

DR Calibration Instructions

GADN/ANNA Series with u-blox F9R

Version 2.1

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Antzer Tech In-Vehicle Module User Manual

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Change History

Version	Date	Author	Description
0.1	2018/8/28	Haney Huang	Draft of the document
1.0	2018/12/10	Haney Huang	First version release
1.1	2019/7/8	Haney Huang	1. Unchecked “Use both WT” option in Chapter 2.9 Step4 according to u-blox FAE suggestion. 2. Added Appendix G
2.0	2020/5/28	Haney Huang	1. Added ANNA series on the cover page 2. Added ADR connection description of M.2 cards (ANNA-M, GADN-M) in the document 3. Added Automatic Mode setting in Chap.2.9 4. Fixed the typo and added more explanation for the ADR signals in Appendix G 5. Changed the voltage requirement for ADR Signals in Appendix G.
2.1	2021/5/11	Vincent Cheng	For F9R

1. Introduction

This document includes Dead Reckoning calibration instructions for the GADN/ANNA series product of Antzer-tech.

Below are the SKUs of GADN/ANNA having Dead Reckoning function:

- **UDR (Untethered Dead Reckoning)** using u-blox NEO-M8U GNSS module.
GADN-FxxUx, ANNA-FxxUx, GADN-MxxUx, ANNA-MxxUx
- **ADR (Automotive Dead Reckoning)** using u-blox NEO-M8L GNSS module.
GADN-FxxLx, ANNA-FxxLx, GADN-MxxLx, ANNA-MxxLx

UDR blends GNSS signals and sensors, such as the accelerometer and gyroscope, to provide accurate positioning performance in areas such as dense cities or covered areas. In addition to the sensors, ADR combines speed information from the vehicle to provide better positioning accuracy when satellite signals are partially or completely blocked.

In the following chapters, (*) indicates the procedure is only for ADR function.

2. Setup Test Environment

Follow the steps below to complete the test environment setup.

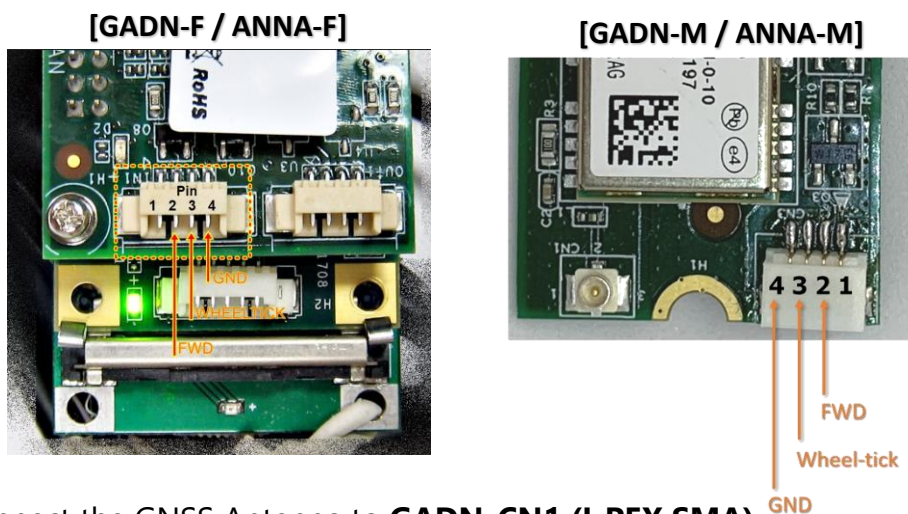
2.1 Hardware setup

Step 1 Insert the GADN/ANNA card to your in-vehicle computer, and install your in-vehicle computer on your vehicle

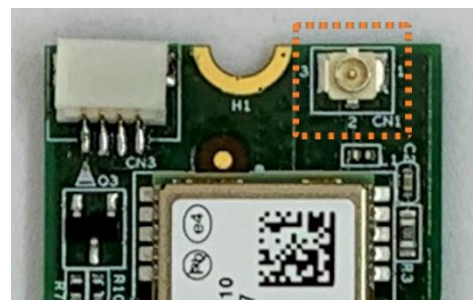
Note: If the direction or the position of the module is moved during or after the process, the module will need to be re-calibrated.

Step 2 Connect the **FWD signal** to the connector **GADN_IN1(Pin2)** or **ANNA_CN3(pin2)** (*)

Step 3 Connect the **WHEELTICK signal** to the connector **GADN_IN1(Pin3)** or **ANNA_CN3(pin3)** (*)



Step 4 Connect the GNSS Antenna to **GADN_CN1 (I-PEX SMA)** or **ANNA_CN1 (I-PEX SMA)**

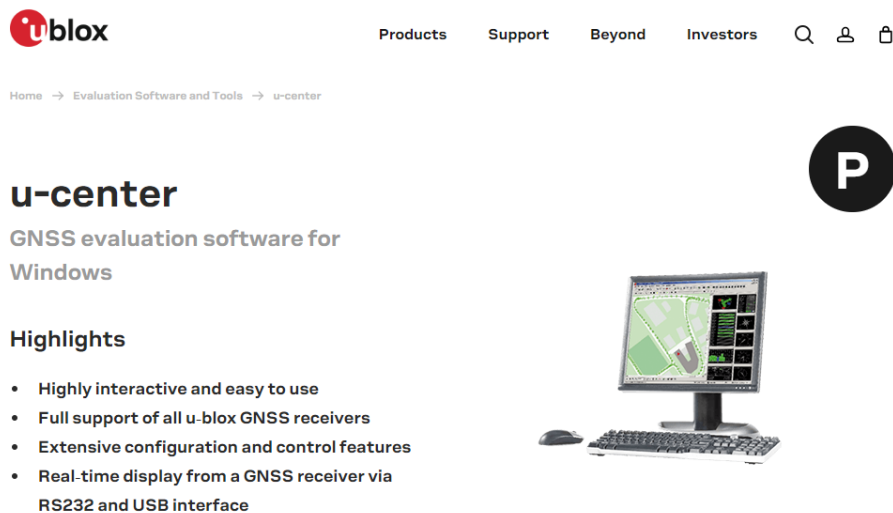


2.2 Install the driver for bridge IC on GADN/ANNA

- For the Windows™, go to "<https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers>" and download Silicon Labs CP2105 bridge IC driver.
- For the Linux™ (Ubuntu 14.04 and later, Debian 8.x and later), Silicon Labs CP2015 driver is already built-in.
- Please contact your sales representative if you need any other help.

2.3 Download the u-center

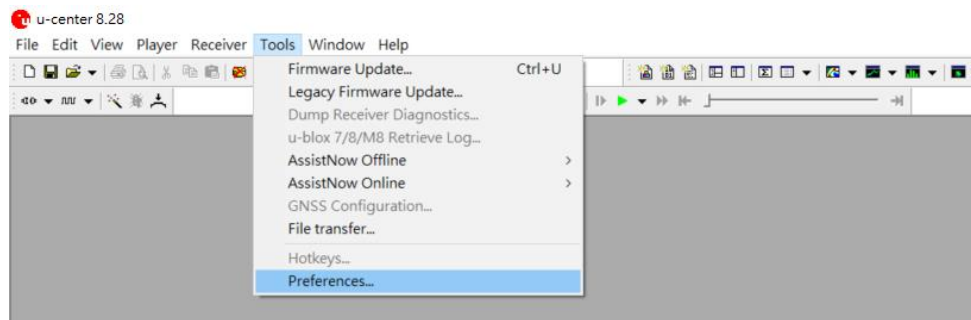
The u-center is a GNSS evaluation software for performance analysis and configuration of u-blox GNSS receivers. Go to "<https://www.u-blox.com/en/product/u-center>" and download u-center from the website.



Note: The u-center is only available for Windows™. To configure the GNSS module under Linux™, please contact your sales representative for more information.

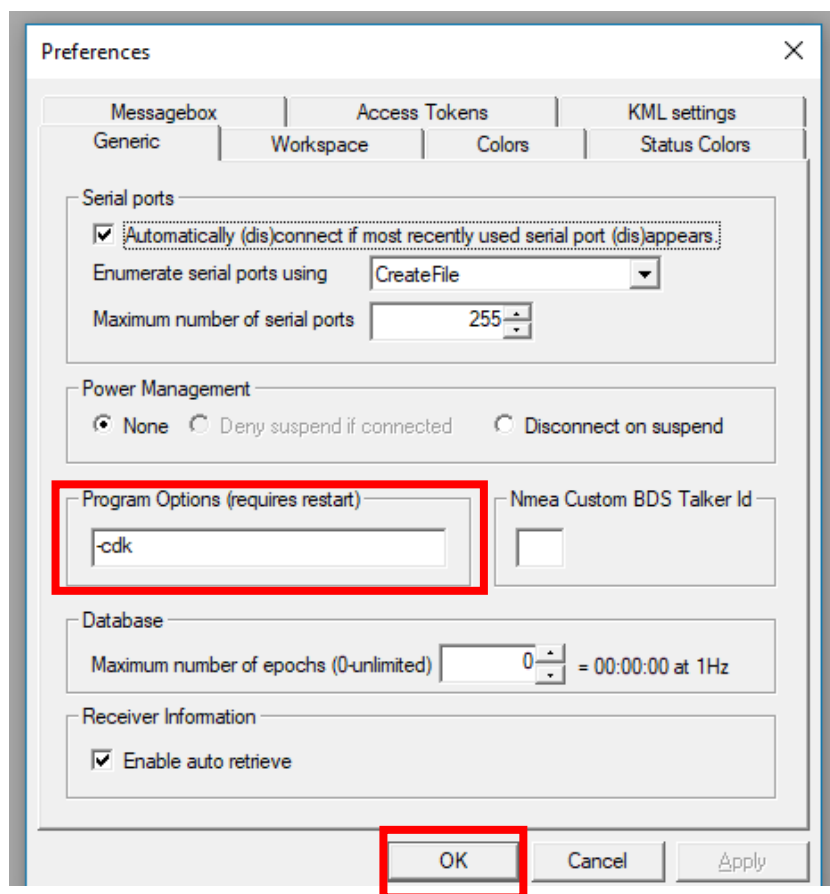
2.4 Change the preferences of u-center in order to see more detailed setting information about the GNSS module.

Step 1 On the main menu bar, click on **Tools → Preferences...**



Step 2 Type in **"-cdk"** in the field of **Program Options**.

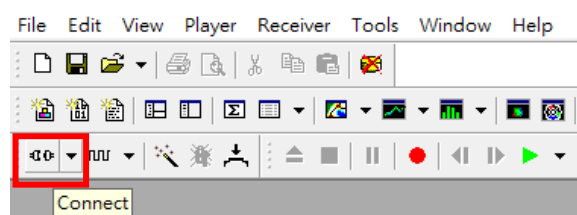
Step 3 Click **"OK"** and then **re-start the u-center to complete the setting**.



2.5 Enable the Serial Port Connection to GADN/ANNA

Press the **“Connect”** button a in the upper left and select the COM port used for GNSS module.

Note: There are two COM pots will be shown in the device manager, one is for GNSS module (Naming: **“Standard Com Port”**) and another one is for the CAN bus (Naming: “Enhanced Com Port”).



