# Inertial Measurement Unit

## TAG310, TAG320

# Support Manual

TAG310N1000
TAG320N1000
TAG320N2000

TAMAGAWA SEIKI CO., LTD.

TAMAGAWA TRADING CO., LTD .

Revision History

| Rev. | Date | Page | Reasons for revision |
|---|---|---|---|
| 1 | 2023.10.12 | - | First edition |
| 2 | 2024.03.14 | 12<br>22, 23 | - Added angular velocity monitoring during offset cancellation<br>- Added speed input |
| 3 | 2024.06.04 | 9 | - Added instructions for sending CAN DATA |
| 4 | 2025.05.09 | 4<br>5 | - Added TAG320N1000 and TAG320N2000 to the applicable models<br>- Added PEAK-System's PCAN-USB FD to the CAN-USB interfaces available in IMUTerm |
| 5 | 2026.01.05 | 5 | - Added Kvaser's Leaf V3 to the CAN-USB interfaces available in IMUTerm |
| 6 | 2026.05.15 | All pages | - Added graph monitoring function in IMUTerm |
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| | | | |
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Table of Contents

1. Introduction

This manual provides the operating procedures and precautions for the TAG310 series and TAG320 series small 3-axis inertial sensor units. Please read this manual together with the device specifications before use.

Preparation Before Use

- **Products**

  **Part Number: TAG310N1000, TAG320N1000, TAG320N2000**

  This product is equipped with a 3-axis MEMS (Micro Electro Mechanical System) gyro and a 3-axis MEMS accelerometer, and calculates attitude and azimuth angles using signals from these sensors, outputting angular velocity, acceleration, attitude angles and azimuth angles.
- **Evaluation cable EU8974N1 (sold separately)**

  Evaluation cables for the TAG310 and TAG320 series are available.
- **CAN communication termination resistor**

  This device is dedicated to CAN communication. The IMU does not have a built-in CAN termination resistor (120 Ω). Please prepare the termination resistor on the user's side.
- **CAN communication tools**

  Please use commercially available tools such as CANalyzer or a CAN communication environment prepared by the user.

  For evaluation purposes, the free terminal software IMUTerm is provided; however, when connecting to a PC, please use the designated CAN-USB interface from our company.

Related Documents

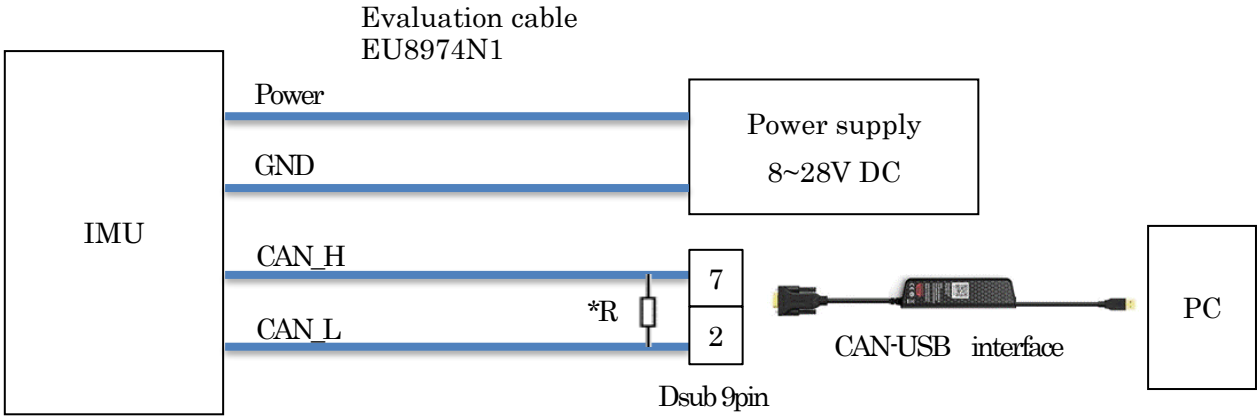
- SPC021015W00 MEMS IMU TAG310N1000 Device Specification
- SPC023187W00 MEMS IMU TAG320N1000 Device Specification
- SPC023188W00 MEMS IMU TAG320N2000 Device Specification

Download

You can download the free software IMUTerm from the URL below.

URL: https://mems.tamagawa-seiki.com/en/download/

2. PC Connection Example




Block Diagram for PC Connection

Note:

For evaluation purposes, the terminal software IMUTerm is provided; however, when connecting to a PC, please use the designated CAN-USB interface from our company.

■CAN-USB interfaces supported by software IMUTerm

Part Number: Leaf Light HS v2 by (Kvaser)

Part Number: USBcan Light 2xHS (Kvaser)

Part Number: Leaf v3 (Kvaser)

Part Number: VN1610 *CH1 only (Vector)

Part Number: PCAN-USB FD (PEAK-System)

Note:

1. Please download and install the above CAN-USB interface driver in advance.
2. PEAK System PCAN-USB FD is supported in IMUTerm Ver105 or later.
3. Leaf v3 (Kvaser) is supported in IMUTerm Ver106 or later.

3. Instructions for Using the Free Terminal Software IMUTerm

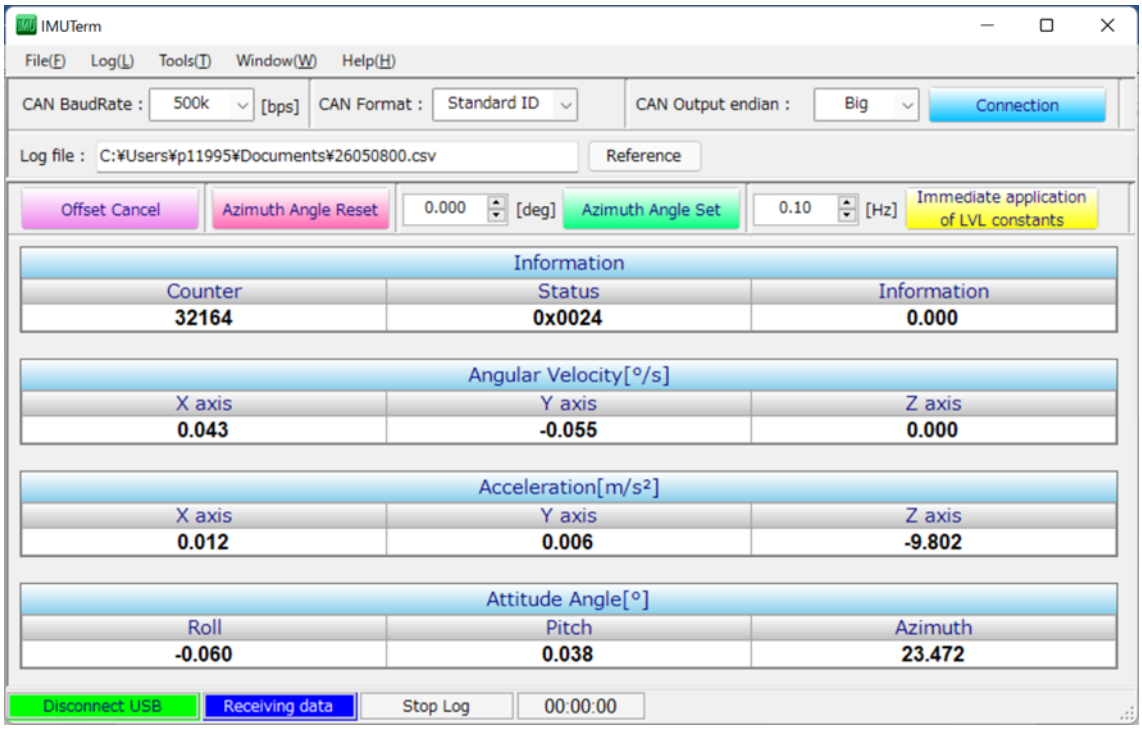
Software Download

Download the terminal software IMUTerm ZIP file from the URL below and extract it to a folder of your choice.

