R&D AHRS CAN Sensor User Manual

Generation 1

Joe Holdsworth
1-1-2021

Revision History

Revision	Comment	Author	Date
0.1	Creation of Document and first issue	Joe Holdsworth	04/12/2020
0.2	First Review	Joe Holdsworth	19/04/2020
1.0	First Release	Joe Holdsworth	19/05/2020
1.1	Corrected Pin mapping	Joe Holdsworth	20/05/2020
1.2	Include Pigtail version, update CAN ID's and other minor changes	Joe Holdsworth	02/01/2021
2	Updated input voltage range	Claire Bishop	26/02/2024

Contents

System Overview

This CAN based Attitude Heading Reference System outputs 3 axes of acceleration, 3 axes of rotation, 3 axes of magnetic field flux, quaternion and Euler angles, pitch, roll and yaw/bearing with yaw being relative to magnetic north. This unit needs to be properly calibrated on installation to achieve maximum performance.

The configurable CAN bus speed and address, along with the supplied DBC file allows easy integration into almost any vehicle with a CAN bus. This sensor can be used to analyse vehicle motion, vibration, shock loading and form part of a wider navigation system.

The choice of 6 pin IP67 connector or 300mm pig tail, wide ranging input voltage and the small size and mass of the unit allows easy interface into most vehicles

Whilst in operation it is not unusual for the rotation output accuracy to drop below high due to excessive vibration and/or magnetic perturbations. The unit might not always start up in with the rotation accuracy high. The user should recalibrate the unit if they require it to be high.

Even when the accuracy is not high, pitch and roll should still be reliable as well as small changes in yaw, it is the yaw accuracy relative to magnetic north that is mainly affected by this and that is why the estimated error in yaw accuracy is output as a parameter.

The units yaw value will not be reliable if it is placed in magnetically noisy area.

Max and Min Values

Sensor

3 Axis Accelerometers	Range	+/- 8	g
	Resolution	0.004	g
	Accuracy (Dynamic[1])	0.036	g
	Max Update Rate	250	Hz
3 Axis Gyro	Range	+/- 2000	˚/s
	Resolution	0.06	˚/s
	Accuracy (Dynamic[1])	3.1	˚/s
	Max Update Rate	250	Hz
3 Axis Magnetometer	Range	+/- 1300	µT
	Resolution	0.3	µT
	Accuracy (Dynamic[1])	1.4	µT
	Max Update Rate	100	Hz
Euler Angles	Range (pitch)	+/- 90	˚(degrees)
	Range (roll)	+/- 180	˚(degrees)
	Range(yaw/bearing)	0 to 360	˚(degrees)
	Resolution	0.1	˚(degrees)
	Accuracy (Static[2])	3.0	˚(degrees)
	Accuracy (Dynamic[1])	4.5	˚(degrees)
	Max Update Rate	250	Hz
Quaternion [8]	Output specifications are the same as the Euler output		

TABLE 1 SENSOR PERFORMANCE

Environmental

Environment	Operating temperature	-40 to +80	˚C
	Dust and Water Ingress	IP67	
Mechanical Shock (Max Values)	Duration < 200µs	10000	g
	Duration < 1ms	2000	g
	Free Fall Distance	1.8	m

Mass		25	grams
Dimensions	Height x Width x Length	22x40x45	mm

TABLE 2 ENVIRONMENTAL PERFORMANCE INFORMATION

Electrical

CAN [3]	Baud Rates	1000, 500, 250	kbps
	Address Range[4]	1 (0x01) to 2042 (0x7FA)	decimal (Hex)

Power	Voltage Range	9-16	V
	Current (Sleep)	110 (10mA)	mA @ 12V
Input Pins	Voltage Range	2-28	V

TABLE 3 ELECTRICAL PERFORMANCE

Connection

Cable Variant (standard is 300mm in length)		
AWG	26	
Wire Spec	Raychem 55	
Cable Jacket	TE Flame Retardant -75 to +150˚C	
OD	3.1mm +-0.1mm	
Connector Variant		
On Unit	B06B-JWPF-SK-R	
Mating [5]	06R-JWPF-VSLE-D	
Crimp	SWPR-001T-P025	
Pin Outs		
Wire Colour	**Pin No.**	**Function**
Brown	1	Ignition/wakeup [6]
Red	2	Supply Voltage
Black	3	Ground
Green	4	CAN High
White	5	CAN Low
Yellow	6	Factory Reset [7]

TABLE 4 CONNECTION INFORMATION

[1] Dynamic accuracy is when the unit is in motion and the calibration accuracy is high.

[2] Static accuracy is when the unit is stationary and the calibration accuracy is high.

[3] The default settings are 1000kbps and start address 768 (0x300), the unit has no CAN termination.

[4] The unit uses 6 CAN addresses which are in consecutive order from the address that the unit is set to.

[5] This connector is not supplied with the unit.

[6] By default this mode is switched off, if it is enabled connect this pin to 2.5v to supply voltage to wake the unit.

[7] To reset the unit to factory settings, pull this from 2.5v to supply voltage on unit power up.

[8] The quaternion output is i, j, k and the real component.

[9] This is the default Euler axis system for the device, the quaternion output pitch is effectively inverted.