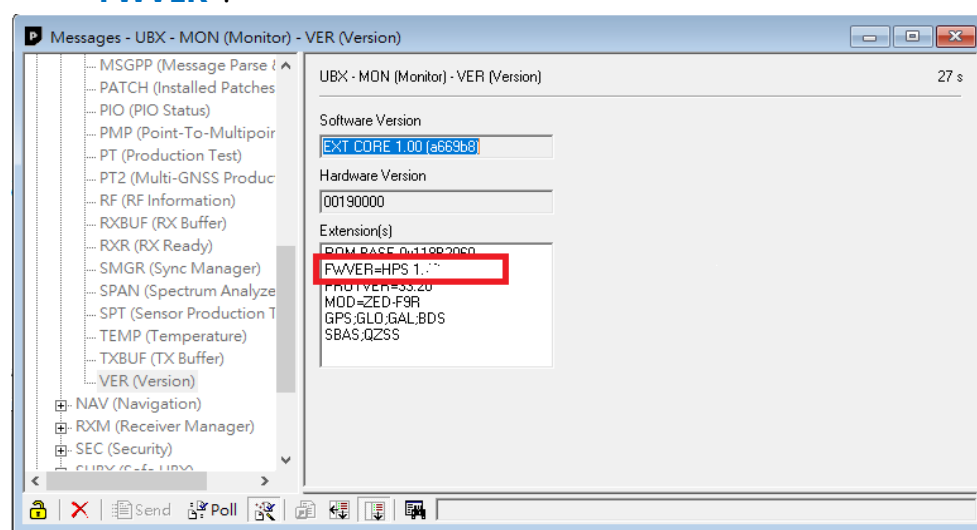
2.6 Check the firmware version of the GNSS module

For ADR application, the firmware version HPS 1.XX or above is recommended from u-blox. (*)

Step 1 Click on View on the upper left menu bar → **Messages View**

Step 2 On the left, expand the **MON (Monitor)** item and select **VER (Version)**

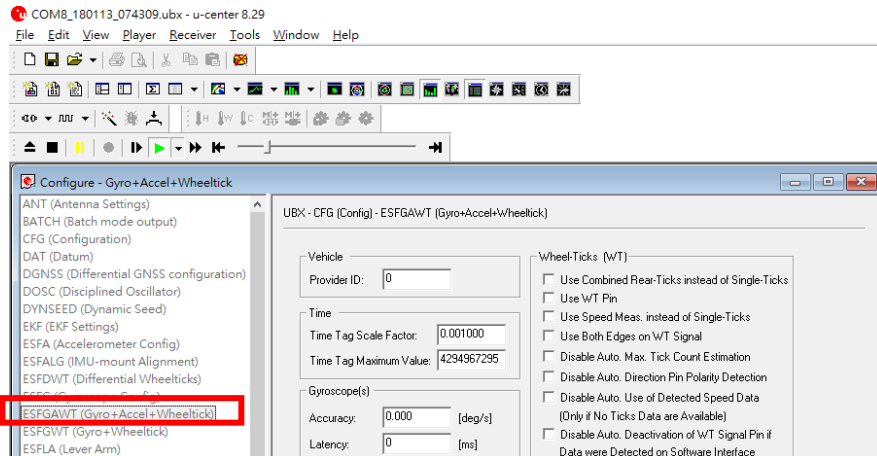
Step 3 You could see the firmware version in the **Extension** column after **“FWVER”**.



Please contact your sales representative if you want to update the firmware of the GNSS module on the card.

2.7 Enable wheel-tick function (*)

Step 1 Under Configuration view, go to ESFGAWT(Gyro+Accel+Wheeltick)



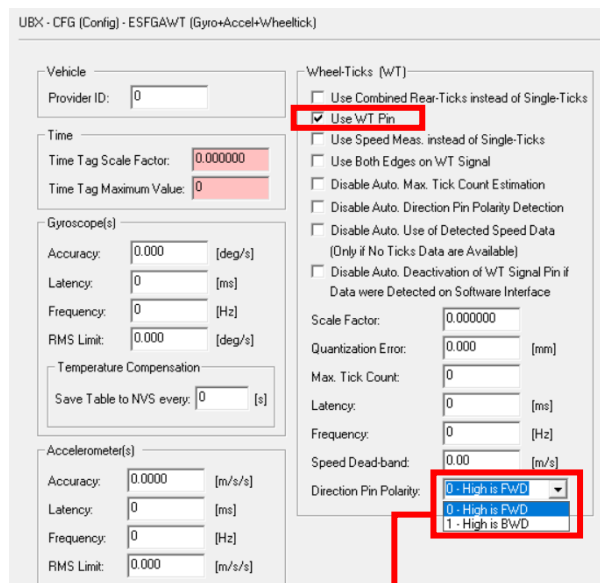
Step 2 Select **Used WT Pin** in **Wheel-Ticks (WT)**

Step 3 **[Not Compulsory]** Select **Used Both Edges on WT Signal** if you want to have more frequently data input from the wheel-tick signal.

Step 4 Choose the direction setting regarding to your vehicle under **Direction Pin Polarity**

"0-High is FWD" (Default setting of NEO-M8L)

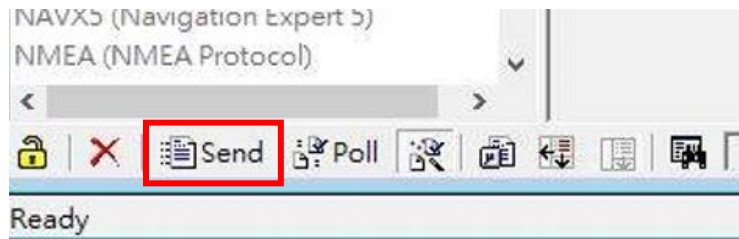
"1-High is BWD"



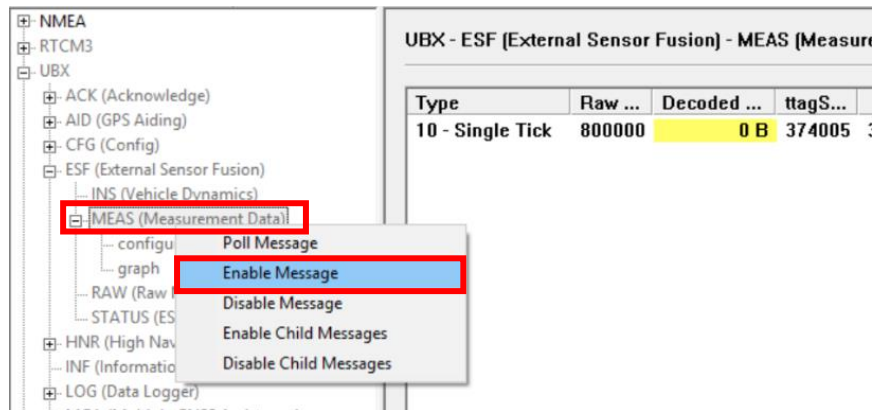
Note: When the reverse signal is not connected from the vehicle:

- **GADN-F / ANNA-F:** The card will by default provide HIGH level signal to the GNSS module.
- **GADN-M / ANNA-M:** The card will by default provide LOW level signal to the GNSS module.

Step 5 Press **Send** to save the settings.

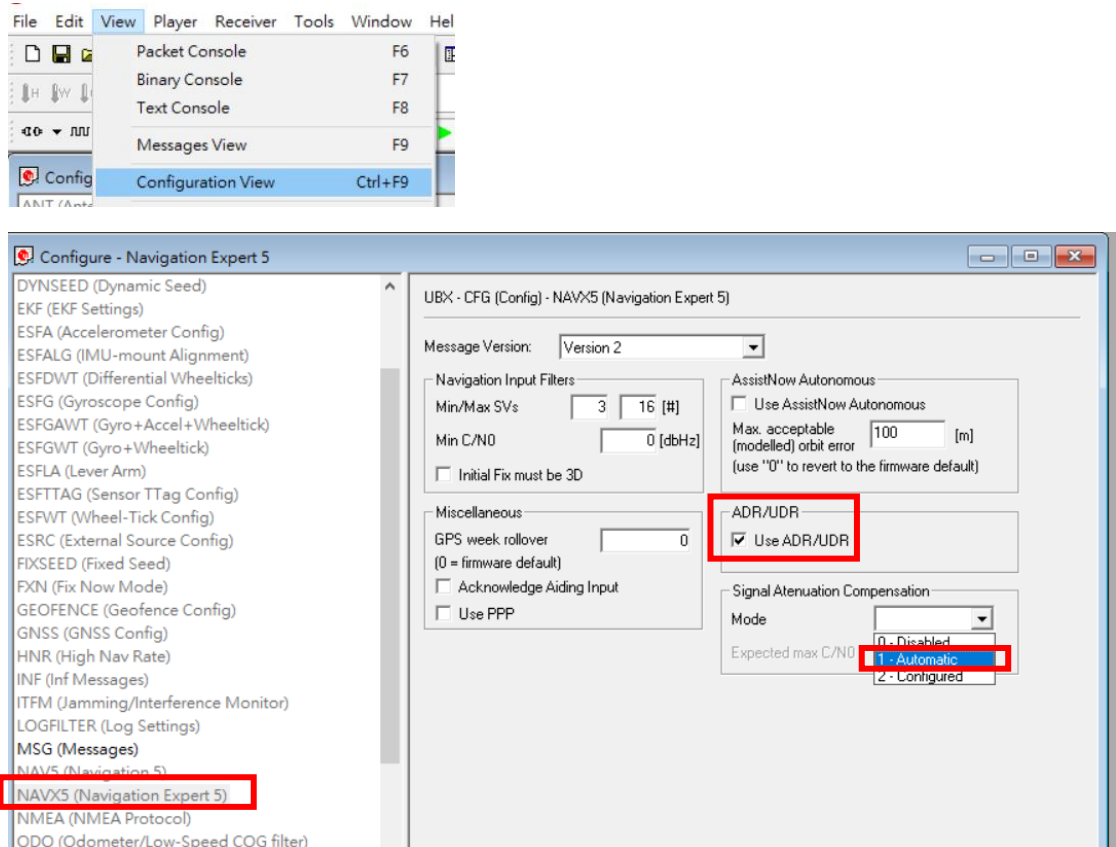


Step 6 Go to **UBX → ESF → MEAS** under **Message View**. Right click on **MEAS(Measurement Data)** and choose **Enable Message**.

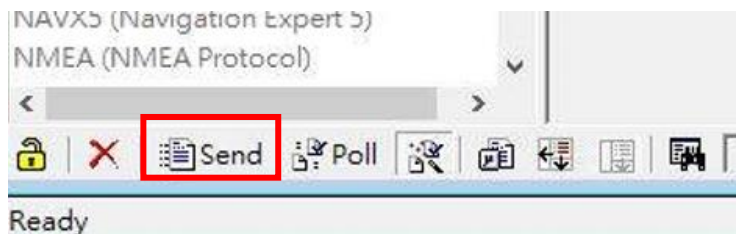


2.8 Activate Auto Alignment function

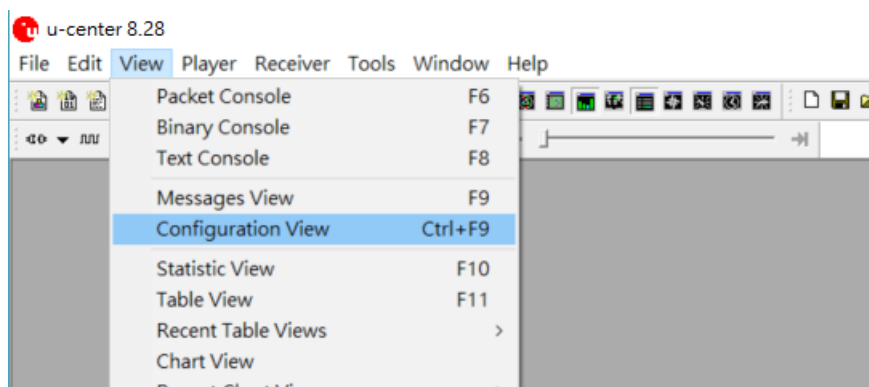
Step 1 Go to **View → Configuration View**. Go to **NAVX5 (Navigation Expert 5)** on the left of control window and select **Use ADR/UDR**. Also, the **Automatic Mode** under the Signal Attenuation Compensation is recommended for the automotive application.