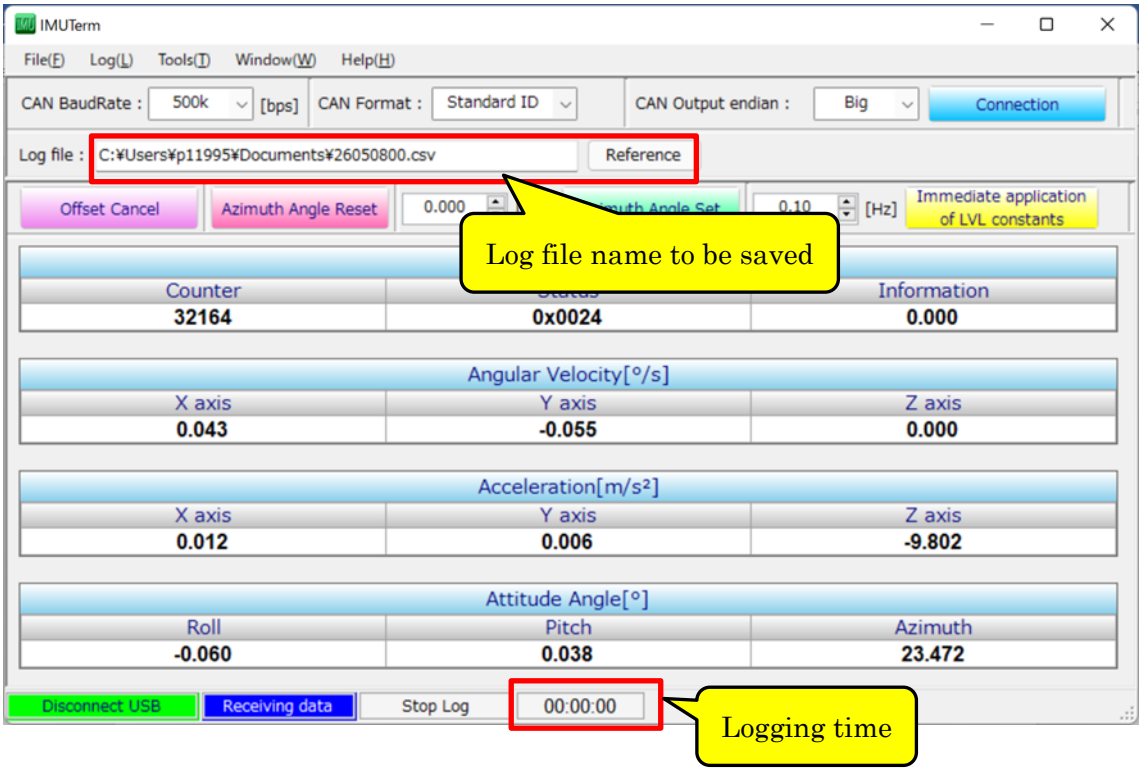
URL: https://mems.tamagawa-seiki.com/en/download/

*Two versions of the terminal software are available: x86 (32-bit OS) and x64 (64-bit OS). Select the appropriate version according to the OS installed on your PC.

Double-click IMUTerm.exe in the folder to launch the software.
When the following screen appears and the IMU is properly connected, angular velocity, acceleration, attitude angles, and other data is output as shown below.



Data Storage

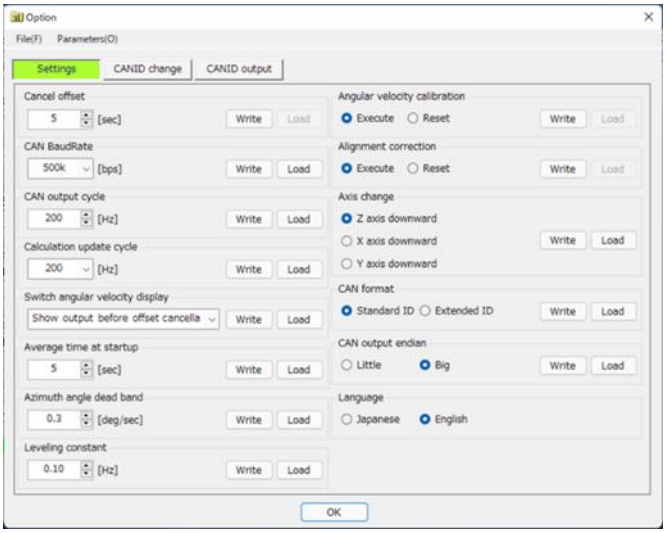



(1) Enter the name of the log file to be saved. (Only the .csv extension is supported.)

(2) To start data logging, select Menu Bar – Log – Start.
You can also start data logging by pressing the F5 function key.
To stop data logging, select Menu Bar – Log – Stop.
You can also start data logging by pressing the F5 function key.

IMU Setting Change

(1) Click Menu Bar – Tools – Options to display the settings screen.




Enter the desired setting values or select the appropriate check boxes, and then click "Write". Click "Load" to display the value currently set in the IMU.

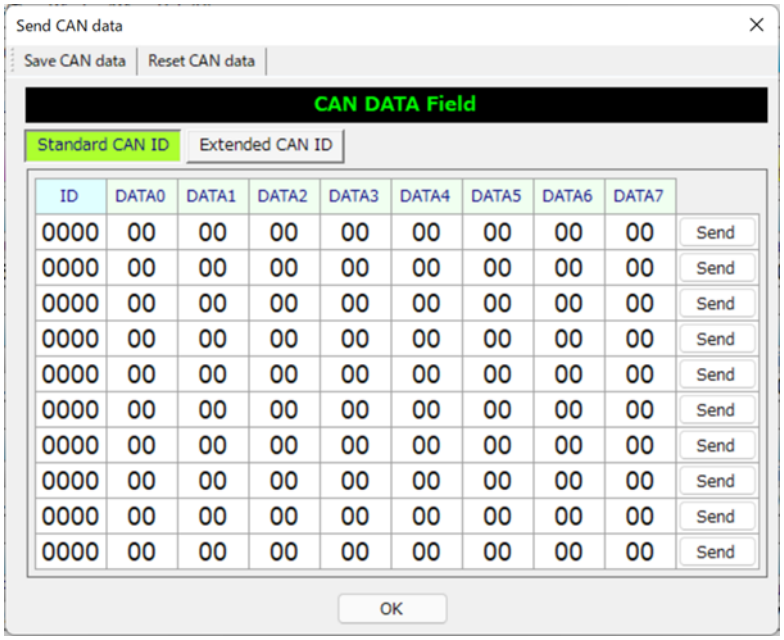
Select "Parameters" – "Save to application settings file" and then restart the software to save the setting values in the software (IMUTerm)

Note) For the commands marked with a circle in the ROM* column of the command list below, the setting changes take effect after the IMU power is cycled.

| No. | Contents | ROM※ | Initial Setting |
|---|---|---|---|
| 1 | Offset cancel | | - |
| 2 | Azimuth angle reset | | - |
| 3 | CAN baud rate change | ○ | 500kbps |
| 4 | CAN output cycle change | ○ | 200Hz |
| 5 | Update cycle change | ○ | 200Hz |
| 6 | Angular velocity output display change | ○ | OFF |
| 7 | Change the average time at startup | ○ | 5 sec |
| 8 | Azimuth dead zone change | ○ | 0.3deg/sec |
| 9 | Leveling constant change | ○ | 0.1Hz |
| A | Run angular velocity calibration | ○ | - |
| B | Run alignment correction | ○ | - |
| C | Axis change | ○ | 1: Z axis downward |
| D | CANID change (Standard ID) | ○ | - |
| E | CANID change (Extended ID) | ○ | - |
| F | CAN format(standard/extended) switching | ○ | 0: Standard format |
| 10 | CAN output endian setting | ○ | 1: Big endian |
| 11 | CAN output ON/OFF switching | ○ | - |
| 12 | Azimuth angle set | | |
| 13 | Setting initialization | ○ | - |
| 14 | Change startup wait time | ○ | 0.7 sec |

CAN DATA Transmission

(2) Click Menu Bar – Tools – Send CAN DATA to display the screen below.