Electrical

Mating Connector

Part No.: 06R-JWPF-VSLE-D

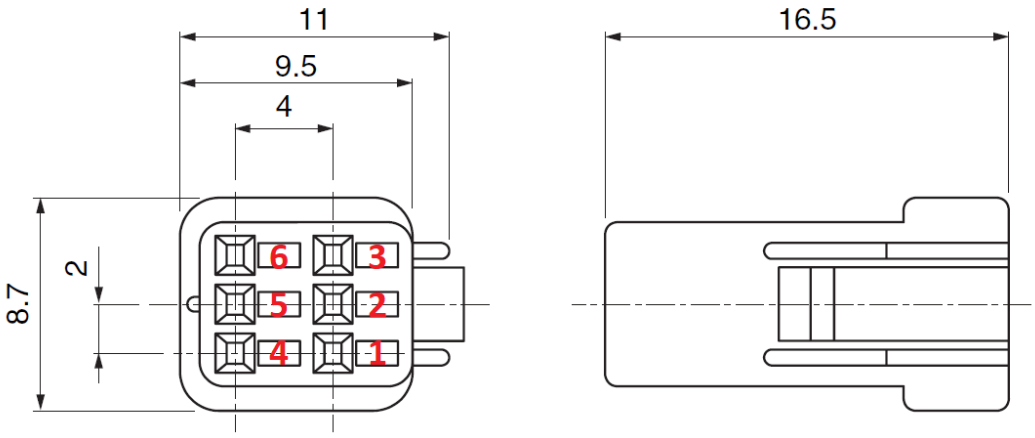


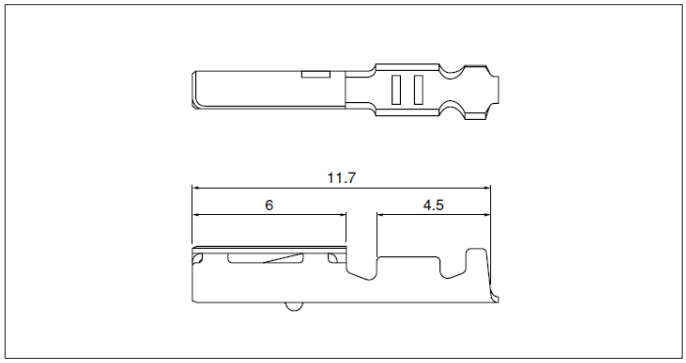
FIGURE 1 MATING CONNECTOR PIN NUMBERING (TOP DOWN VIEW)

Crimps

Crimp Part No.: SWPR-001T-P025

Crimp Tool Part No.: WC-JWPF

12” Pre-Crimped Cable Part No.: AJWPFJWPF22K305R



Model No.	Applicable wire		Insulation O.D (mm)	Q'ty / reel
	mm²	AWG#		
SWPR-001T-P025	0.13~0.33	26~22	1.4~1.7	8,200

Material and Finish
Copper alloy, tin-plated (reflow treatment)
RoHS compliance

Contact	Crimping machine	Applicator		
		Crimp applicator	Dies	Crimp applicator with dies
SWPR-001T-P025	AP-K2N	MKS-L	MK/SWPR/T-001-025	APLMK SWPR/T001-025
		–	–	–

FIGURE 2 CONNECTOR CRIMP DETAILS

CAN Termination

The unit does not have a termination resistor.

Mechanical

Mounting

Mount using 4 x M2.5 bolts and washer to protect between the bolt and anodized aluminum base.

JWPF Dimensions

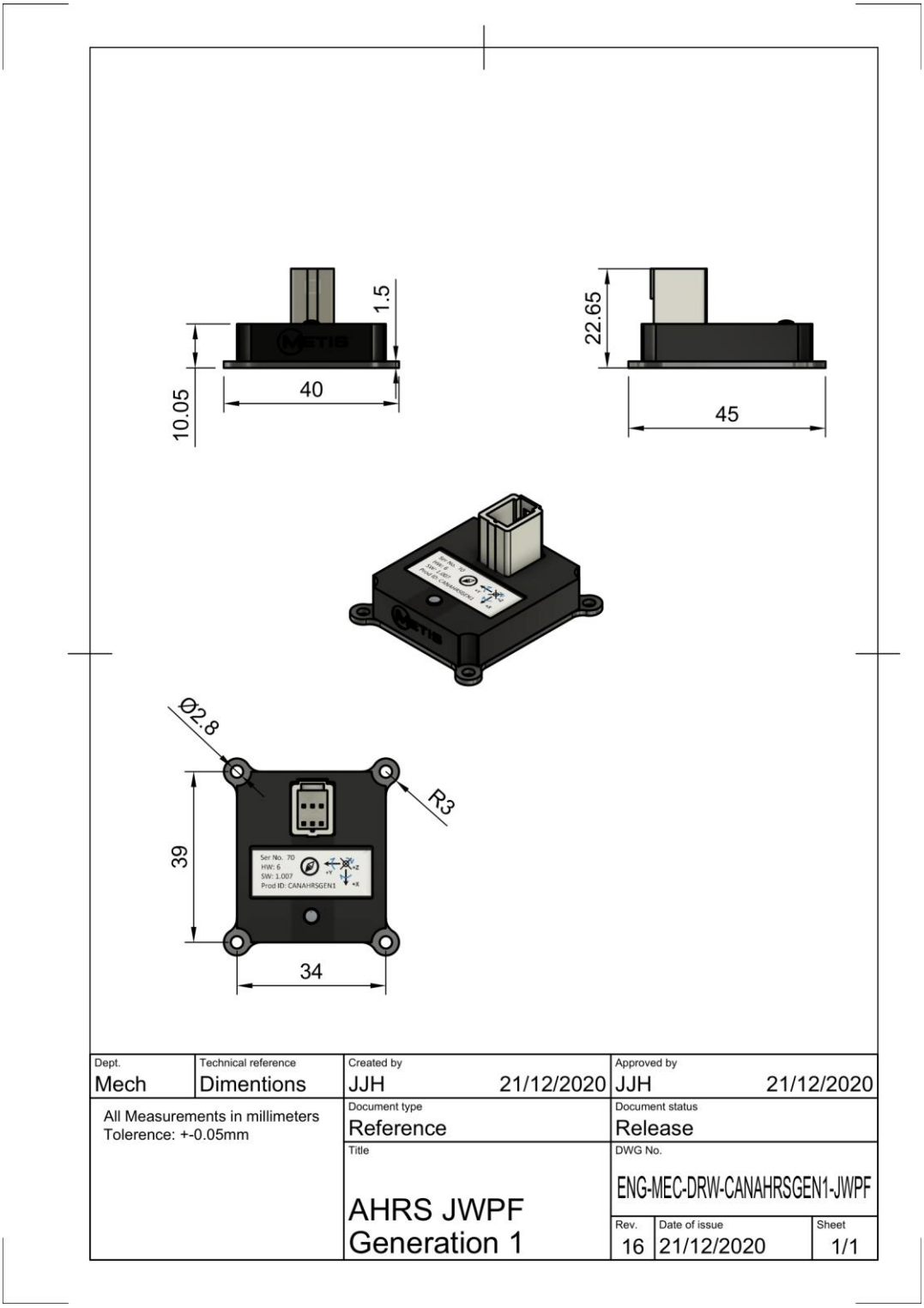
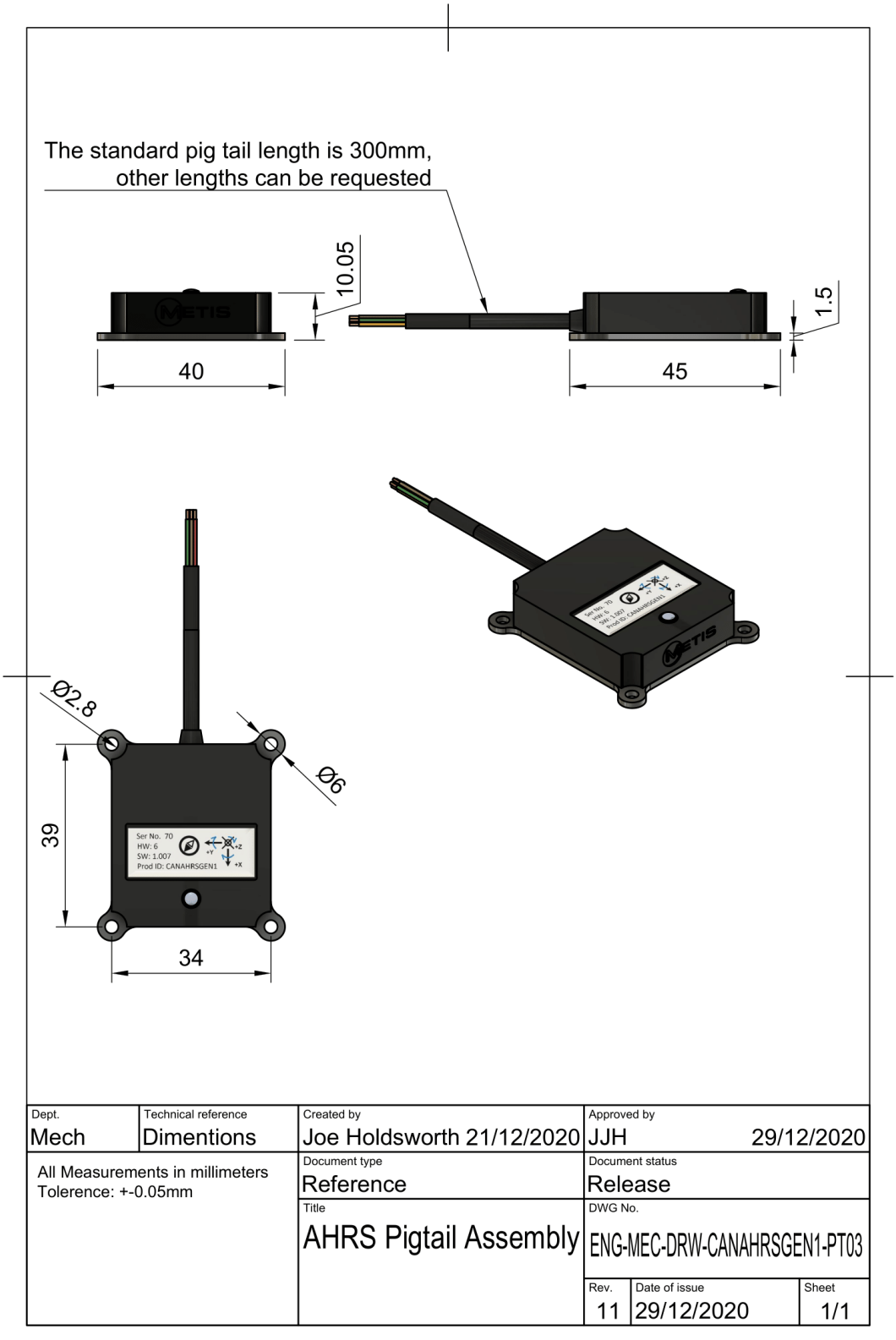