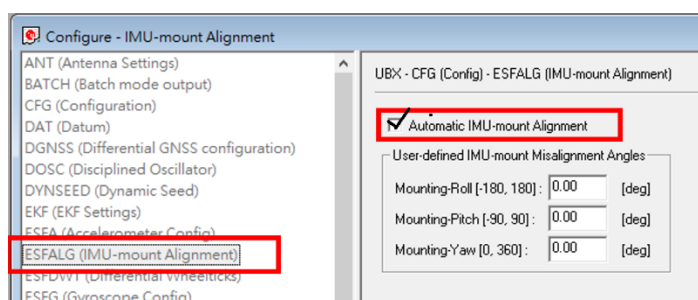
Step 2 Press **Send** to activate ADR/UDR function.



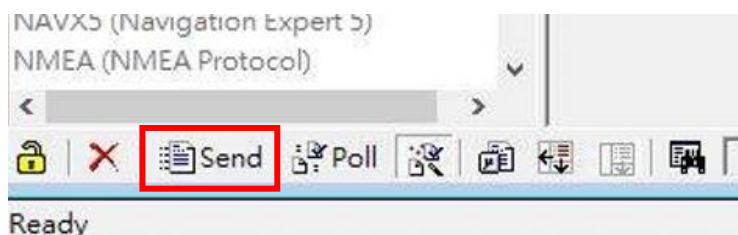
Step 3 Go to **View → Configuration View** and select **ESFALG (IMU-mount Alignment)**.



Step 4 Select **Automatic IMU-mount Alignment**



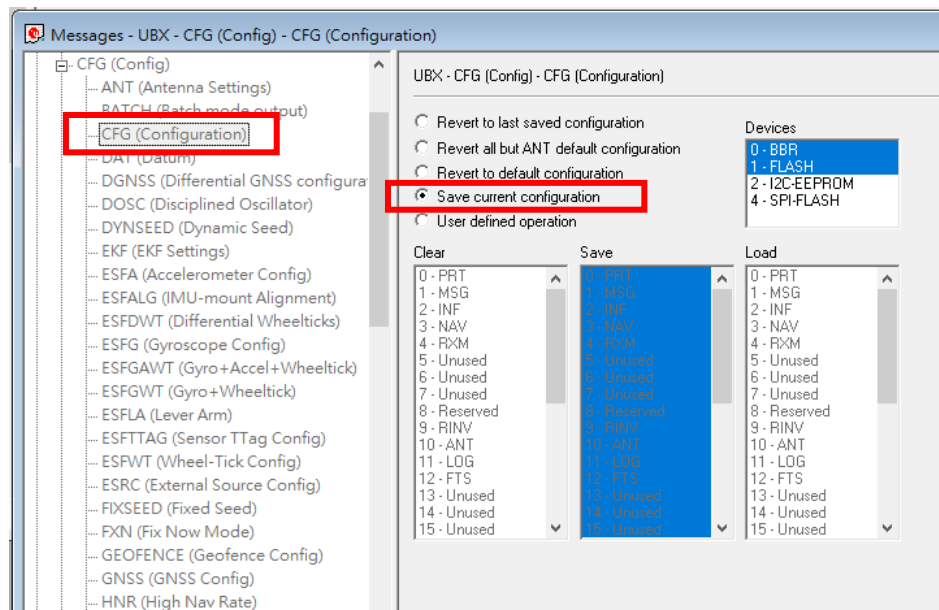
Step 7 Press **Send** to enable Auto-alignment function.



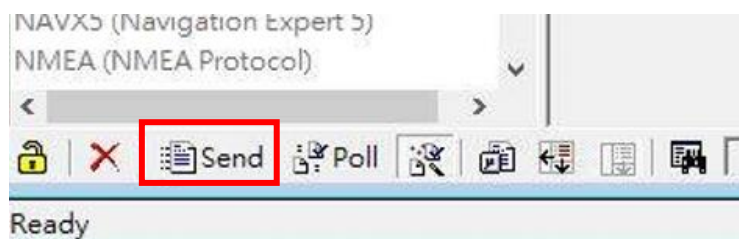
2.9 Save the configuration

After all the settings is done, please follow the steps below to save current configuration to the GNSS module.

Step 1 Select **UBX → CFG → CFG(Configuration)** under the **Messages View** and choose **“Save current configuration”**



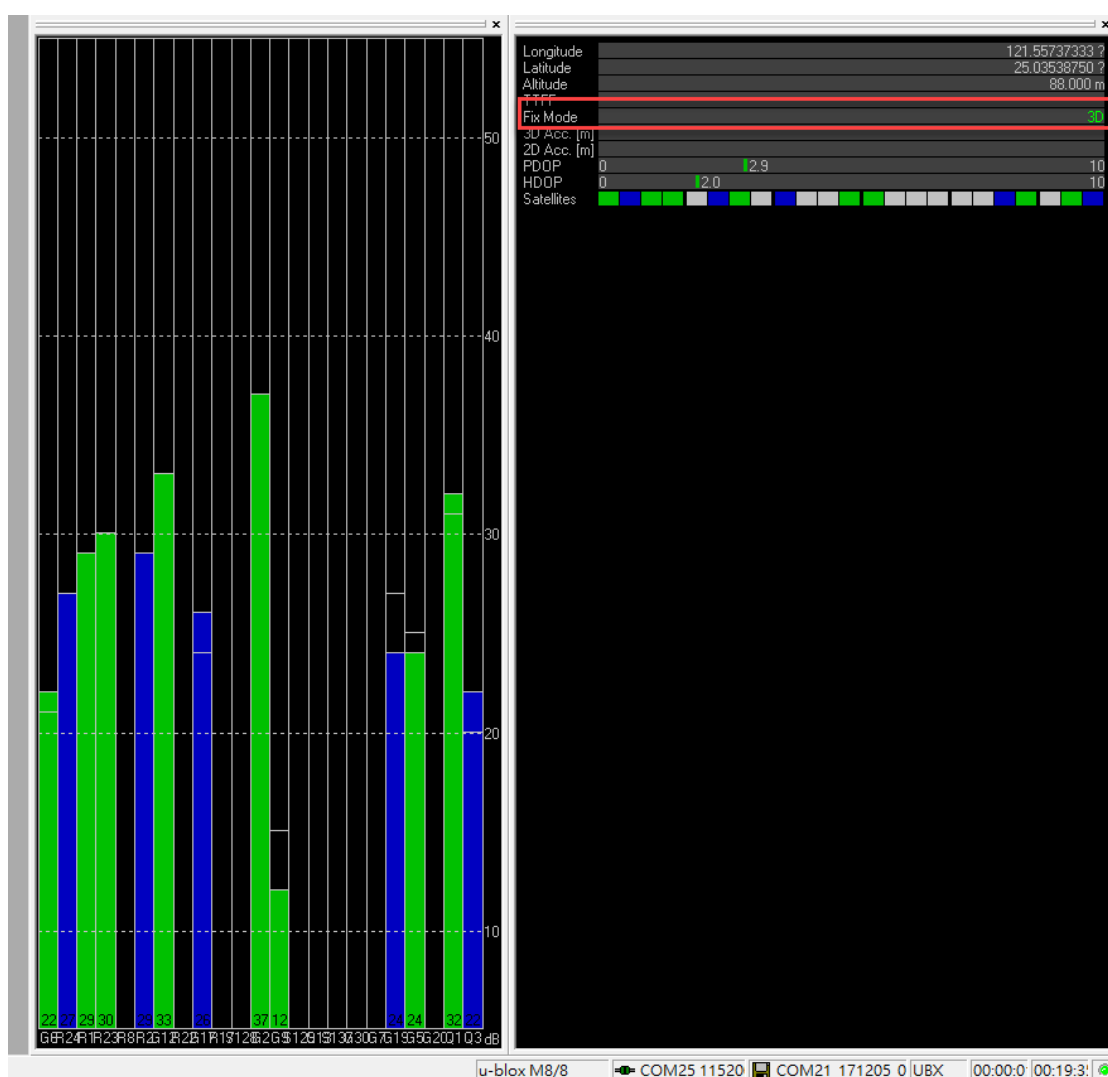
Step 2 Press **Send** to save current configuration in GNSS module



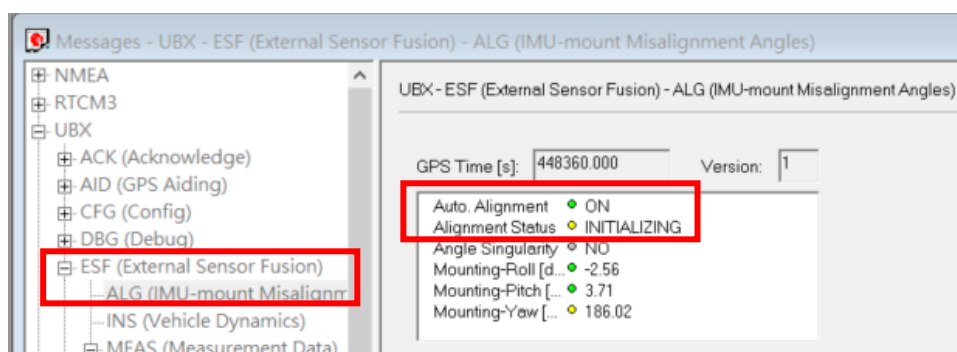
3. Start DR Calibration

Follow the steps below to proceed to DR Calibration.

- Step 1 Park the vehicle installed with GADN/ANNA at a wide and flat open space.
- Step 2 Run u-center application to check whether the GNSS signal is received. On the right side of the main page, the status of **Fix Mode** will show **3D** when GNSS positioning is fixed.