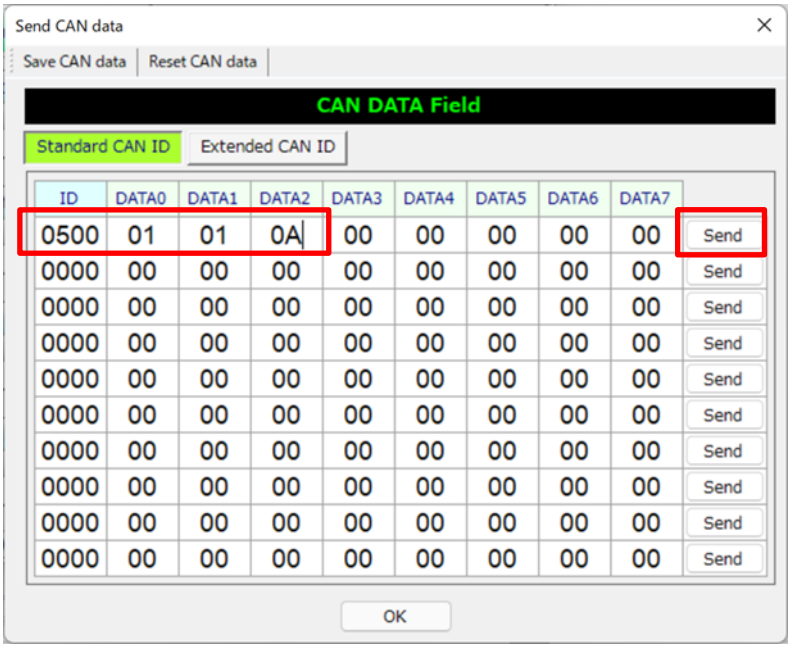



Settings can also be changed by entering commands from this screen.

Please refer to page 17 and later of the specifications for details on setting changes.

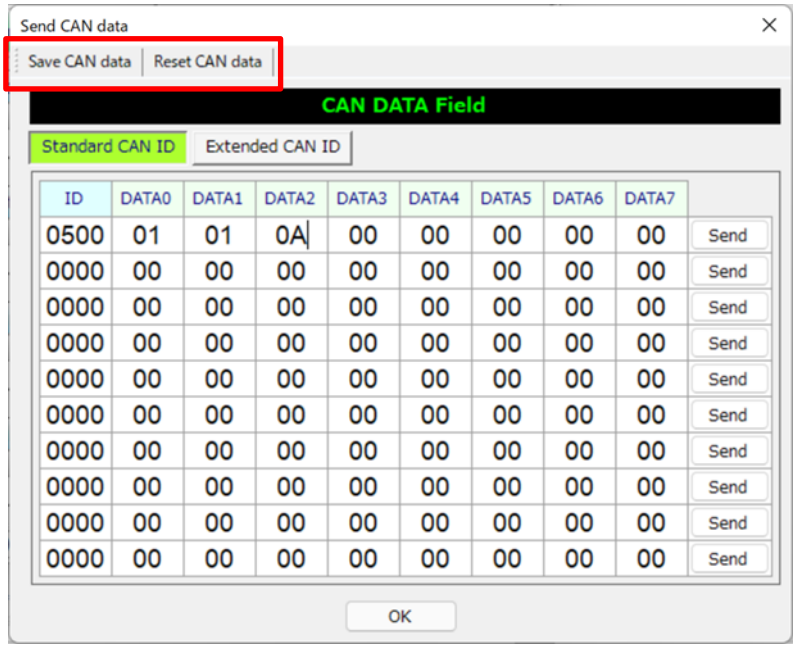
Example of command input: Execute offset cancellation for 10 seconds (setting value: 0x0A).

Enter the values like below and click "Send" to send the command.



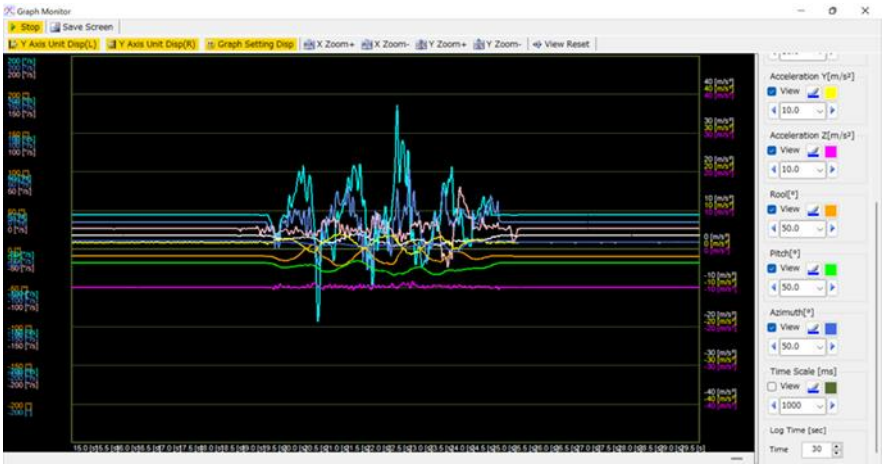
Click “Save CAN DATA” to save the modified values.
The settings are retained even after the power is cycled.

Click “Reset CAN DATA” to reset the modified values.



Graph monitoring function

(3) Click Menu Bar – Tools – Graph Monitor to display the screen below.
The CAN output data for angular velocity (X,Y,Z), acceleration (X,Y,Z), roll angle, pitch angle, and azimuth angle can be displayed as a graph. The scale of the vertical & horizontal axes and the color & thickness of line can be changed. Image saving function is also available.