FIGURE 3 JWPF SENSOR DIMENSIONS

Pigtail Dimensions



Dept.	Technical reference	Created by	Approved by
Mech	Dimentions	Joe Holdsworth 21/12/2020	JJH 29/12/2020
All Measurements in millimeters Tolerence: +-0.05mm		Document type: Reference	Document status: Release
		Title: AHRS Pigtail Assembly	DWG No.: ENG-MEC-DRW-CANAHRSGEN1-PT03
			Rev.: 11 / Date of issue: 29/12/2020 / Sheet: 1/1

FIGURE 4 PIGTAIL SENSOR DIMENSIONS

Axis System

Default Euler Axis

The default axis system for the Euler angles output follows the SEA J670 standard.

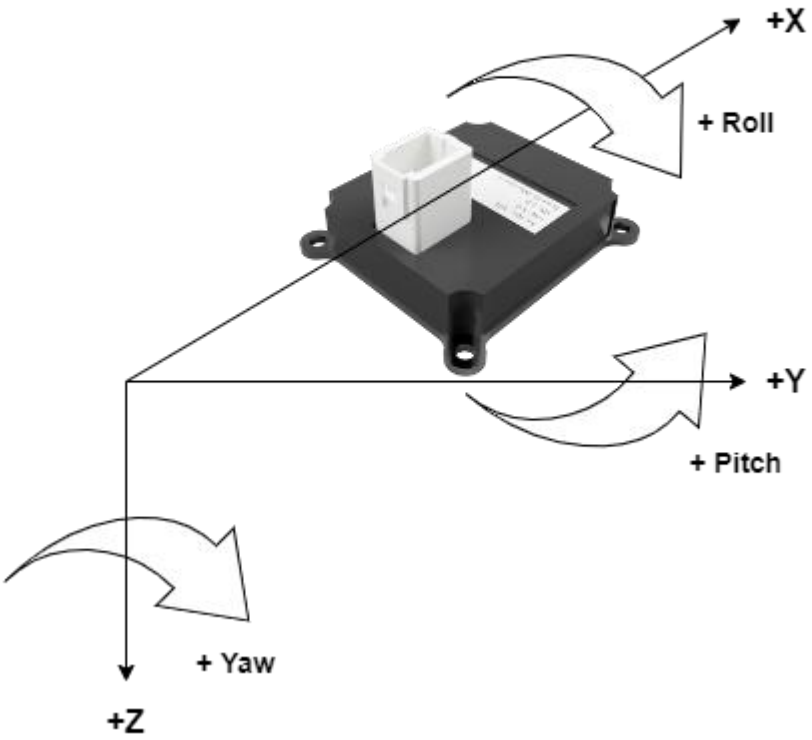


FIGURE 5 DEFAULT AXIS SYSTEM

Suggested Installation

Install into vehicle with the AHRS's axis (on the label) aligned as closely as possible with the vehicle axis. Any small offsets for the Euler angles can be configured over the CAN interface. The units label should point toward the front of the vehicle. Place as far away from sources of varying magnetic fields such as electric motors or spinning magnetically permeable objects, e.g. gear box with rotating ferrous parts.