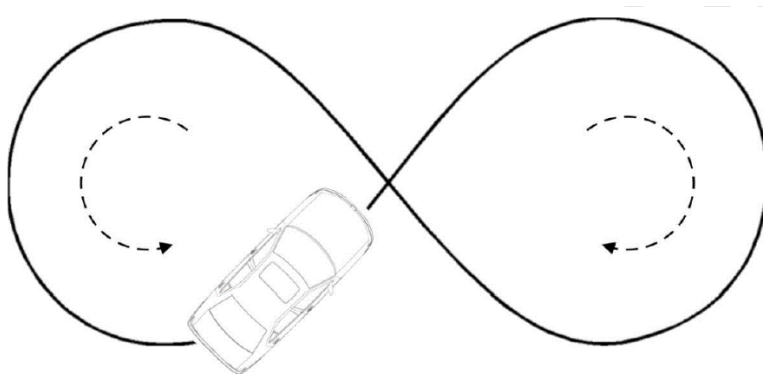
- Step 3 On the main page of u-center, click on **View** on the upper left menu bar → **Messages View**
- ✓ On the left, expand **ESF (External Sensor Fusion)** → **ALG (IMU-mount Misalignment Angles)**
 - ✓ Auto. Alignment should show **"ON"**, and Alignment Status should be **"INITIALIZING"**
(If the Auto Alignment shows "OFF", please return to Chapter 2.9 and make sure all the steps are executed correctly)

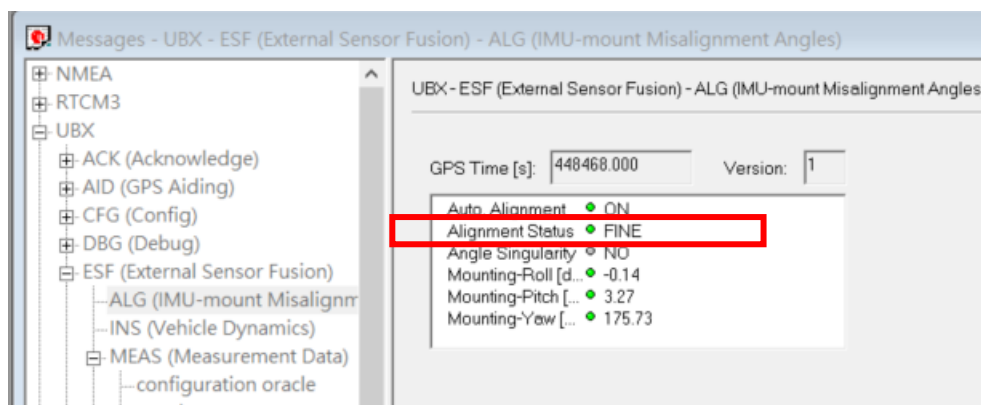


- Step 4 Operate the vehicle with **one of the following two methods** to calibrate the mounting location of the module.
- ✓ After you finish Step 4, you will get relatively stable values of **Mounting-Roll**, **Mounting-Pitch** and **Mounting Yaw** and the Alignment Status will turn **"FINE"**.
 - ✓ The three values will keep changing unless you **disable auto-alignment function**.

[Method_1]

Operate **in the route of "∞ shape"** at a constant speed until Alignment Status shows **"FINE"**

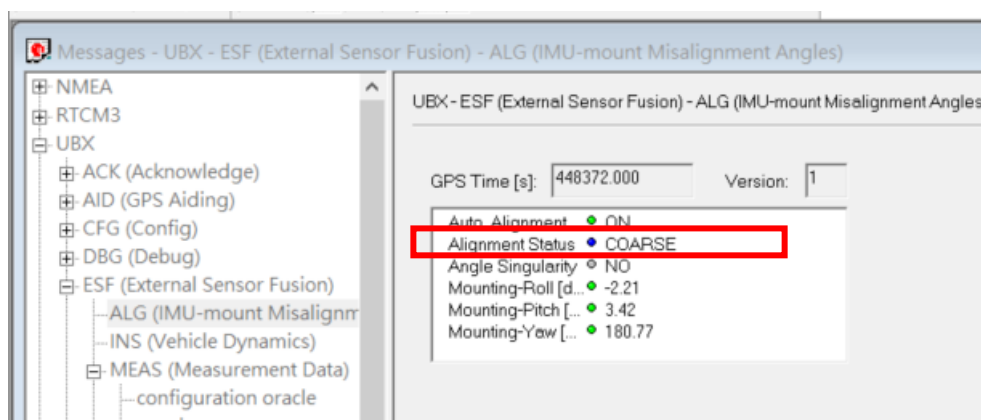
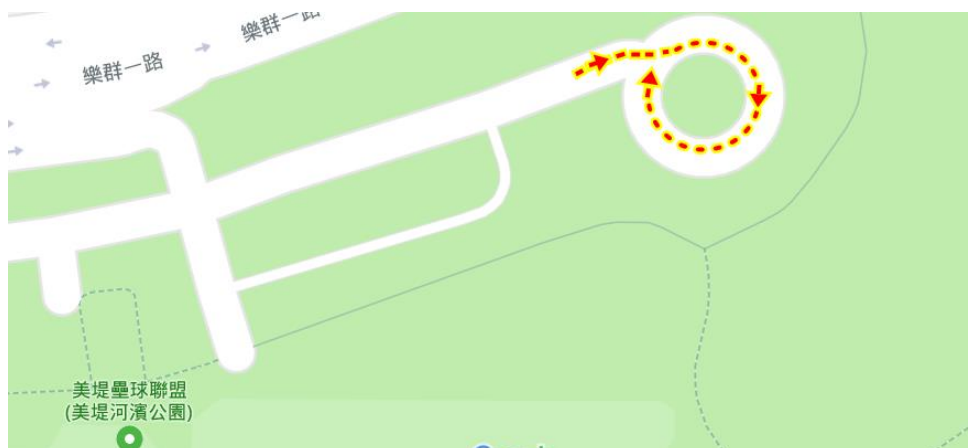




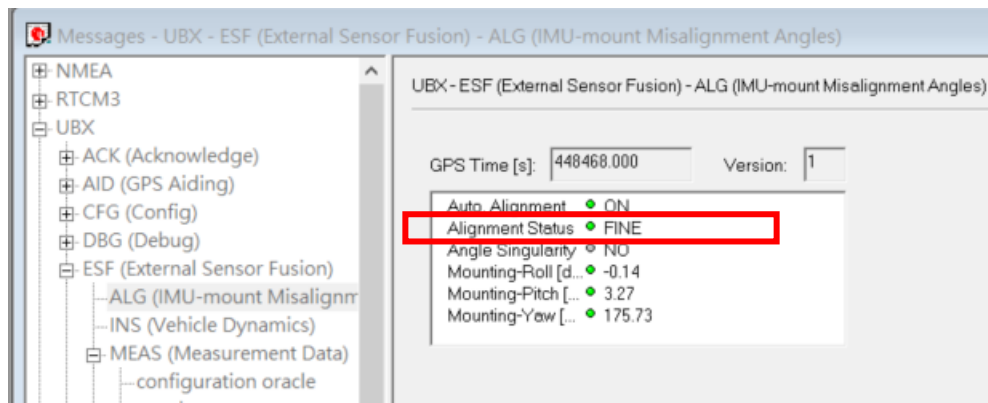
[Method_2]

Operate the vehicle **along a circular track**.

- ✓ Operate the vehicle clockwise with a constant speed. (In the process, the status of Auto. Alignment will show **"COARSE"**)

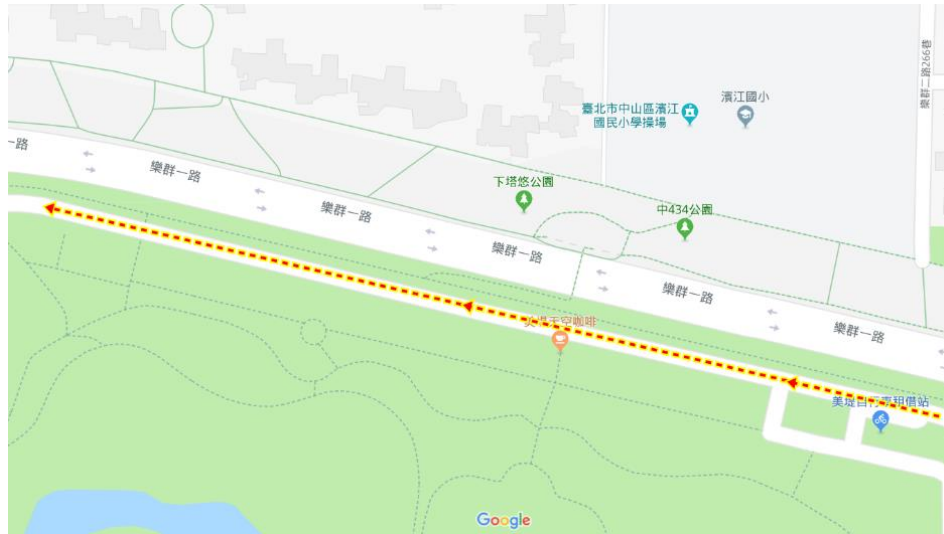


- ✓ Operate the vehicle counter clockwise with continuous speed. (In the process, the status of Auto. Alignment will show **"FINE"**)



Step 5 Operate the vehicle straight forward for 500 meters with the speed of 40 km/hour to calibrate **Gyroscope Z** and **Single Tick**.

- ✓ After you finish Step 5, the status of **Gyroscope Z** and **Single Tick** will turn **"CALIBRATED"**.
- ✓ (*) The "Single Tick" information only appears in NEO-M8L sku.



Messages - UBX - ESF (External Sensor Fusion) - STATUS (ESF Status)

UBX - ESF (External Sensor Fusion) - STATUS (ESF Status)

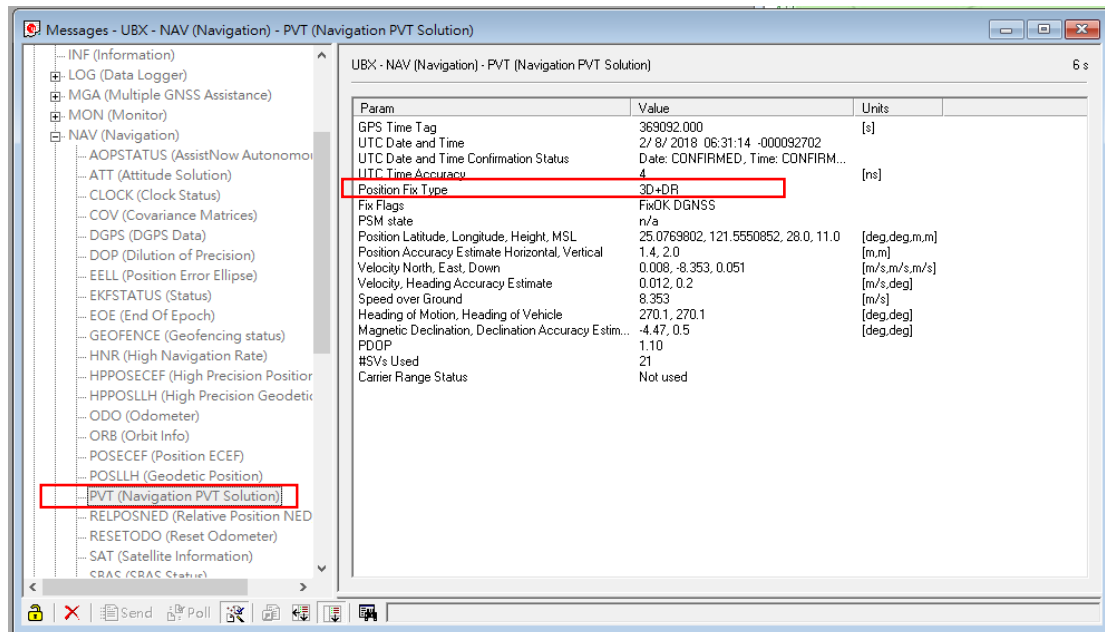
GPS Time [s]: 448793.000 Version:

Fusion Filter Mode: FUSION
IMU Status: INITIALIZED
Wheel-tick Sensor Stat...: INITIALIZED
INS Status: INITIALIZED
IMU-mount Alignment ...: INITIALIZED

Sensor	Status	Ti...	Freq	Faults
Gyroscope Z	CALIBRATED	FB	10	
Single Tick	CALIBRATED	FB	10	
Gyroscope Temp.	NOT CALIBRATED	FB	10	
Gyroscope Y	NOT CALIBRATED	FB	10	
Gyroscope X	NOT CALIBRATED	FB	10	
Accelerometer X	CALIBRATED	FB	10	
Accelerometer Y	NOT CALIBRATED	FB	10	
Accelerometer Z	NOT CALIBRATED	FB	10	

The calibration is done after step 5 is finished.