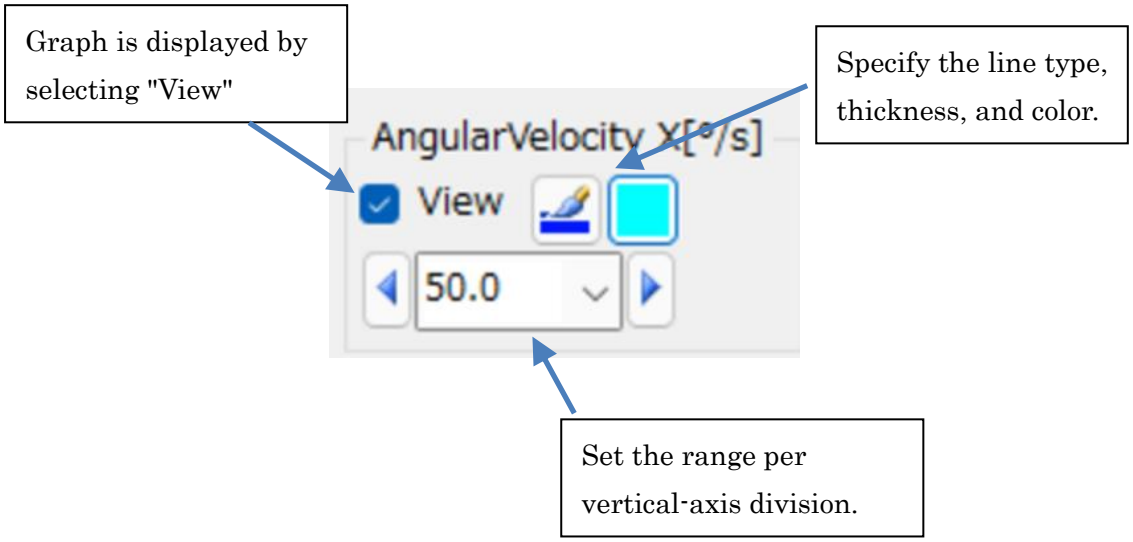



Toolbar Description

| Toolbar Menu | Function Description |
|---|---|
| Stop | Toggle waveform display between run and stop. |
| Save Screen | Save displayed waveform as image data.<br>Please stop the display before saving the image data. |
| Y Axis Unit Disp(L) | Toggle visibility of left Y-axis items on/off in graph. |
| Y Axis Unit Disp(R) | Toggle visibility of right Y-axis items on/off in graph. |
| Graph Setting Disp | Toggle visibility of the settings panel on graph display. |
| X Zoom in | Zoom in along the horizontal (time) axis. |
| X Zoom out | Zoom out along the horizontal (time) axis. |
| Y Zoom in | Zoom in along the vertical (item) axis. |
| Y Zoom out | Zoom out along the vertical (item) axis. |
| View Reset | Reset the vertical-axis offset position of the graph display to its default state.<br><br>Note: In order to change the vertical axis offset position of the graph, left-clicking and dragging up or down is required for the scale of items or displayed graph. |

Panel Description of Graph Display Settings

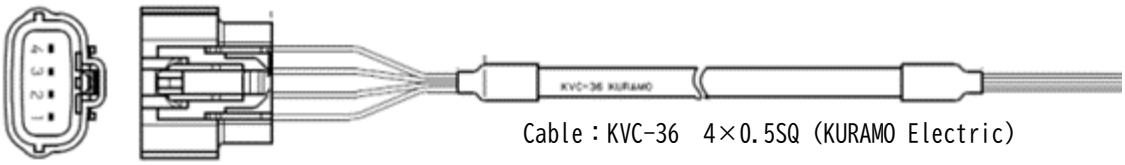
You can change the display settings for the items to be shown on the graph.



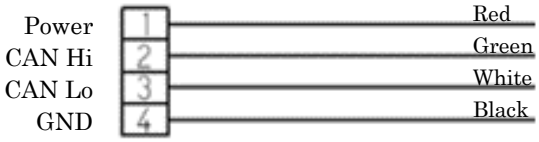
4. Harness Preparation

If a harness is prepared by the user to connect to the IMU, please refer to the pinout and connector part number below. Evaluation cable (P/N EU8974N1) is also available as optional accessories (sold separately).

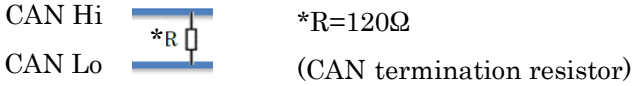
Example of harness for TAG310 and TAG320




Housing : 6189-0551 (Sumitomo Wiring Systems)
Wire seals : 7165-0547 (Sumitomo Wiring Systems
Terminal : 8100-1466 (Sumitomo Wiring Systems)




Note) The TAG310, TAG320, and the evaluation cable EU8974N1 do not have a built-in CAN termination resistor (120 Ω).
If necessary, install a 120 Ω termination resistor between the CAN Hi and CAN Lo lines as shown in the figure below.



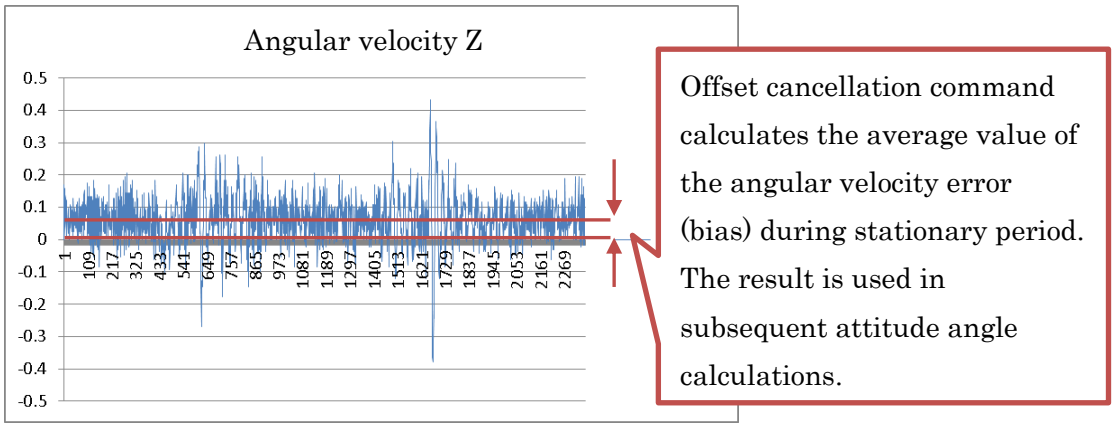
## 5. Command List

| No. | Contents | ROM* | Factory Default Settings | Reference |
|---|---|---|---|---|
| 1 | Perform offset cancellation | | - | P15 |
| 2 | Perform azimuth reset | | - | |
| 3 | Change CAN baud rate | ○ | 500kbps | P17 |
| 4 | Change CAN output cycle | ○ | 200Hz | P17 |
| 5 | Change update cycle | ○ | 200Hz | P17 |
| 6 | Change angular velocity output display | ○ | OFF | P15 |
| 7 | Change average startup time | ○ | 5 seconds | P20 |
| 8 | Change azimuth dead band | ○ | 0.3deg/sec | P22 |
| 9 | Change leveling constant | ○ | 0.1Hz | P22 |
| A | Perform angular velocity calibration | ○ | - | P21 |
| B | Perform alignment correction | ○ | - | P23 |
| C | Change axis | ○ | 1: Z axis downward | P24 |
| D | Change CANID (standard ID) | ○ | - | |
| E | Change CANID (extended ID) | ○ | - | |
| F | Switch CAN format (standard/extended) | ○ | 0: standard format | |
| 10 | Set CAN output endian | ○ | 1:big endian | |
| 11 | Switch CAN output ON/OFF | ○ | - | |
| 12 | Set azimuth angle | | | |
| 13 | Reset setting | ○ | - | P25 |
| 14 | Change startup wait time | ○ | 0.7 seconds | P25 |

For commands marked with a circle in the ROM* column, restart the IMU power at least 1 second after sending the command. The setting changes take effect after the power is restarted.

## ■ Offset cancellation

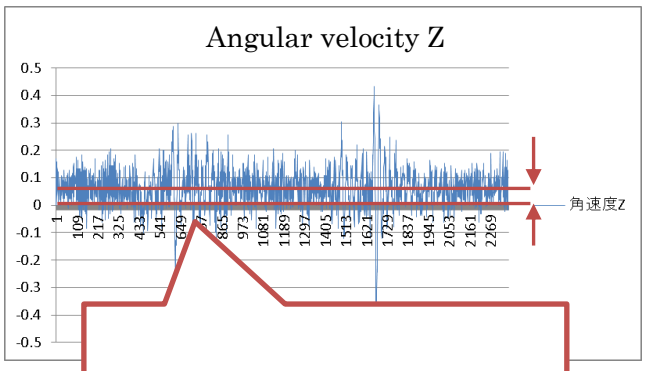
This command calculates the average value of the angular velocity error (bias component) during stationary period for the time specified. In subsequent attitude angle calculations, the calculated bias component is subtracted.
After offset cancellation, the azimuth angle is reset to 0.