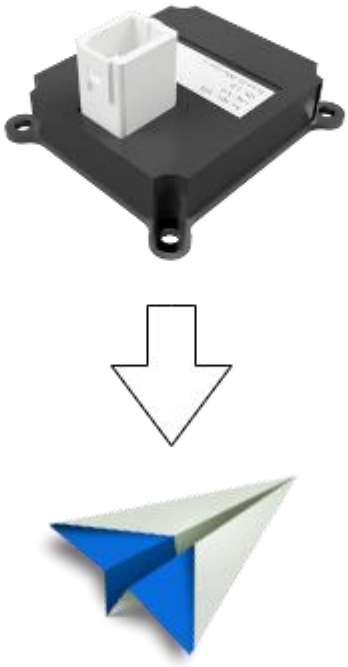


FIGURE 6 MECHANICAL INSTALLATION ORIENTATION

Options

The Euler output can be configured over the CAN interface. As well as the ability to enter offsets for any of the axis (pitch, roll, yaw), any axis can be flipped in terms of what is considered a positive rotation via the CAN interface.

The unit can also output Quaternion values. The quaternion output cannot be configured in terms of offsets.

Compared to the Euler output, the quaternion equivalent of pitch is positive, i.e. in the opposite direction to the Euler pitch positive direction.

Flipping the Euler axis will not change what is considered positive for gyro or accelerometer output. These will always stay the same and match the quaternion output.

CAN Interface

Quick Start Guide

This section gives a quick overview of how to change settings on the device.

To see Default settings the unit ships with please refer to the CAN Message Summary section.

Step 1: Power Up Unit

Make sure power and CAN is connected to the device using the pin outs previously described in the **Error! Reference source not found.** section

If the CAN bus is unterminated or the unit is the only node on the CAN bus, please place a 120Ohm resister between CAN high and CAN low lines. The metis CAN development kit is useful for this.

Apply 9-28VDC to the unit at >=120mA.

Step 2: Connect CAN Tool

Ideally use a CAN tool such as PCAN or CANalyser.

Make sure the CAN bus connection settings in the tool match the settings specified in the unit's default settings section, i.e. 11bit address and 1MBit CAN bus speed.

Import the unit's dbc or symbols file into your CAN tool.

Start the CAN interface on your Computer.

You should now see the CAN Heartbeat message coming from the unit and other CAN Devices that may be on the bus. If you don't, then check the following;

1. The unit has power,
2. Your CAN tools connection settings are correct
3. The CAN bus is terminated correctly
4. CAN high and low are the right way round

Step 3: What you should see

Figure 6 shows the default message output from the unit. Please take note of the Unique ID value and the Key value.

You will need to use these numbers when entering Setup mode or saving any changes to the setup.

Please be aware that the Key value changes each time a valid enter setup command has been received.

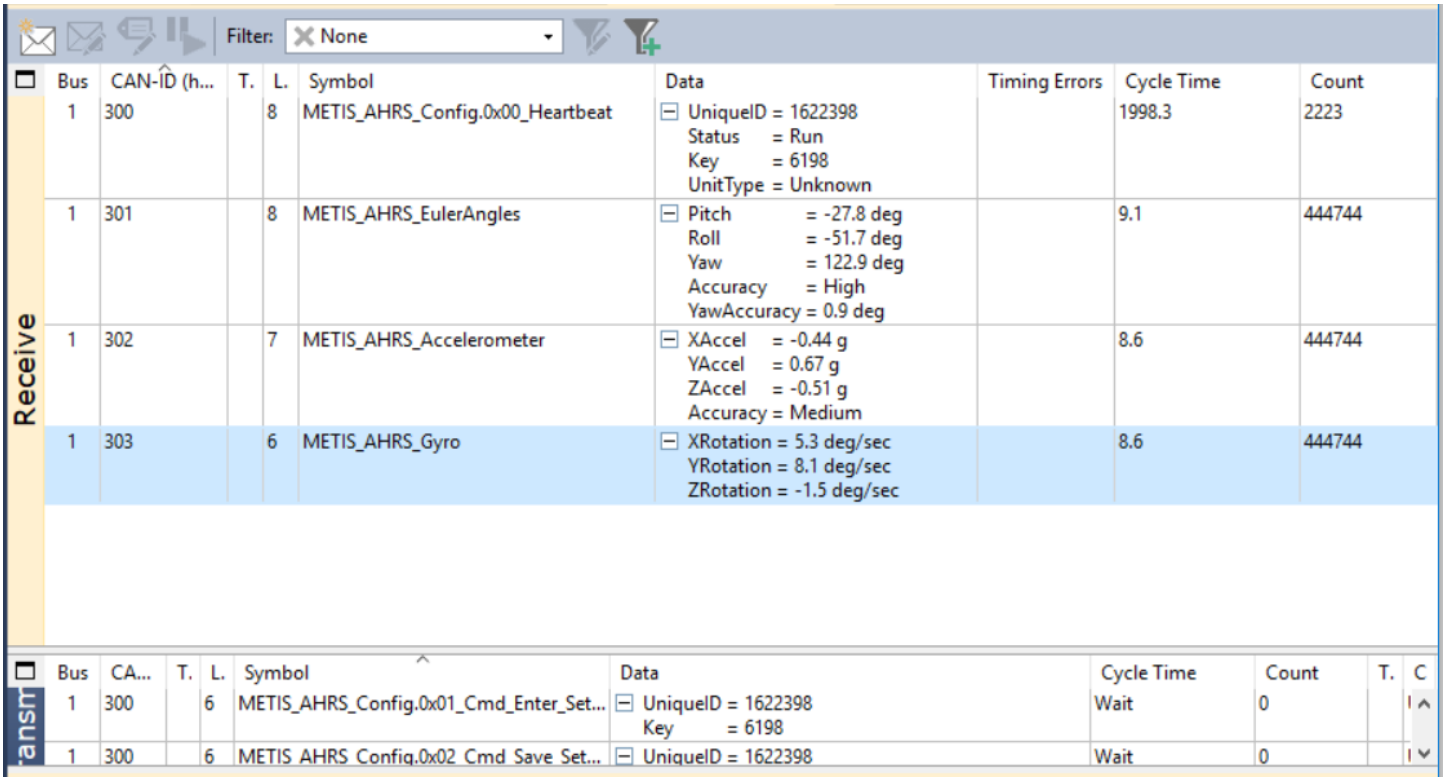


FIGURE 7 DEFAULT CAN MESSAGE OUTPUT

If you want to change any settings move to step 4. If not move to step 7 and calibrate the device.

Step 4: Enter Setup mode

The Heartbeat message should give:

1. A Unique ID value.
2. A Key value.
3. The unit type sending the heartbeat message.
4. The run mode, this should be ‘Run’ if the unit has just powered up.