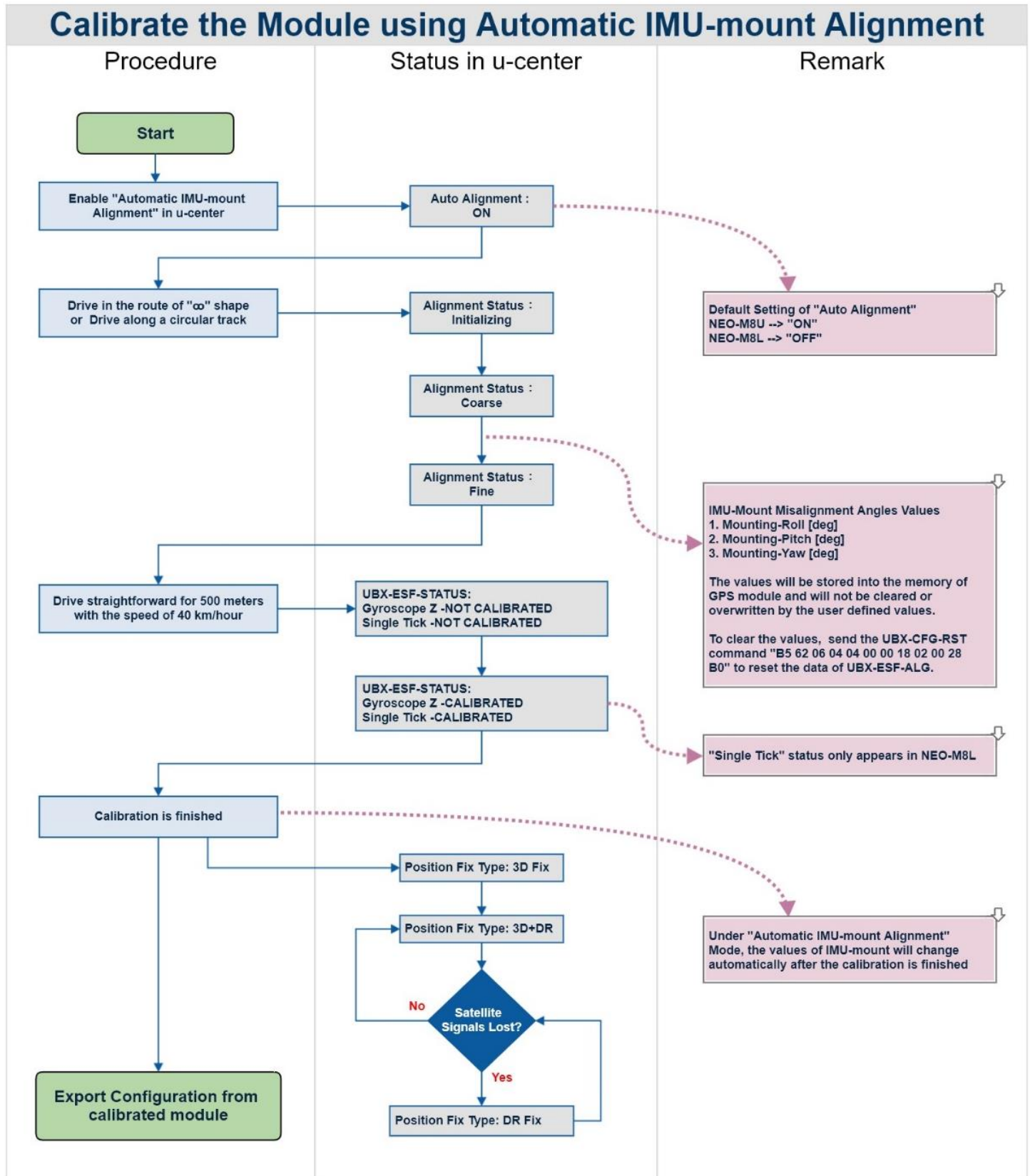
The status of **Position Fix Type** under **UBX-NAV-PVT** will be **"3D+DR"** which means the GNSS module is calibrated and is able to enter DR mode when losing satellite signals.



Different Status of **Position Fix Type**:

	Before Calibration	When Calibration is Finished	Finish Calibration and Lost Satellite Signals
Status	3D Fix	3D +DR	DR Fix

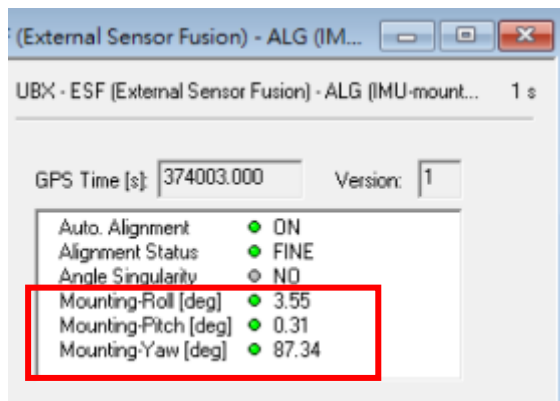
Below is the flow chart shows the procedure for DR calibration.



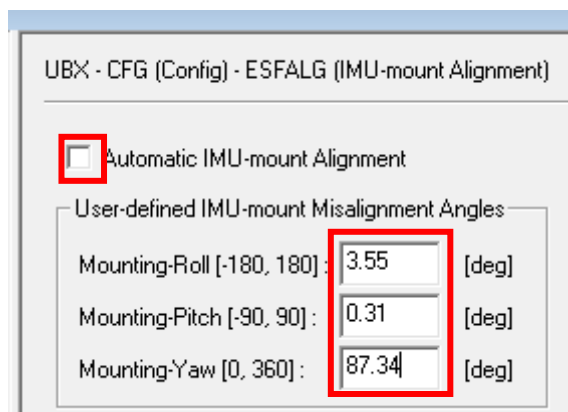
4. Export Configuration from Calibrated Module

To deploy the GADN/ANNA cards to a number of vehicles (same type) in your fleet, you don't need to repeat calibrating each vehicle. You just need to copy the calibrated parameters to other GNSS modules. Chapter 4 and 5 show you how to export the configuration of calibrated module and import the configuration to an uncalibrated module.

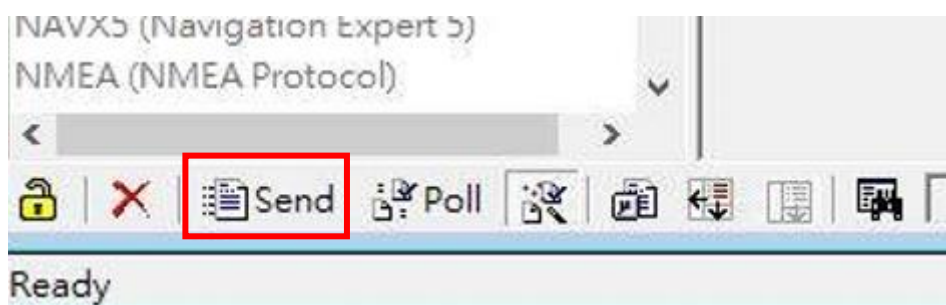
Step 1 After the calibration is finished, keep the record of **Mounting-Roll**, **Mounting-Pitch** and **Mounting-Yaw** in UBX -> ESF -> ALG.



Step 2 Deselect **Automatic IMU-mount Alignment** and then fill the records into **User-defined IMU-mount Misalignment Angles**.

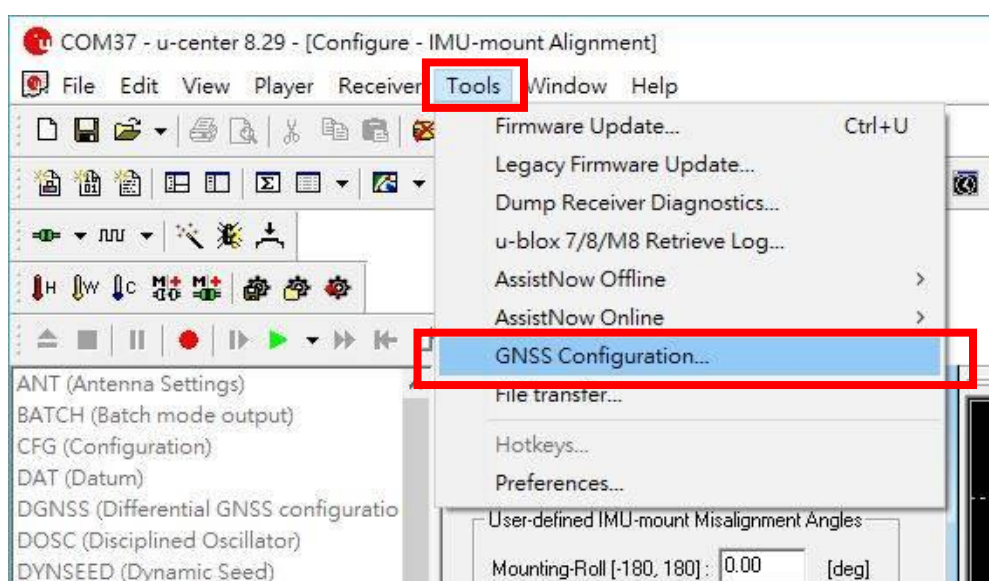


Step 3 Press **Send** to save the settings.



Step 4 Follow the steps in Chapter 2.10 to save the configuration in the GNSS module.

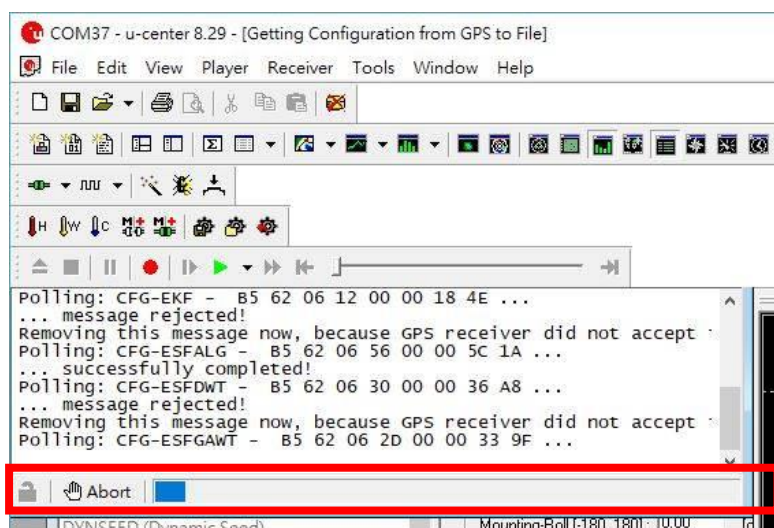
Step 5 Go to **Tools** and choose **GNSS Configuration**



Step 6 Click **"GNSS>File"** button to save configuration to the file.