## ■ Change angular velocity output display

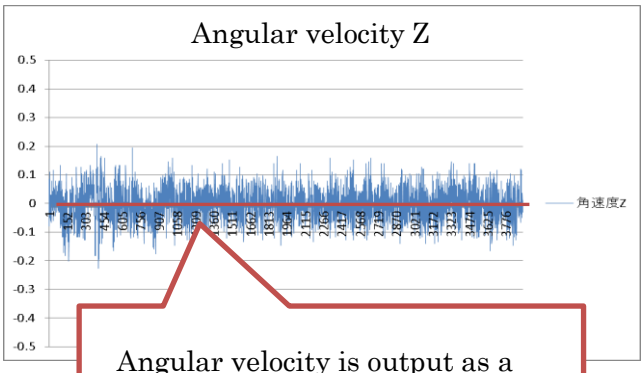
You can select whether the angular velocity output is provided before offset cancellation (before bias removal, raw sensor values) or after offset cancellation (after bias removal, values obtained by subtracting the bias from the raw sensor values).

Before offset cancellation (before bias removal)




Angular velocity is output as a biased value (raw sensor value).

After offset cancellation (after bias removal)



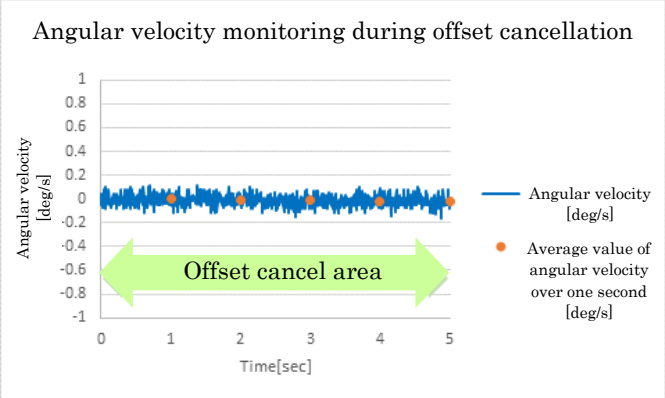

Angular velocity is output as a value obtained by subtracting the bias from the raw sensor values).

## ■ Angular velocity monitoring during offset cancellation

When calculating the average angular velocity bias at power-on or during execution of the offset cancellation command, the 1-second average of the angular velocity is monitored. If the difference between the maximum and minimum values of the 1-second average exceeds the threshold, bit 6 of the status is set, allowing detection of motion during offset cancellation.

The threshold at power-on is specified in Byte 3 of "(7) Change the average time at startup" in the device specifications. The threshold during execution of the offset cancellation command is specified in Byte 3 of "(1) Execute offset cancellation." If the threshold is exceeded, bit 6 of the status is set. If bit 6 of the status is set, the angular velocity bias may not have been calculated correctly. In this case, it is recommended to execute offset cancellation again.

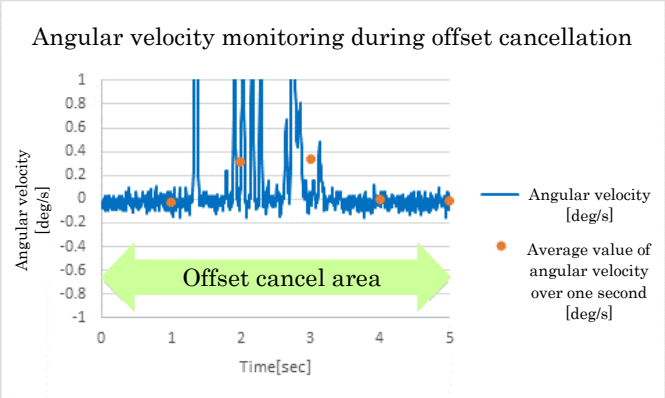
<u>When the device remains stationary during offset cancellation</u>




| Averaging area [s] | Average angular velocity [deg/s] | |
|---|---|---|
| 0～1 | -0.0020 | ←max |
| 1～2 | -0.0045 | |
| 2～3 | -0.0143 | |
| 3～4 | -0.0179 | |
| 4～5 | -0.0182 | ←min |
| max-min | 0.0162 | |

If the angular velocity threshold is set to 0.1 [deg/s], the max-min is below the threshold, so bit 6 of the status is not set.

<u>When the device remains moving during offset cancellation</u>




| Averaging area [s] | Average angular velocity [deg/s] | |
|---|---|---|
| 0～1 | -0.0218 | ←min |
| 1～2 | 0.3152 | |
| 2～3 | 0.3319 | ←max |
| 3～4 | 0.0033 | |
| 4～5 | -0.0184 | |
| max-min | 0.3537 | |

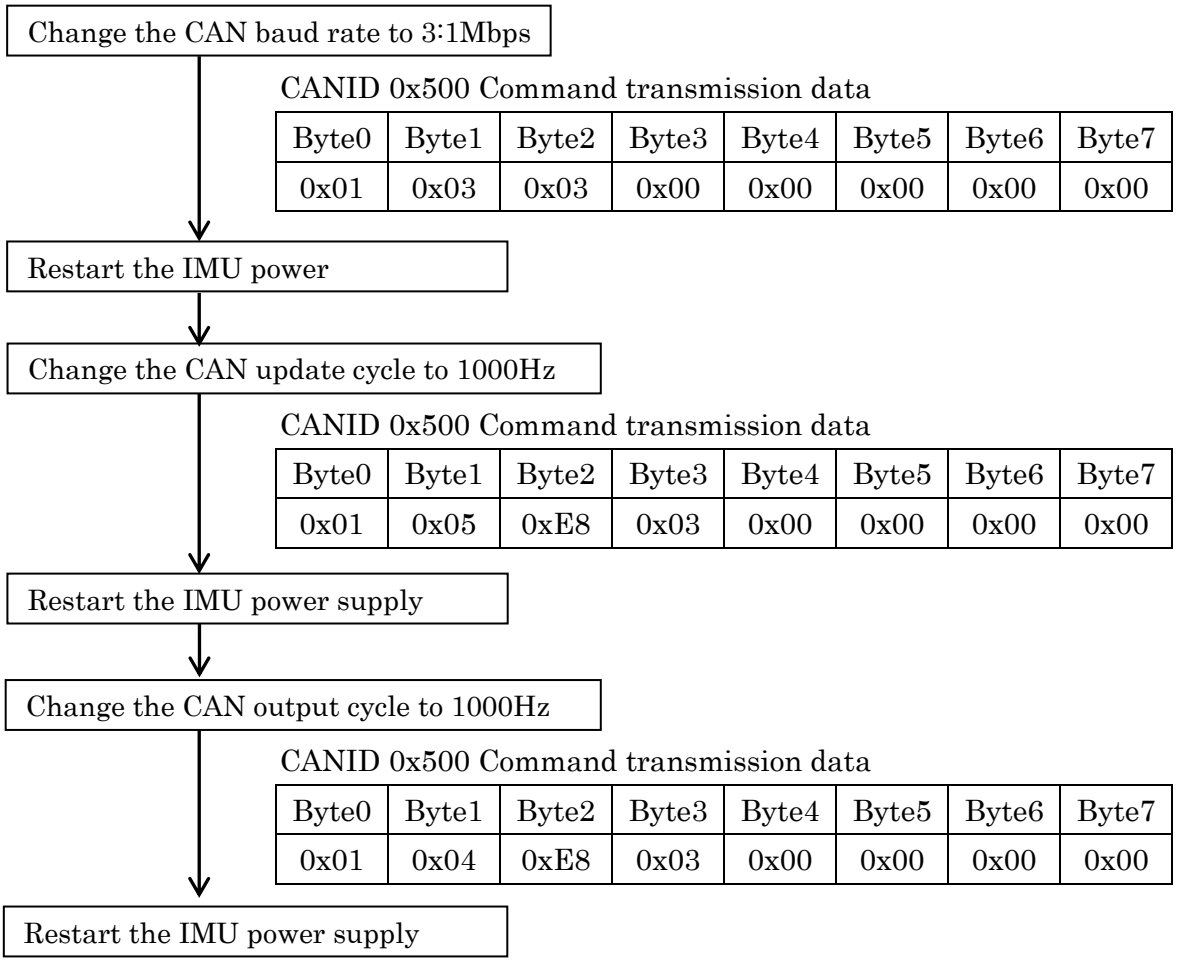
If the angular velocity threshold is set to 0.1 [deg/s], the max-min is below the threshold, so bit 6 of the status is set.