Take note of both the Unique ID value and the Key value.

Create a Enter Setup Mode message and populate the Unique ID field and Key field with the values noted from the heartbeat message.

Send the ‘Enter Setup Mode’ Command to the unit, this should only be sent once.

The next Heartbeat message received from the unit should have the run mode changed to ’Unit in Setup mode’. If this is not the case check your unique ID and Key value match those in the heartbeat message.

Once in setup mode you can configure the unit.

Any changes that have been made will not be applied until a ‘Save Setup’ command has been sent.

To cancel any changes prior to the ‘Save Setup’ command, send a the ‘Cancel Setup’ command or power cycle the device.

Step 5: Save Setup

To apply any configuration changes, send the ‘Save Setup’ command with the Unique ID and Key value field populated with the current value in the heartbeat message.

Note: The Key value changes each time a successful message with one in has been received.

Any changes to the unit will not be applied until a ‘Save Setup’ command has been sent.

Step 6: Reset to factory defaults

If for any reason you want to restore factory settings or you do not appear to be able to communicate with the device you can connect the factory reset pin to the power supply voltage and then power cycle the device.

If you still have CAN communication you can also send a factory reset command to the unit.

Step 7: Calibrate the Sensors

The unit should be calibrated in the environment it is to be used.

The unit constantly takes in the environment around it and calibrates its self over time. The unit can also be calibrated at any time.

When the unit has been calibrated correctly (the rotation/Euler output accuracy = high) the LED on the device will turn from blue to green. (see Figure 7 for LED location)

Whilst in operation it is not unusual for the rotation output accuracy to drop below high due to excessive vibration and/or magnetic perturbations. The unit might not always start up in with the rotation accuracy high. The user should recalibrate the unit if they require it to be high.

Even when the accuracy is not high, pitch and roll should still be reliable as well as change in yaw, it is the yaw accuracy relative to magnetic north that is mainly affected by this and that is why the estimated error in yaw accuracy is output as a parameter.

To calibrate the sensors please perform the following steps. Please keep an eye on the LED or the CAN Euler messages Accuracy field.

FIGURE 8 ACCURACY STATUS LED LOCATION, GREEN = HIGH ACCURACY

Gyroscope Calibration

Perform the following steps until the CAN Gyro messages accuracy field = high

1. Device should be set down on a stationary surface for approximately 2-3 seconds to calibrate the gyroscope

Accelerometer Calibration

Perform the following steps until the CAN Accelerometer messages accuracy field = high

1. For 3D calibration the device should be moved into 4-6 unique orientation and held still in each orientation for about 1 second to calibrate the accelerometer
2. Be rotated around its Z-axis by at least 180 degrees

Magnetometer Calibration

Perform the below at least once or until the accuracy status LED turns green.

1. Device should be rotated about 180° and back to the beginning position in each axis (roll, pitch and yaw).
2. Device should be rotated about 2 seconds on each axis.
3. Perform 10 fin air figure 8's as close as possible to the sensor mounting point.

CAN Message Format

Can Messages Identifier: 11bit

Data Format (all messages): Intel.

Termination: Unterminated (no 120 Ohm termination resistor)

Default CAN Bus Speed: 1MBps

Default CAN Start Address (decimal): 0x300 (768)

CAN Message Summary

The unit uses up to 6 CAN message ID's.

When configuring the CAN start address in the unit's settings it configures the start address of the Configuration message, other message addresses from the unit will have an offset from the start address.

Default CAN Address Hex (Decimal)	Message Name	Description	Frequency Sent from Unit	Frequency To Unit	Default On or Off
0x300 (768)	AHRS_Config	Used to send and receive configuration settings and values from the unit. This address is also used by the unit to send its heart beat message. Functionality is selected by changing the multiplexor value field in this message	1000ms (Heartbeat)	User dependant	On
0x301 (769) [1 + Config Address]	AHRS_EulerAngles	Euler angle output	4ms (default) to 100ms	NOT APPLICABLE	On
0x302 (770) [2 + Config Address]	AHRS_Accelerometer	Accelerometer output	4ms (default) to 100ms	NOT APPLICABLE	On
0x303 (771) [3 + Config Address]	AHRS_Gyro	Gyro output	4ms (default) to 100ms	NOT APPLICABLE	On
0x304 (772) [4 + Config Address]	AHRS_Mag	Magnetometer output	10ms (default) to 100ms	NOT APPLICABLE	Off
0x305 (773) [5 + Config Address]	AHRS_Quaternion	Quaternion output	same as Euler angle output	NOT APPLICABLE	Off

TABLE 5 CAN MESSAGE OUTPUT SUMMARY

AHRS Config (0x300[default])

Configuration CAN Message

CAN ID: Please see unit's default CAN start address details in the unit specific CAN message section.

Overview: This CAN message is used to send configuration commands to the unit and is also used to receive configuration data from the unit. To put the unit into Setup mode and any other commands CAN messages must be sent to this CAN address. The different Commands sent to this address are selected by changing the Message Type Field.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	The unit's unique identifier, enabling the user to distinguish between multiple unit's on the same CAN bus.
3	Unsigned 8 bit integer	Message Type	This field is a multiplexor used to identify the message type. Mux values 0x00(0) to 0x29(41) are common across all units. Please refer to the common CAN message section. Mux values 0x30(42) to 0xFF(255) change depending on what particular type the unit is being used. Please refer to the unit specific CAN message section.
4-7 (length can vary depending on message type)	Variable	Variable	The remaining 4 bytes are used depending on the command or data being sent back from the unit, not all 8 bytes are populated in every message.

TABLE 6:CAN CONFIGURATION MESSAGE

Common CAN Message Types

Overview: These are the multiplexor message ID's that populate byte 3 of the configuration CAN message. The multiplexor messages highlighted below in grey only work if the unit is in Setup mode.