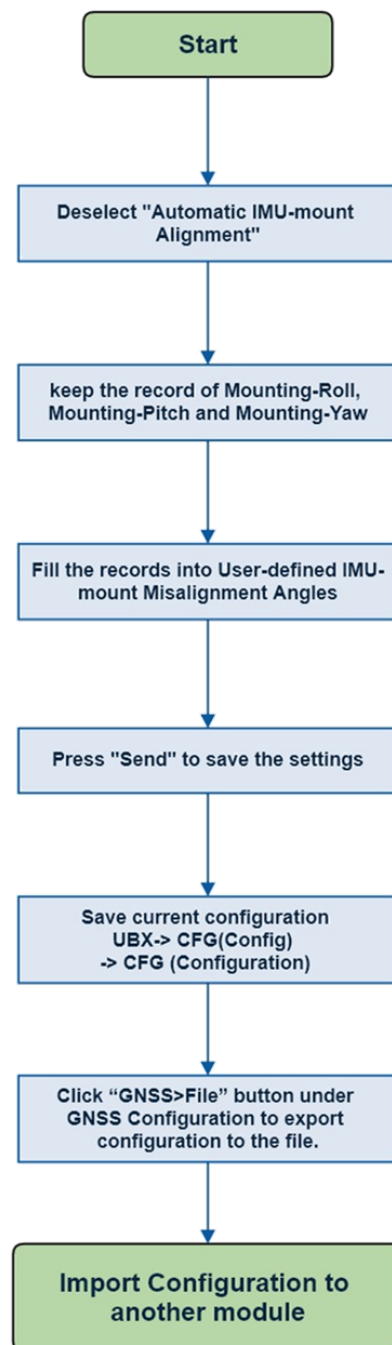
Step 7 u-center will start exporting the configuration to the file you chose in step 6.



Below is the flow chart shows the procedure for exporting the configuration from calibrated module.

Export Configuration from Calibrated Module

Procedure



5. Import Values from the Calibrated Module

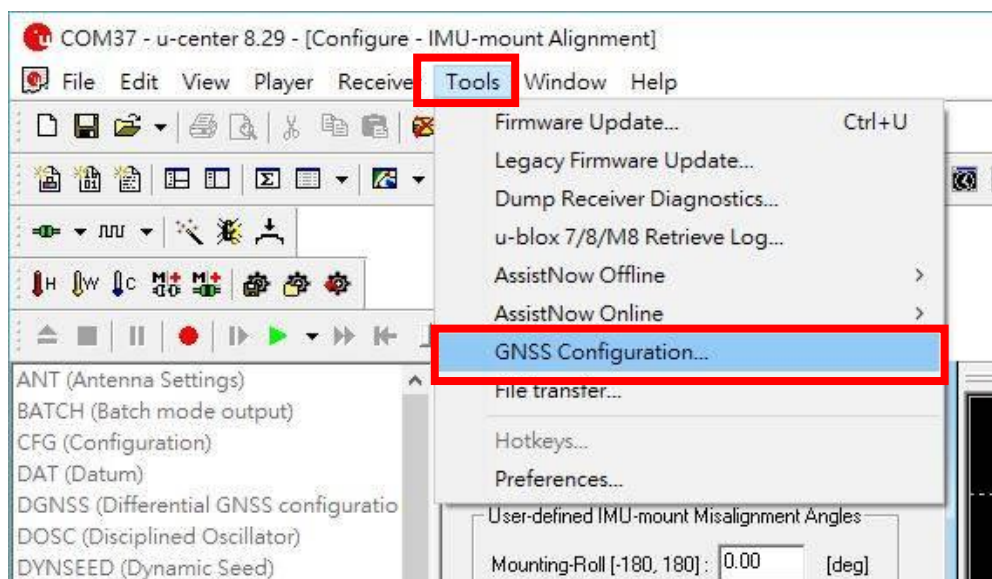
To use user-defined values, the GNSS modules needs to be mounted on the same place and direction in the vehicle to ensure that the values of **Mounting-Roll**, **Mounting-Pitch** and **Mounting-Yaw** from the calibrated module works.

Step 1 There are two ways to set **user-defined IMU-mount Misalignment Angels** to the GNSS module.

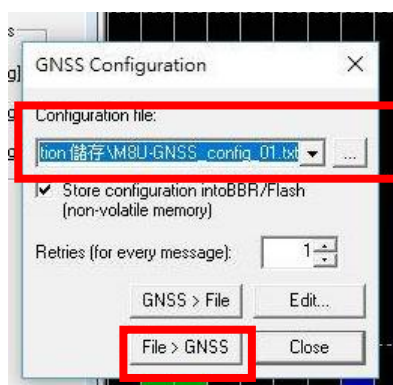
[Method_1]

Import all settings from the calibrated module.

- ✓ Go to **Tools** and choose **GNSS Configuration**

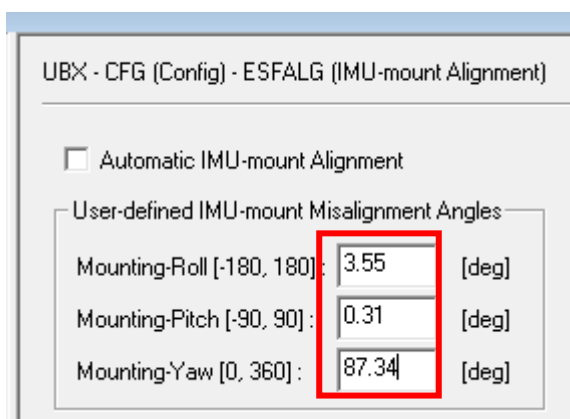


- ✓ Choose the configuration file you saved before and click **"File>GNSS"** button.

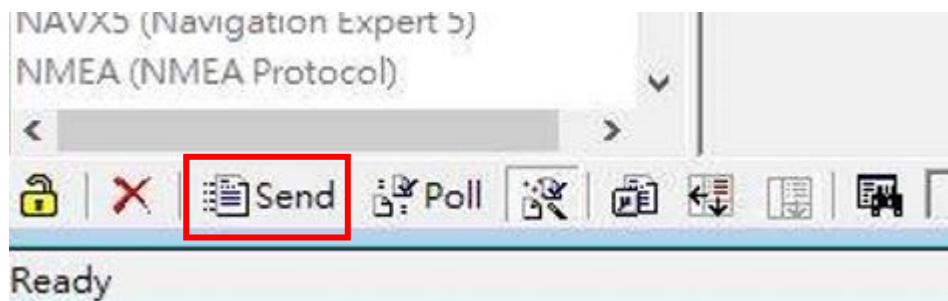


[Method_2]

- ✓ Keep the record of **Mounting-Roll**, **Mounting-Pitch** and **Mounting-Yaw** in UBX -> ESF -> ALG from the calibrated module.
- ✓ Fill the records into **User-defined IMU-mount Misalignment Angles**.



- ✓ Press **Send** to save the settings.

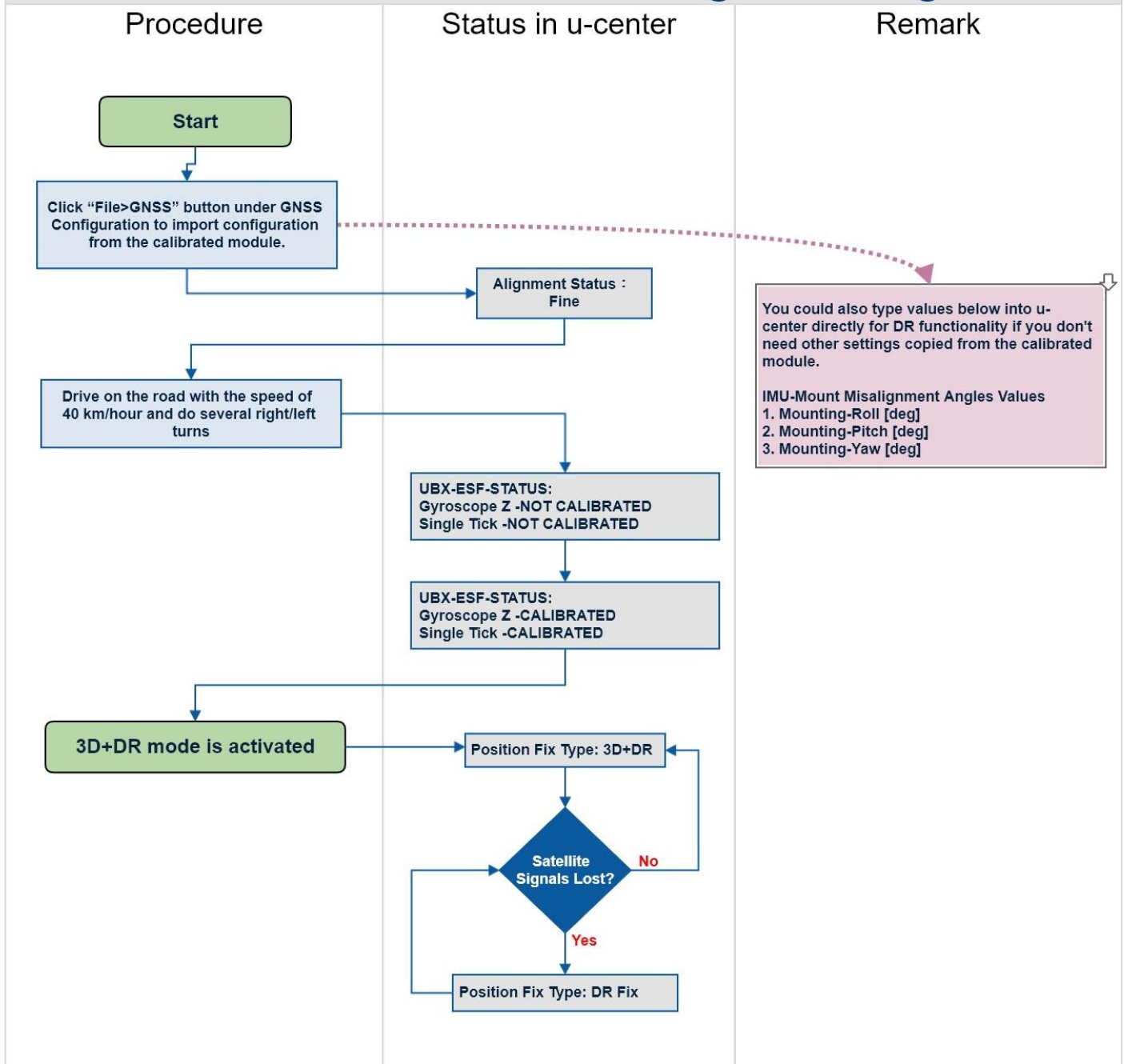


- ✓ Follow the steps in Chapter 2.10 to save the configuration in the GNSS module.

Step 2 To enter DR mode using **user-defined IMU-mount Misalignment Angles**, drive on the road with the speed of 40 km/hour and do several right/left turns until the status of **Position Fix Type** under **UBX-NAV-PVT** changes to **"3D+DR"**.

Below is the flow chart shows the procedure for using user-defined values to enter DR mode.

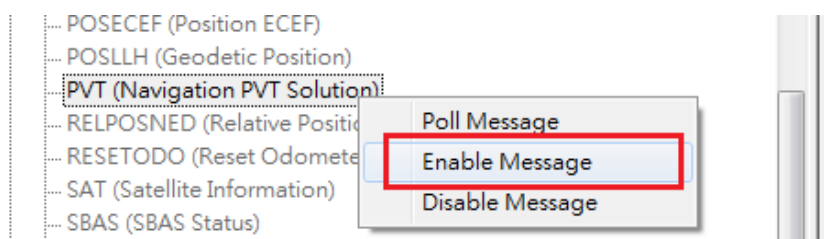
User-defined IMU-mount Misalignment Angles.