■ **Change CAN baud rate, change CAN output cycle, and change update cycle**

Set the output period to the same value as or longer than the update period. An output period shorter than the update period cannot be set.
Set the baud rate so that the data rate does not exceed the baud rate.
When increasing settings, refer to Configuration Example 1 for the command sending order. When decreasing settings, setting Configuration Example 2.

**Configuration Example 1: when increasing settings**

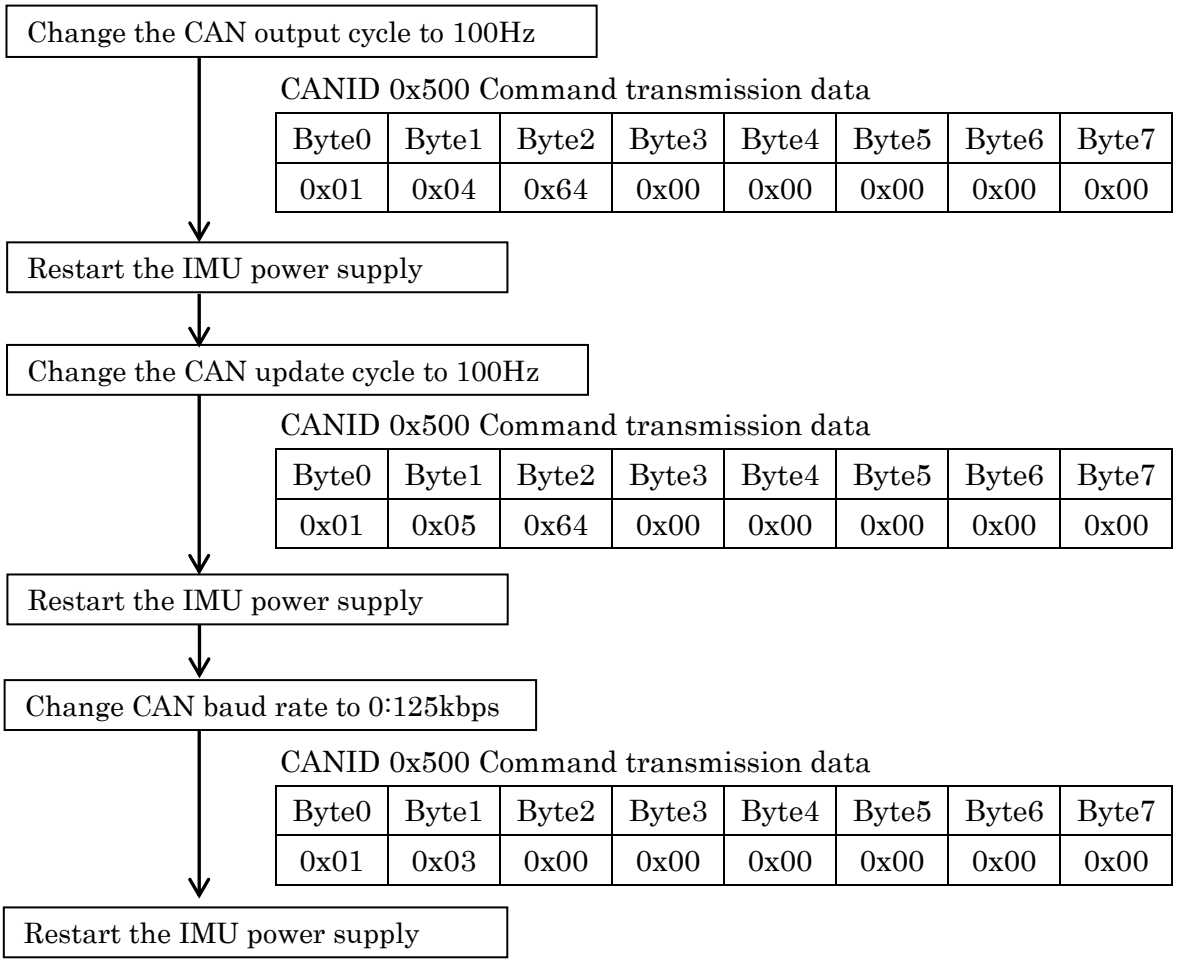
Before change: baud rate 500kbps, output cycle 200Hz, update cycle 200Hz
After change: baud rate 1Mbps, output cycle 1000Hz, update cycle 1000Hz



**Configuration Example 2: when decreasing settings**

Before change: baud rate 500kbps, output cycle 200Hz, update cycle 200Hz

After change: baud rate 125kbps, output cycle 100Hz, update cycle 100Hz



The maximum configurable output period depends on the baud rate and update period, as shown below:

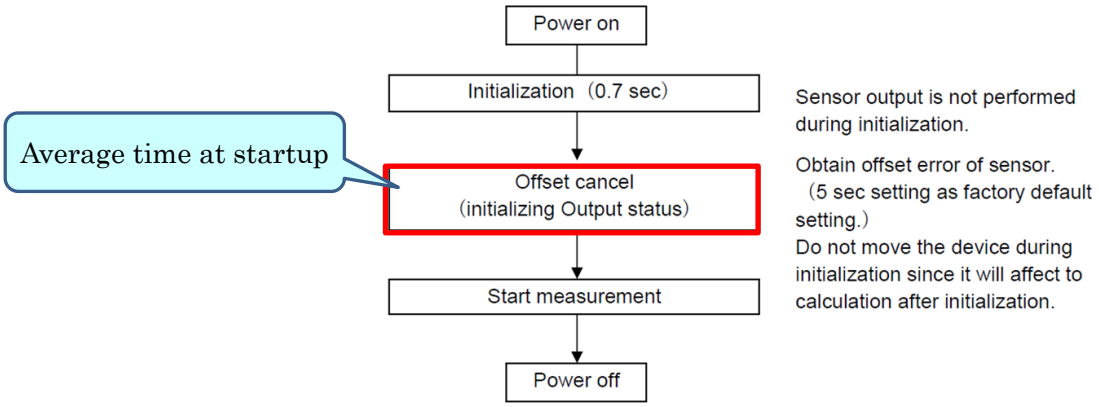
*When one IMU is connected to the CAN bus

*Yellow color shows factory default settings

| | | | Maximum output cycle [Hz] | | | |
|---|---|---|---|---|---|---|
| Update cycle [Hz] | Sampling [Hz] | Sensor Average Number of times | 1000kbps | 500kbps | 250kbps | 125kbps |
| 1000 | 1000 | none | 1000 | 1000 | 500 | 200 |
| 500 | 1000 | 2 | 500 | 500 | 500 | 200 |
| 200 | 1000 | 5 | 200 | 200 | 200 | 200 |
| 100 | 1000 | 10 | 100 | 100 | 100 | 100 |
| 50 | 1000 | 20 | 50 | 50 | 50 | 50 |
| 20 | 1000 | 50 | 20 | 20 | 20 | 20 |
| 10 | 1000 | 100 | 10 | 10 | 10 | 10 |

■ **Change average startup time**

In the factory default configuration, offset cancellation is performed for 5 seconds at startup. This command allows the user to change the offset cancellation duration at startup. In applications such as marine vessels, where it may not be possible to keep the IMU stationary at power-on, offset cancellation may not be performed correctly. In such cases, it is recommended to set the startup averaging time to 0 seconds.