Hex (Decimal) Value	Purpose	CAN dbc Name	Description
0x00 (0)	Heartbeat	0x00_Heartbeat	Message that gets sent out to indicate the unit is alive on the CAN bus, its status and what the unit type is.
0x01 (1)	Enter Setup	0x01_Cmd_Enter_Setup	Command sent to unit to put it into setup mode, **the unit needs to be in setup mode to make any configuration changes to the unit.**
0x02 (2)	Save Setup	0x02_Cmd_Save_Setup	Command to save any configuration changes that have been made whilst the unit was in Setup mode. **In order to apply any configuration changes this needs to be sent.** The unit reboots after this message is sent.
0x03 (3)	Cancel Setup	0x03_Cmd_Cancel_Setup	Command to cancel any changes that have been made in the current Setup mode.
0x04 (4)	Reset Unit to Factory Defaults	0x04_Cmd_Rst_to_Factory_Defaults	Resets the unit to factory defaults.
0x05 (5)	Get the CAN bus speed	0x05_Cmd_Get_CAN_Bus_Speed	Request the unit to send the current CAN bus speed. [1]
0x06 (6)	Set the CAN bus speed	0x06_Cmd_Set_CAN_Bus_Speed	Set the unit's CAN bus speed.
0x07 (7)	CAN bus speed response	0x07_Resp_CAN_Bus_Speed	The unit's response message indicating the current CAN bus speed.[1]
0x08 (8)	Get the CAN start address	0x08_Cmd_Get_CAN_Start_Address	Request the unit to send the current CAN start address. [1]
0x09 (9)	Set the CAN start address	0x09_Cmd_Set_CAN_Start_Address	Set the unit's CAN bus start address.
0x0A (10)	CAN bus start address response	0x0A_Resp_CAN_Start_Address	The unit's response message indicating the current CAN bus start address for the unit.[1]
0x0B (11)	Get unit sleep mode	0x0B_Cmd_Get_Sleep_Mode	Request the unit to send the current sleep mode of the unit. [1]
0x0C (12)	Set unit sleep mode	0x0C_Cmd_Set_Sleep_Mode	Set the unit's sleep mode.
0x0D (13)	Sleep mode response	0x0D_Resp_Sleep_Mode	The unit's response message indicating the sleep mode of the unit.[1]
0x0E (14)	Reboot the unit	0x0E_Cmd_Reboot_Device	Reboot the unit
0x0F (15)	Get the unit software version	0x0F_Cmd_Get_Software_Version	Get the software version on the unit
0x10 (16)	Software version response	0x10_Resp_Software_Version	The unit's response message to the software version on the device.

TABLE 7 CONFIGURATION MESSAGE TYPES

[1] If the value has been reconfigured but not saved the unit will send the reconfigured value.

Heartbeat (0x00_Heartbeat)

Mux Value Hex (Decimal): 0x00 (0)

Type: Transmitted from unit

Frequency: 2000ms

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x00** – Heartbeat
4-5	Unsigned 16 bit integer	Key	This value is used to enter Setup mode, save setup or restore the unit back to factory defaults. Values Range from 1 to 10000.
6	Unsigned 8 bit integer	Status	The status of the unit: 1. Run – normal operation, no configuration changes can be made. 2. Unit in Setup mode – configuration can be changed.
7	Unsigned 8 bit integer	Unit Type	The type of unit attached to the bus e.g. a value of 0x00 is a standard CAN AHRS unit. Please see CAN unit types section for a complete list.

Enter Setup Command (0x01_Cmd_Enter_Setup)

Mux Value Hex (Decimal): 0x01 (1)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: Sending this command with the correct Key value puts the unit into Setup mode. Until the unit is in Setup mode no configuration options can be changed.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x01** – Enter setup command
4-5	Unsigned 16 bit integer	Key	This value in this field **must** be the same as the Key value in the heartbeat message for the command to be accepted. The key value will change each time a correct one has been received.

Save Setup Command (0x02_Cmd_Save_Setup)

Mux Value Hex (Decimal): 0x02 (2)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: Sending this message with the correct key value in the key field will save any configuration changes that have been made during Setup mode.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x02** – Save setup command

4-5	Unsigned 16 bit integer	Key	This value in this field **must** be the same as the Key value in the heartbeat message for the command to be accepted. The key value will change each time a correct one has been received.

Cancel Setup Command (0x03_Cmd_Cancel_Setup)

Mux Value Hex (Decimal): 0x03 (3)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: Sending this message will exit any current Setup mode and **not** save any changes.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x03** – Cancel setup command

Reset Unit To Factory Default Settings (0x04_Cmd_Rst_to_Factory_Defaults)

Mux Value Hex (Decimal): 0x04 (4)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: Sending this message and a valid Key will reset the unit to factory default settings, unit does not need to be in setup mode for this to work.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x04** – Restore to Factory Defaults command
4-5	Unsigned 16 bit integer	Key	This value in this field must be the same as the Key value in the heartbeat message for the command to be accepted. The key value will change each time a correct one has been received.

Get CAN Bus Speed (0x05_Cmd_Get_CAN_Bus_Speed)

Mux Value Hex (Decimal): 0x05 (5)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message only works if the unit is in Setup mode. If this CAN message is sent the unit will respond with the configured CAN bus speed.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x05** – Get CAN bus speed command

Set CAN Bus Speed (0x06_Cmd_Set_CAN_Bus_Speed)

Mux Value Hex (Decimal): 0x06 (6)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message only works if the unit is in Setup mode. This will set the CAN bus speed.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x06** – Set CAN bus speed command
4	Unsigned 8 bit integer	CAN bus speed	The below values in this field correspond to the following CAN speeds: 0 = 1000kbps (default) 1 = 800kbps 2 = 500kbps 3 = 250kbps 4 = 125kbps

Received CAN Bus Speed (0x07_Resp_CAN_Bus_Speed)

Mux Value Hex (Decimal): 0x07 (7)

Type: Transmitted from unit

Frequency: NOT APPLICABLE

Description: This message only works if the unit is in Setup mode. This is a units response to a set or get CAN Bus Speed message.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x07** – CAN bus speed
4	Unsigned 8 bit integer	CAN bus speed	The below values in this field correspond to the following CAN speeds: 0 = 1000kbps (default) 1 = 800kbps 2 = 500kbps 3 = 250kbps 4 = 125kbps

Get CAN start address (0x08_Cmd_Get_CAN_Start_Address)

Mux Value Hex (Decimal): 0x08 (8)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message only works if the unit is in Setup mode. If this CAN message is sent the unit will respond with the configured CAN start address, the start address is the Configuration Message and Heartbeat CAN address, any CAN messages specific to the unit's functions will be sent consecutively after this address.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x08** – get CAN start address

Set CAN start address (0x09_Cmd_Set_CAN_Start_Address)

Mux Value Hex (Decimal): 0x09 (9)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message only works if the unit is in Setup mode. If this CAN message is sent the unit it will set the new CAN start address and respond with the configured CAN start address. The start address is the Configuration CAN address, any CAN messages specific to the unit's functions will be sent consecutively after this address.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x09** – set CAN start address
4 - 5	Unsigned 11 bit integer	CAN address	A value between 0x000 (0) to 0x7FF (2047), this is the theoretical maxAHRSm start address, but this will actually be determined by the number of CAN addresses used up by the unit. MaxAHRSm start address = 2047 – number of CAN addresses used.