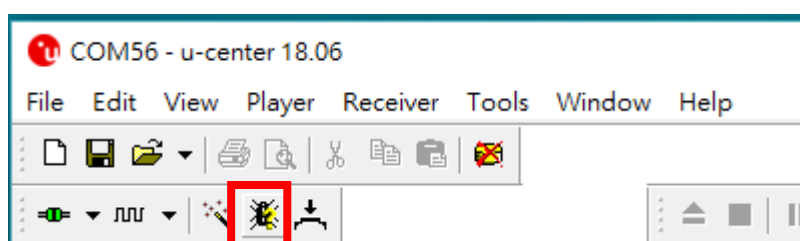
6. Log DR information

Step 1 Make sure that the settings in Chapter 2 is completed.

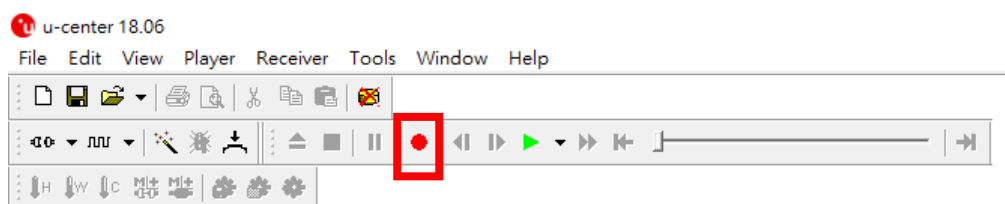
Step 2 Double-check if the **UBX-NAV-PVT** under **Message View** is enabled. If not, right click on **UBX-NAV-PVT** to enable the message and then follow the steps in Chapter 2.10 to save the configuration in the GNSS module.



Step 3 Press **Debug Message Button**

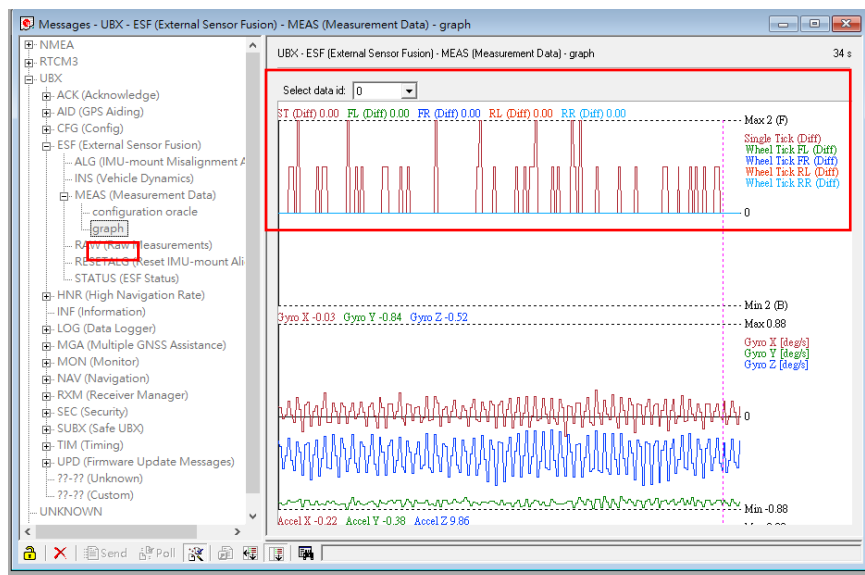


Step 4 Press **Record Button** and u-center will start recording the data of GNSS module including DR information.

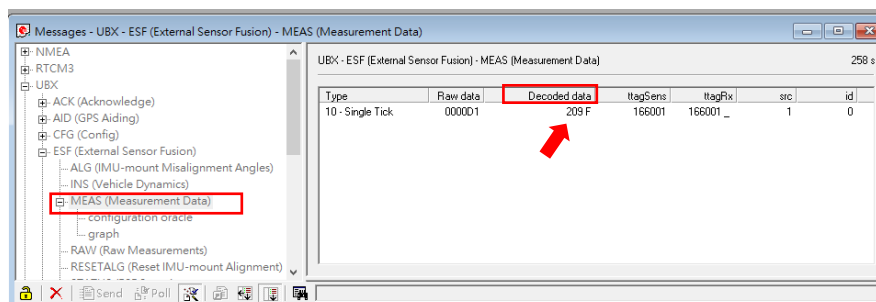


Appendix A - How to Check the status of Wheel-tick Signal (*)

- Step 1 Make sure all the Hardware and Software settings have been done according to the steps in Chapter 2.
- Step 2 On the main page of u-center, click on **View** on the upper left menu bar → **Messages View**
- Step 3 Click on **graph** under **UBX → ESF → MEAS**
If the Wheel-tick signal has been connected correctly you will see the value changing in the graph.



Note_1: The number in **Decode data** shouldn't change when the speed of the vehicle is the same. If it changes when the car doesn't move or change the speed, you might connect the wrong signal from the vehicle.

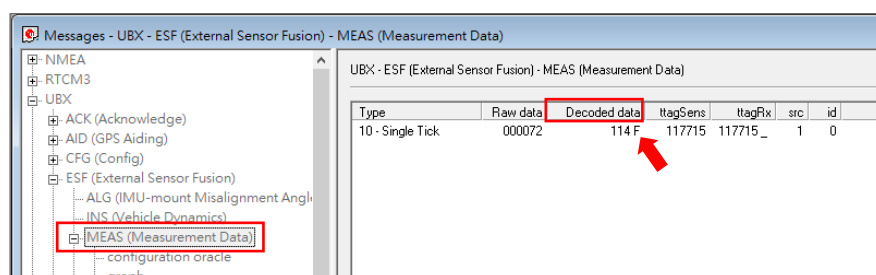


Type	Raw data	Decoded data	ItagSens	ItagFix	src	id
10 - Single Tick	000001	209 F	166001	166001	1	0

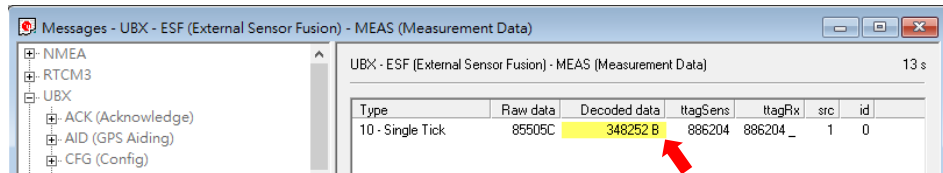
Note_2: Please refer to Appendix G for the voltage requirements for the signals of ADR.

Appendix B - How to Check the Status of Reverse Signal (*)

- Step 1 Make sure all the Hardware and Software settings have been done according to the steps in Chapter 2.
- Step 2 On the main page of u-center, click on **View** on the upper left menu bar → **Messages View**. You will see **"F"** shown in the **Decode data** under **UBX → ESF → MEAS** when the car is moving forward and **"B"** when the car is moving backward.



The value will turn **Yellow** when it shows **"B"**.



When the reverse signal is not detected from the vehicle:

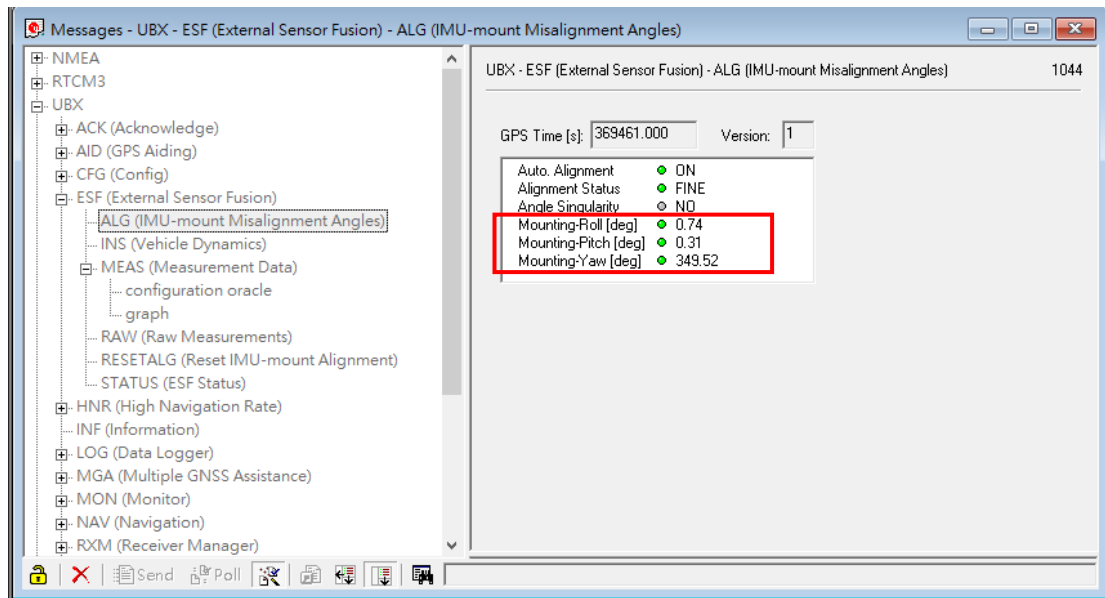
- **GADN-F / ANNA-F:** default, provide HIGH level signal to the GNSS module. Hence, **"F"** will appear in **Decode data** even when the reverse signal is not connected.
- **GADN-M / ANNA-M:** default, provide LOW level signal to the GNSS module. Hence, **"B"** will appear in **Decode data** even when the reverse signal is not connected.

(The default setting of **Direction Pin Polarity** is **"0-High is FWD"**. Please refer to the Step 3 in Chapter 2.8 for the setting instruction)

Note: Please refer to Appendix G for the voltage requirements for the signals of ADR.

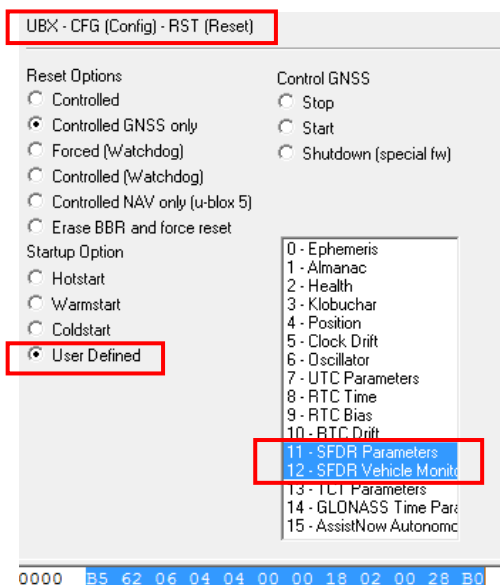
Appendix C - IMU-Mount Misalignment Angles Values

There are three values related to the attitude and heading of GADN/ANNA on the vehicle:



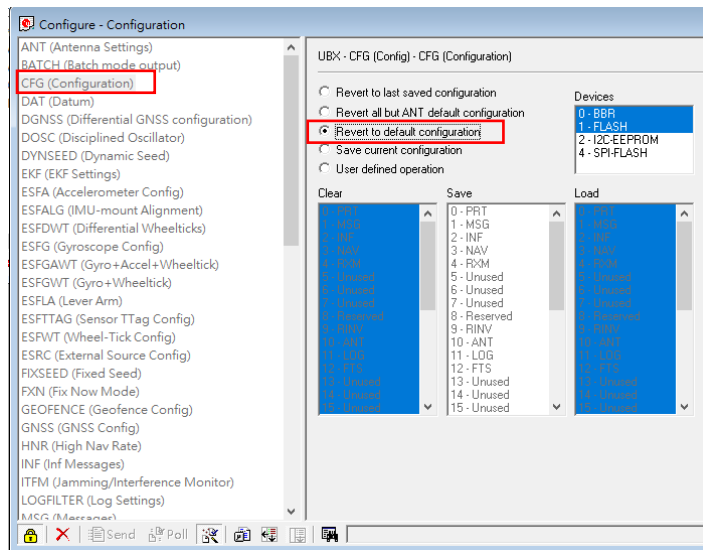
These values will be store into the memory of GNSS module once the **Alignment Status** has shown "**CORSE**" or "**FINE**" and will not be cleared or overwritten by the user defined values.