■ **Angular velocity calibration**

The angular velocity calibration command allows the angular velocity bias value calculated during offset cancellation to be saved.
It is recommended to perform offset cancellation followed by angular velocity calibration in an environment where the device can remain stationary, and to use this in combination with the startup averaging time change command.

After performing offset cancellation and angular velocity calibration in an environment where the device can remain stationary, set the startup averaging time to 0.

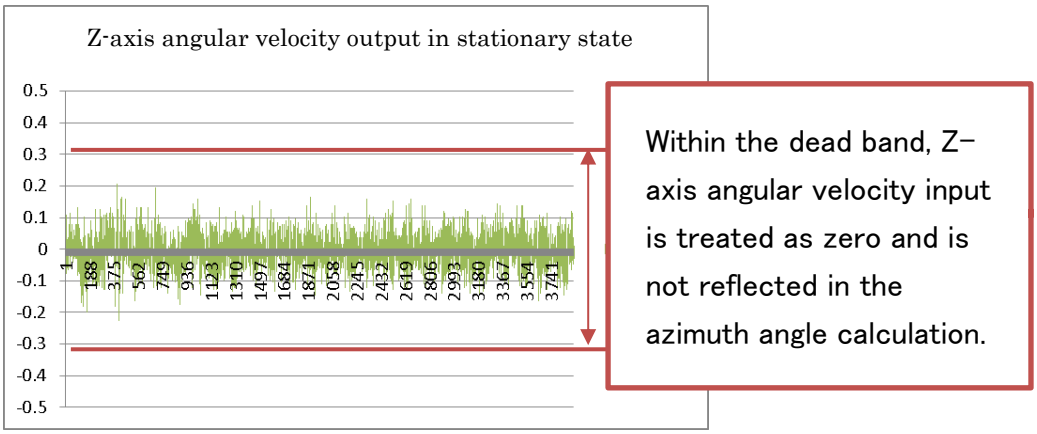
Using this command enables operation even in environments where a stationary condition cannot be ensured, such as on a vessel.

To perform angular velocity calibration again, perform calibration reset first.

■ **Change azimuth dead band**

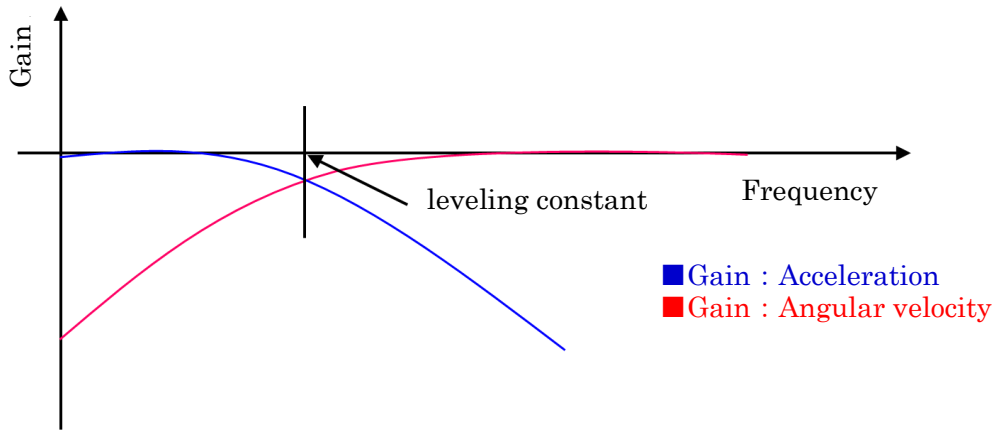
This device allows a dead band to be set for angular velocity to suppress azimuth angle drift while the device is stationary. Within the configured dead band, Z-axis angular velocity input is treated as zero and is not reflected in the azimuth angle calculation.
To measure slow motion where an object rotates within the dead band range, reduce the dead band setting value using this command.

Factory Default (dead band setting 0.3°/sec)




■ **Change leveling constant**

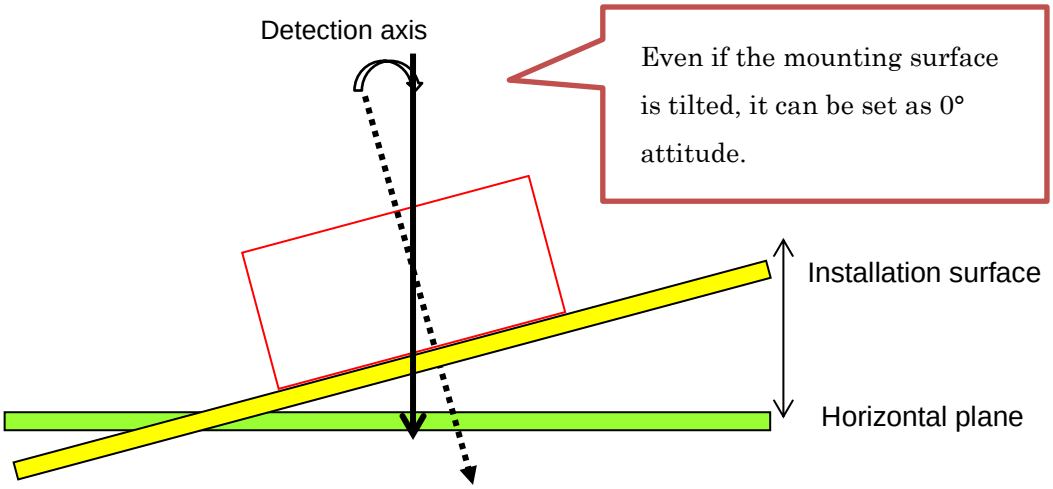
This product uses the accelerometer for attitude calculation in low-frequency area and the gyro in high-frequency area. The factory default leveling constant is 0.1; reducing it (approximately 0.01–0.03) helps minimize attitude errors caused by acceleration disturbances. Contact our sales window for further details.



■ Alignment correction

This command allows the mounting surface to be set as 0° attitude even if installation errors or tilt are present. To re-calibrate alignment, execute alignment reset, power-cycle the IMU, and then perform the calibration again, since calibration does not work correctly while the previous value is stored.

Usage example of alignment correction

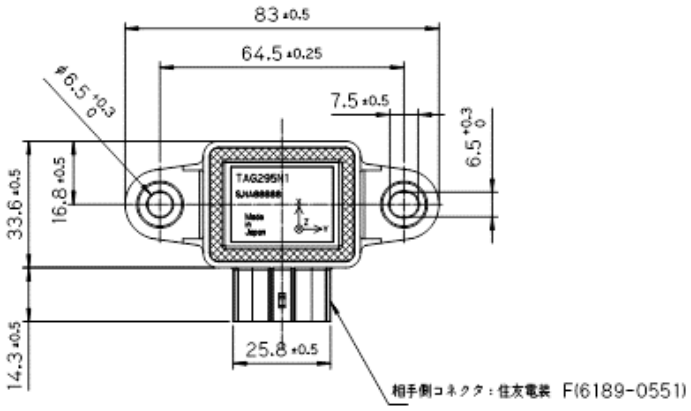


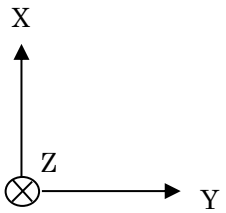

Executing alignment calibration reset restores the settings to their default values.