Received CAN Start Address (0x0A_Resp_CAN_Start_Address)

Mux Value Hex (Decimal): 0x0A (10)

Type: Transmitted from unit

Frequency: NOT APPLICABLE

Description: This is the unit's response to a set or get CAN Bus start address message

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x0A** – CAN start address
4 – 5	Unsigned 11 bit integer	CAN address	A value between 0x000 (0) to 0x7FF (2047), this is the theoretical maxAHRSm start address, but this will actually be determined by the number of CAN addresses used up by the unit. MaxAHRSm start address = 2047 – number of CAN addresses used.

Get Sleep Mode (0x0B_Cmd_Get_Sleep_Mode)

Mux Value Hex (Decimal): 0x0B (11)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message only works if the unit is in Setup mode. If this CAN message is sent the unit will respond with the configured sleep mode.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x0B** – Get sleep mode command

Set Sleep Mode (0x0C_Cmd_Set_Sleep_Mode)

Mux Value Hex (Decimal): 0x0C (12)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message only works if the unit is in Setup mode. This message configures the unit sleep mode. The sleep mode may depend on the unit, for example the unit could be permanently powered on but unless the external wake pin is high the unit will sleep after 2 seconds. This allows the unit to keep any volatile values whilst consuming minimal power.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x0C** – Set sleep mode command
4	Unsigned 8 bit integer	Sleep Mode	The below values in this field correspond to the following sleep modes: 0 = Off 1 = Wake On External Wake Pin

Sleep Mode Response (0x0D_Resp_Sleep_Mode)

Mux Value Hex (Decimal): 0x0D (13)

Type: Transmitted from unit

Frequency: NOT APPLICABLE

Description: This is a unit's response to a set or get sleep mode message.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x0D** – Sleep mode response message
4	Unsigned 8 bit integer	Sleep Mode	The below values in this field correspond to the following sleep modes: 0 = Off 1 = Wake On External Wake Pin

Reboot Device (0x0E_Cmd_Reboot_Device)

Mux Value Hex (Decimal): 0x0E (14)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: Sending this message and a valid Key value will reboot the device.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x0E** – Reboot device command
4-5	Unsigned 16 bit integer	Key	This value in this field must be the same as the Key value in the heartbeat message for the command to be accepted. The key value will change each time a correct one has been received.

Get Software Version (0x0F_Cmd_Get_Software_Version)

Mux Value Hex (Decimal): 0x0F (15)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message only works if the unit is in Setup mode. If this CAN message is sent the unit will respond with the configured sleep mode.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x0F** – Get unit's software version

Software Version Response (0x10_Resp_Software_Version)

Mux Value Hex (Decimal): 0x10 (16)

Type: Transmitted from unit

Frequency: NOT APPLICABLE

Description: This is a unit's response to a get software version message

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x10** – set CAN start address
4 - 7	Float 32bit	Software Version	The unit reported software version.

CAN Unit Types

Unit Type Value **Hex(decimal)**	**Unit Name**	**Description**
0x00 (0)	Unknown	
0x10 (16)	Standard AHRS	Standard Attitude Heading Reference System

AHRS Settings

This section documents CAN messages used to configure settings for the AHRS. To change any settings the unit needs to be in Setup mode.

Get Rotation Angle Update Rate (0x30_Cmd_Get_Rotation_Update_ms)

Mux Value Hex (Decimal): 0x30 (48)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: If this CAN message is sent the unit will respond with the configured CAN message update rate in milliseconds of the Euler and/or Quaternion values.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x30** – Get unit's rotation update rate

Set Rotation Angle Update Rate (0x31_Cmd_Set_Rotation_Update_ms)

Mux Value Hex (Decimal): 0x31 (49)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message configures the unit's CAN message update rate in milliseconds of the Euler and/or Quaternion values.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x31** – Set unit's rotation update rate
4 - 5	Unsigned 16 bit integer	Update Rate	4ms to 100ms (4ms is default)

Rotation Angle Update Response (0x32_Resp_Rotation_Update_ms)

Mux Value Hex (Decimal): 0x32 (50)

Type: Transmitted from unit

Frequency: NOT APPLICABLE

Description: This is the unit's response to a set or get rotation update rate.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x32** – Sleep mode response message
4 - 5	Unsigned 16 bit integer	Update Rate	4ms to 100ms (4ms is default)

Get Accelerometer Update Rate (0x33_Cmd_Get_Accel_Update_ms)

Mux Value Hex (Decimal): 0x33 (51)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: If this CAN message is sent the unit will respond with the configured CAN message update rate in milliseconds of the accelerometer values.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x33** – Get unit's accelerometer update rate

Set Accelerometer Update Rate (0x34_Cmd_Set_Accel_Update_ms)

Mux Value Hex (Decimal): 0x34 (52)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message configures the unit's CAN message update rate in milliseconds of accelerometer values.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x34** – Set unit's accelerometer update rate
4 - 5	Unsigned168 bit integer	Update Rate	4ms to 100ms (4ms is default)

Accelerometer Update Response (0x35_Resp_Accel_Update_ms)

Mux Value Hex (Decimal): 0x35 (53)

Type: Transmitted from unit

Frequency: NOT APPLICABLE

Description: This is the unit's response to a set or get accelerometer update rate.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x35** – Accelerometer update rate response message
4 - 5	Unsigned 16 bit integer	Update Rate	4ms to 100ms (4ms is default)

Get Gyro Update Rate (0x36_Cmd_Get_Gyro_Update_ms)

Mux Value Hex (Decimal): 0x36 (54)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: If this CAN message is sent the unit will respond with the configured CAN message update rate in milliseconds of the gyro values.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x36** – Get unit's gyro update rate

Set Gyro Update Rate (0x37_Cmd_Set_Gyro_Update_ms)

Mux Value Hex (Decimal): 0x37 (55)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message configures the unit's CAN message update rate in milliseconds of gyro values.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x37** – Set unit's gyro update rate
4 - 5	Unsigned 16 bit integer	Update Rate	4ms to 100ms (4ms is default)

Gyro Update Response (0x38_Resp_Gyro_Update_ms)

Mux Value Hex (Decimal): 0x38 (56)

Type: Transmitted from unit

Frequency: NOT APPLICABLE

Description: This is the unit's response to a set or get gyro update rate.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x38** – Gyro update rate response message
4 5	Unsigned 16 bit integer	Update Rate	4ms to 100ms (4ms is default)