To clear these values, reinstall the coin battery on top of GADN/ANNA or send the **UBX-CFG-RST** command "**B5 62 06 04 04 00 00 18 02 00 28 B0**" to reset the data of UBX-ESF-ALG.

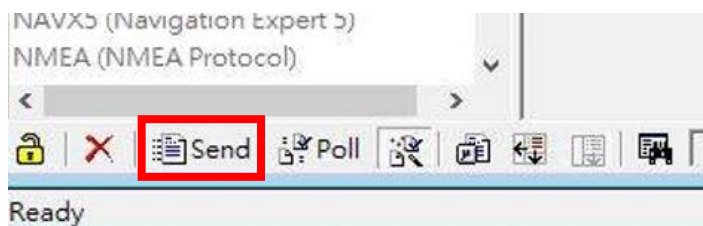


Appendix D - Load Default Setting

- Step 1 On the main page of u-center, click on **View** on the upper left menu bar → **Configuration View**
- Step 2 Go to **UBX-CFG(Config)-CFG(Configuration)** and choose **Revert to default configuration**



- Step 3 Press Send to load default setting to the module.



Note:

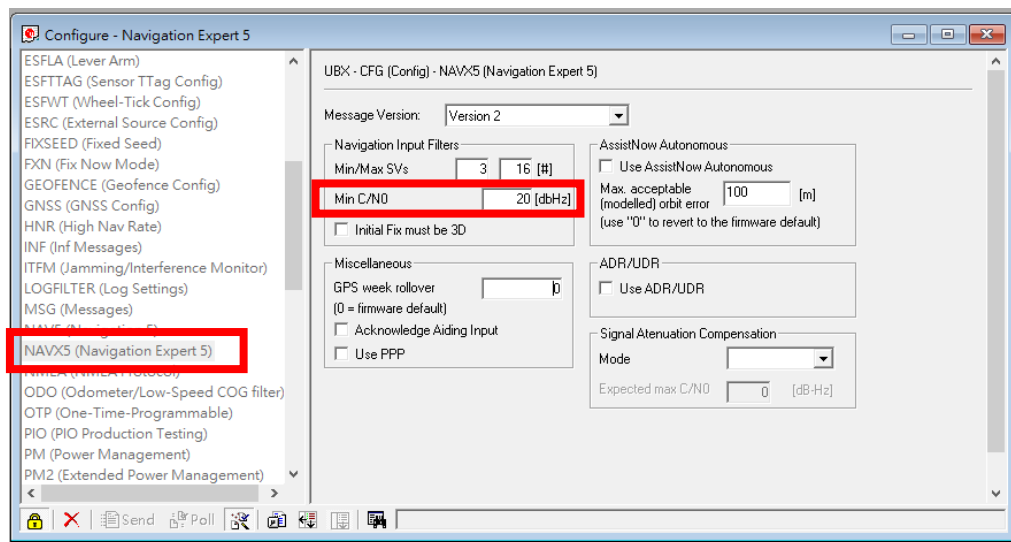
This procedure won't reset the data of UBX-ESF-ALG. Please refer to Appendix C for the instructions.

Appendix E - Min C/NO

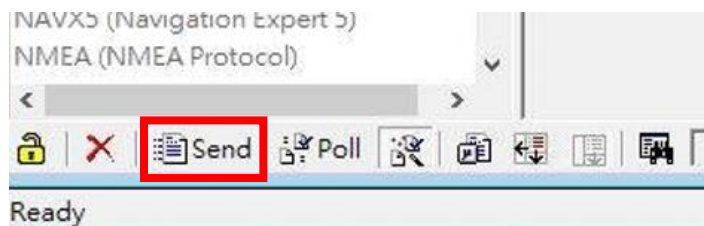
Min C/NO is the minimum satellite signal level for navigation. Once the satellite signal level is lower than the value set in C/NO, NEO-M8U and NEO-M8L will switch to the DR mode.

For the DR application, the recommended value of C/NO from u-blox is around 18 to 20. Below is the instruction to change the C/NO:

Step 1 Change the value of **"C/NO"** in **UBX-CFG-NAVX5** under Configuration View



Step 2 Press Send to save the settings.



Step 3 Follow the steps in Chapter 2.10 to save the configuration in the GNSS module.

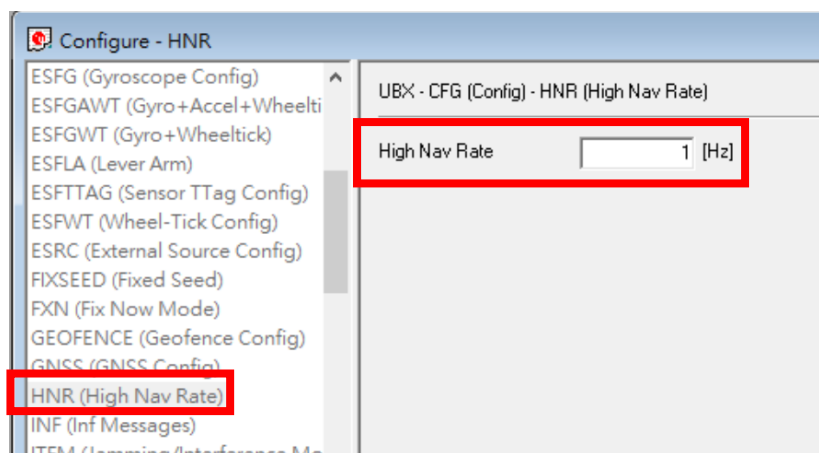
Appendix F - Navigation Rate

The navigation rate is the rate of navigation solution output. The u-blox receivers support high rates of navigation update up to 30 Hz.

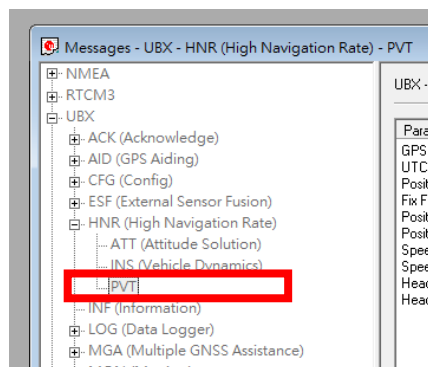
The update rate has a direct influence on the power consumption. The more fixes that are required, the more CPU power and communication resources are required. For most applications, a 1Hz update rate would be sufficient.

Below is the instruction to change the navigation rate:

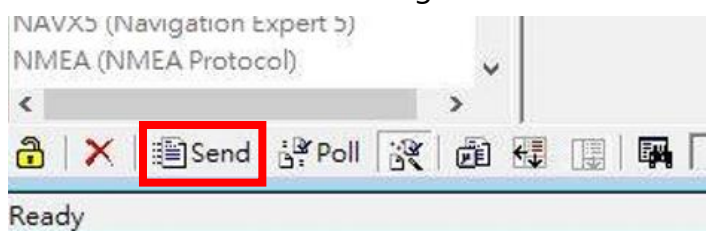
Step 1 Change the value of **“High Nav Rate”** in **UBX-CFG-HNR** under Configuration View



Step 2 Right click on **UBX-HNR-PVT** and choose **“Enable Message”** and the HNR setting will be activated.



Step 3 Press **Send** to save the settings.



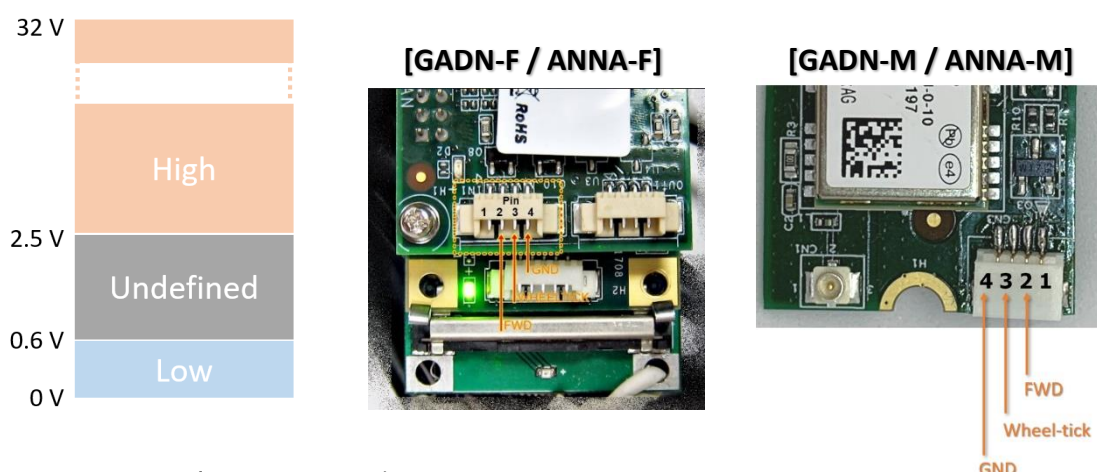
Step 4 Follow the steps in Chapter 2.10 to save the configuration in the GNSS module.

Note:

The information of HNR in "UBX-HNR-PVT" only appears after the HNR is activated.

Appendix G – Requirements for the Signals of ADR (*)

The wheel-tick and the reverse (FWD) signals from the vehicle to GADN/ANNA must meet the logic voltage level below.



For GADN-F and ANNA-F series:

The **Floating** signal will be recognized as **HIGH** level to the GNSS module.
(There is a pull-high 3.3V resistor on the card)

	u-center Direction Pin Polarity	Reverse Signal not Connected	Reverse Signal Connected (>2.5V)	Reverse Signal Connected (<0.6V)
Default	0-High is FWD	FWD	FWD	BWD
	1-Low is FWD	BWD	BWD	FWD

For GADN-M and ANNA-M series:

The **Floating** signal will be recognized as **LOW** level to the GNSS module.

	u-center Direction Pin Polarity	Reverse Signal not Connected	Reverse Signal Connected (>2.5V)	Reverse Signal Connected (<0.6V)
Default	0-High is FWD	BWD	FWD	BWD
	1-Low is FWD	FWD	BWD	FWD

Besides electronic signals, basically, there will be two types of vehicles with the signals that has **Floating** status.

To install on the other type of vehicle, you will need the optional SKU (BOM change) of the card. Please contact your sales representative for more detailed information.



Type 1

Floating / High



Applicable for **GADN-M / ANNA-M**



Type 2

Floating / Low



Applicable for **GADN-F / ANNA-F**