■ Change axis

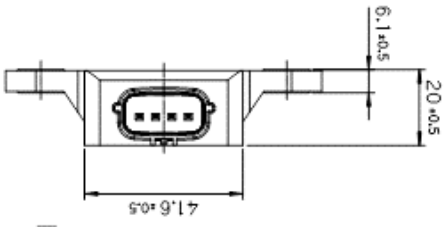
This command allows the axis definition to be changed. Send this command to change the axis definition, such as when operating this product in a vertical orientation. After the axis change, the axis definitions (XYZ) are set as shown below:

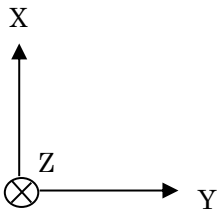
1: Z -axis downward (factory default setting)



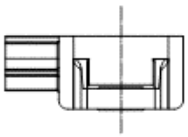



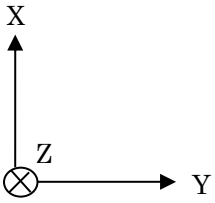

2: Set X-axis downward to Z-axis downward




3: Set Y-axis downward to Z-axis downward



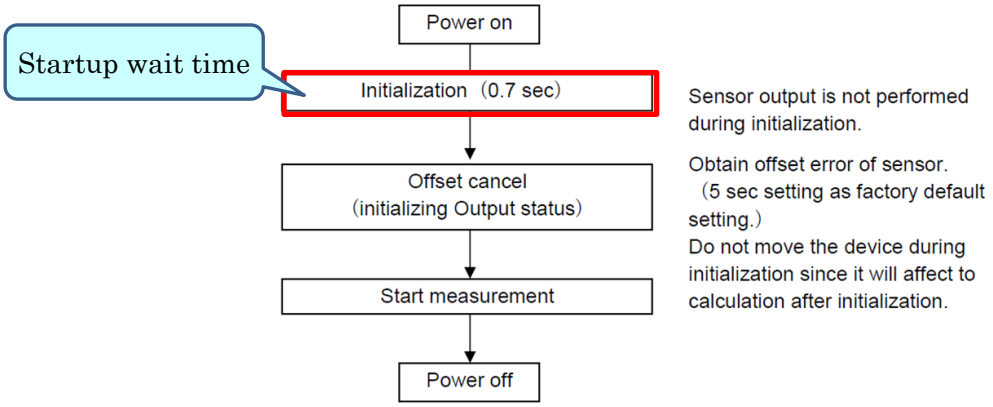


■ **Reset setting**

This command restores all settings to the factory default state.
The changes take effect from the next startup.

■ **Change startup wait time**

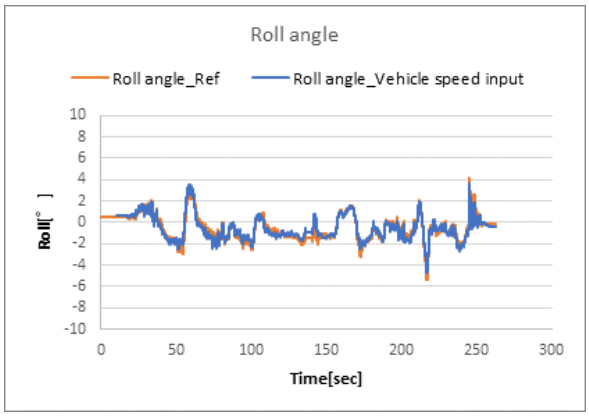
This command changes the wait time after power-on. Offset cancellation is performed and CAN output starts after the wait time elapses. If there are large disturbances immediately after startup (e.g., engine vibrations) or if you want to exclude sensor startup drift, set a longer wait time according to the environment.

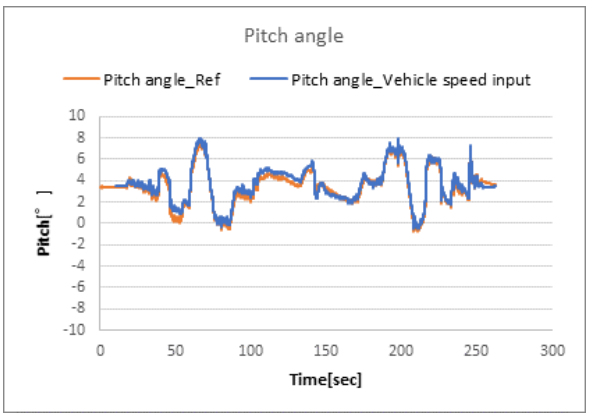


■ **For speed input**

The attitude angles (roll and pitch) of this device are calculated using the gravitational acceleration detected by the accelerometer. If additional acceleration components except gravity, such as vehicle acceleration/deceleration or centrifugal force during turning, are applied, attitude angle errors may occur.
When mounted on a moving platform such as a vehicle, these errors can be reduced by inputting forward velocity information from the host system.

Example of speed input) Install an IMU in a vehicle and drive on a public road.
In case of no error in the input vehicle speed, the error in the roll angle and pitch angle (difference from the reference) is 1°rms.



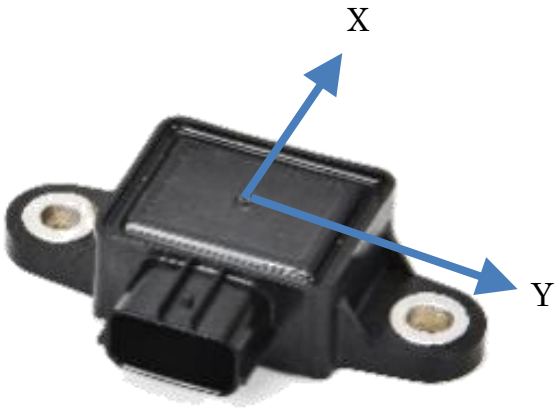

<Cautions for speed input>

- It is recommended to update the velocity input at frequency 10 Hz or higher.
- Input the velocity at the IMU's mounting position. For example, if the IMU is mounted at the center of a 4-wheel vehicle, use the average vehicle speed.
- Velocity errors directly increase roll and pitch errors.
- Input the velocity along the axis of movement. For X-axis velocity, align the IMU X-axis with the travel direction
- For movement opposite the X-axis, input a negative velocity with minus sign.
- On platforms with lateral slip during turning (e.g., vessels), using only X-axis velocity (no Y direction speed is input) may increase attitude errors. Reducing the leveling constant from 0.1 Hz to 0.02–0.01 Hz helps reduce errors during turns.

<For entering direction and speed>

Table 9 Velocity Input Commands List

| No. | ID※ | Byte | Data | Size [byte] | LSB | Unit | Note |
|---|---|---|---|---|---|---|---|
| 13 | 0x501 (0x13) | 0 | Fixed value | 1 | --- | --- | "0x01" Fixed value |
| | | 1,2 | X-axis input velocity | 2 | 0.01 | m/s | Singed short type |
| | | 3,4 | Y-axis input velocity | 2 | 0.01 | m/s | Singed short type |
| | | 5-7 | Spare | 5 | --- | --- | |




- For movement in the X direction (arrow in the figure), input the velocity in Byte 1 and 2.
- For movement opposite the X direction, input the velocity with a negative sign in Byte 1 and 2.
- For movement in the Y direction (arrow in the figure), input the velocity in Byte 3 and 4.
- For movement opposite the Y direction, input the velocity with a negative sign in Byte 3 and 4.
- If the axis definition has been changed, input the velocities according to the new X and Y axes.