calibration resulted in error.
   The number of static samples gathered can be configured by changing the value of “Static Samples” located in the configuration window, in the “user settings” tab, under the “UKF settings” section. (see: Figure 23)
c. Click “Stop” in cases where we wish to give the math, handling the calibration calculations, less samples than the preconfigured amount – we can click the “Stop” button.
   Please Note: If less than a 1000 samples were gathered, the calibration will return false.
   The calibration math can only handle 1000-9000 samples.
   Any deviation from that range will result in error.
d. To save the static calibration, on FLASH, for future use, users have to click the “Save Calibration” button, located in the “General Control” group.

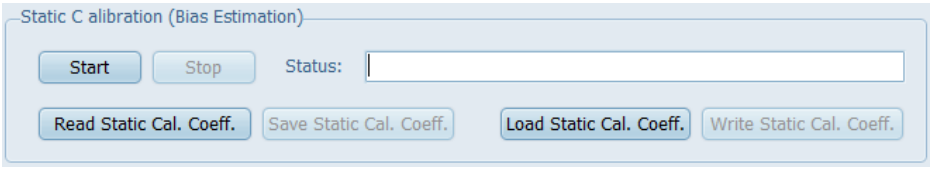


Figure 31 – Calibration's static-calibration control pane

6.2.3 Loading & Saving Calibration

The static calibration also allows for reading and writing of static calibration coefficients from the RAM memory onto a file and vice versa.
To obtain static calibration coefficients from a file, users have to do the following:

a. Click the "Load Static Cal. Coeff." Button.
b. Choose the file, containing the coefficients, to load.
c. Once loaded, the "Write Static Cal. Coeff." Button will be enabled. Clicking on that button will write the coefficients loaded to the RAM memory of the unit.
   Please Note: The new values are only written to RAM memory. In order to save it to flash, users must click the "Save Calibration" button, located in the "General Control" group.

To save current static calibration onto a file, users have to do the following:

a. Click on "Read Static Cal. Coeff." button.
b. Once all the coefficients were read from unit, the "Save Static Cal. Coeff." button will be enabled.
   Clicking on that button will open a "Save to File" dialogue.
   Choose a name and path for the new file and click "Save".

6.3 2D Hard Iron Calibration

6.3.1 2D Hard-Iron Calibration Overview

The navigation systems that uses magnetometers sensors (AHRS, INS) needs to compensate the magnetic environment where the system was installed at least for the first installation.

Like for the bias estimation, the navigation system is equipped with instructions for doing hard-iron calibration, reading hard-iron calibration values and writing the hard-iron calibration values.

The hard-iron calibration can take place only manually. The user needs to enter calibration mode, send the "Start HI calibration" command, rotate horizontally the platform on which the navigation system is installed for 360 degrees (720 degrees is better) and send the "Stop HI calibration" Command. The user should verify that the calibration has ended successfully and send the command "Burn to Flash" to save the current calibration results.

When the user exits the Calibration mode, the connected navigation system will do a soft reset.

During the calibration process, the connected system should send Status messages:

1. smStartHICal – for receiving Start HI Calibration instruction
2. smInHiCal - indicating the amount of messages processed.
3. smDoneCal – when calibration calculation ended successfully.
4. smHICalError – when calibration calculation ended unsuccessfully.

The user also has the option to read the calibration values by using command: "Get Hard-Iron Calibration". The user can save the results on the host controller and write them back when it is needed by using the complementary command: "Set Hard-Iron Calibration".

6.3.2 Producing Calibration

Using the magnetic-calibration group of controls (see: Figure 32), users can perform a magnetic calibration (also known as: Hard-Iron Calibration).
The way to perform a magnetic calibration is the following:

a. Fix the unit to a steady place that can rotate the unit.
   It can be a rotating platform (if indoors) or a vehicle (if outdoors).
b. Press the “Start” button.
   This will cause:
   1. The disabling of the “Start” button and enabling of the “Stop” button.
   2. The status textbox to show a running value representing the number of samples gathered.
c. Start rotating the unit slowly (direction of rotation is meaningless) until you’ve reached a full circle.
   Please Note: It is highly recommended performing two full circles for more accurate results).
d. Once the rotations are done, we need to click the “Stop” button.
   This will:
   1. Start performing mathematical calculations, with the gathered samples, and come up with a result that will be presented in the “Status” textbox.
   If the calibration resulted in error, system will present it in the “Status” textbox as well.
   2. The “Stop” button will be disabled and the “Start” button enabled.
e. To save the magnetic calibration, on FLASH, for future use, users have to click the “Save Calibration” button, located in the “General Control” group.

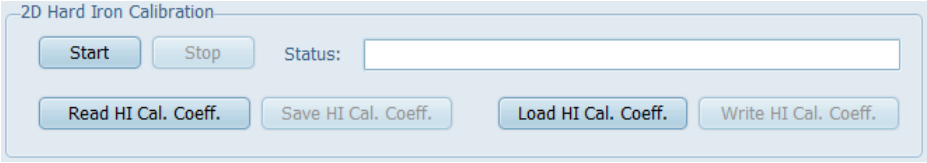


Figure 32 - Calibration’s magnetic-calibration control pane

6.3.3 Loading & Saving Calibration

The magnetic-calibration group of controls also allows for reading and writing of magnetic calibration coefficients from the RAM memory onto a file and vice versa.

To obtain magnetic calibration coefficients from a file, users have to do the following:

a. Click the “Load HI Cal. Coeff.” Button.
b. Choose the file, containing the coefficients, to load.
c. Once loaded, the “Write HI Cal. Coeff.” Button will be enabled.
   Clicking on that button will write the loaded coefficients to the RAM memory of the unit.
   Please Note: The new values are only written to RAM memory.
   In order to save it to flash, users must click the “Save Calibration” button, located in the “General Control” group.

To save current static calibration onto a file, users have to do the following:

a. Click on “Read HI Cal. Coeff.” button.
b. Once all the coefficients were read from unit, the “Save HI Cal. Coeff.” button will be enabled.
   Clicking on that button will open a “Save to File” dialogue.
   Choose a name and path for the new file and click “Save”.