Get Magnetometer Update Rate (0x39_Cmd_Get_Mag_Update_ms)

Mux Value Hex (Decimal): 0x39 (57)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: If this CAN message is sent the unit will respond with the configured CAN message update rate in milliseconds of the magnetometer values.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x39** – Get unit's magnetometer update rate

Set Magnetometer Update Rate (0x3A_Cmd_Set_Mag_Update_ms)

Mux Value Hex (Decimal): 0x3A (58)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message configures the unit's CAN message update rate in milliseconds of magnetometer values.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x3A** – Set unit's magnetometer update rate
4 -5	Unsigned 16 bit integer	Update Rate	10ms to 100ms (10ms is default)

Magnetometer Update Response (0x3B_Resp_Gyro_Update_ms)

Mux Value Hex (Decimal): 0x3B (59)

Type: Transmitted from unit

Frequency: NOT APPLICABLE

Description: This is the unit's response to a set or get magnetometer update rate.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x3B** – Magnetometer update rate response message
4 – 5	Unsigned 816bit integer	Update Rate	10ms to 100ms (10ms is default)

Get Euler CAN message output on or off (0x3C_Cmd_Get_Euler_On_Or_Off)

Mux Value Hex (Decimal): 0x3C (60)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: If this CAN message is sent the unit will respond with if the Euler angle CAN message is on or off.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x3C** – Get Euler CAN message setting on or off

Set Euler CAN message output on or off (0x3D_Cmd_Set_Euler_On_Or_Off)

Mux Value Hex (Decimal): 0x3D (61)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message configures if the unit's Euler angle CAN message is on or off.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x3D** – Set unit's Euler message to on or off
4	Unsigned 8 bit integer	On or Off	0 = off 1 = on (default)

Euler CAN message output on or off Response (0x3E_Resp_Euler_On_Or_Off)

Mux Value Hex (Decimal): 0x3E (62)

Type: Transmitted from unit

Frequency: NOT APPLICABLE

Description: This is the unit's response to a set or get Euler angle CAN message is on or off.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x3E** – Euler message on or off response message
4	Unsigned 8 bit integer	On or Off	0 = off 1 = on (default)

Get Quaternion CAN message output on or off (0x3F_Cmd_Get_Quatern_On_Or_Off)

Mux Value Hex (Decimal): 0x3F (63)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: If this CAN message is sent the unit will respond with if the Quaternion CAN message is on or off.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x3F** – Get Quaternion CAN message setting on or off

Set Quaternion CAN message output on or off (0x40_Cmd_Set_Quatern_On_Or_Off)

Mux Value Hex (Decimal): 0x40 (64)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message configures if the unit's Quaternion CAN message is on or off.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x40** – Set unit's Quaternion message on or off
4	Unsigned 8 bit integer	On or Off	0 = off (default) 1 = on

Quaternion CAN message output on or off Response (0x41_Resp_Quatern_On_Or_Off)

Mux Value Hex (Decimal): 0x41 (65)

Type: Transmitted from unit

Frequency: NOT APPLICABLE

Description: This is response to a set or get Quaternion CAN message is on or off.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x41** – Quaternion on/off response message
4	Unsigned 8 bit integer	On or Off	0 = off (default) 1 = on

Get Accelerometer CAN message output on or off (0x42_Cmd_Get_Accel_On_Or_Off)

Mux Value Hex (Decimal): 0x42 (66)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: If this CAN message is sent the unit will respond with if the Accelerometer CAN message is on or off.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x42** – Get Accelerometer message setting on or off

Set Accelerometer CAN message output on or off (0x43_Cmd_Set_Accel_On_Or_Off)

Mux Value Hex (Decimal): 0x43 (67)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message configures if the unit's Accelerometer CAN message is on or off.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x43** – Set Accelerometer message to on or off
4	Unsigned 8 bit integer	On or Off	0 = off 1 = on (default)

Accelerometer CAN message output on or off Response (0x44_Resp_Accel_On_Or_Off)

Mux Value Hex (Decimal): 0x44 (68)

Type: Transmitted from unit

Frequency: NOT APPLICABLE

Description: This is the unit's response to a set or get Accelerometer CAN message on or off.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x44** – Accelerometer on or off response message
4	Unsigned 8 bit integer	On or Off	0 = off 1 = on (default)

Get Gyro CAN message output on or off (0x45_Cmd_Get_Gyro_On_Or_Off)

Mux Value Hex (Decimal): 0x45 (69)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: If this CAN message is sent the unit will respond with if the Accelerometer CAN message is on or off.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x45** – Get gyro message setting on or off

Set Gyro CAN message output on or off (0x46_Cmd_Set_Gyro_On_Or_Off)

Mux Value Hex (Decimal): 0x46 (70)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message configures if the unit's Gyro CAN message is on or off.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x46** – Set if gyro message is on or off
4	Unsigned 8 bit integer	On or Off	0 = off 1 = on (default)

Gyro CAN message output on or off Response (0x47_Resp_Gyro_On_Or_Off)

Mux Value Hex (Decimal): 0x47 (71)

Type: Transmitted from unit

Frequency: NOT APPLICABLE

Description: This is the unit's response to a set or get Gyro CAN message on or off.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x47** – Gyro on or off response message
4	Unsigned 8 bit integer	On or Off	0 = off 1 = on (default)

Get Magnetometer CAN message output on or off (0x48_Cmd_Get_Mag_On_Or_Off)

Mux Value Hex (Decimal): 0x48 (72)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: If this CAN message is sent the unit will respond with if the Magnetometer CAN message is on or off.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x48** – Get magnetometer message setting on or off

Set Magnetometer CAN message output on or off (0x49_Cmd_Set_Mag_On_Or_Off)

Mux Value Hex (Decimal): 0x49 (73)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message configures if the uni'ts Magnetometer CAN message is on or off.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x49** – Set if magnetometer message is on or off
4	Unsigned 8 bit integer	On or Off	0 = off (default) 1 = on

Magnetometer CAN message output on or off Response (0x4A_Resp_Mag_On_Or_Off)

Mux Value Hex (Decimal): 0x49 (74)

Type: Transmitted from unit

Frequency: NOT APPLICABLE

Description: This is the unit's response to a set or get Magnetometer CAN message on or off.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x4A** – Magnetometer on or off response message
4	Unsigned 8 bit integer	On or Off	0 = off (default) 1 = on

Get Euler Pitch Inverted on or off (0x4B_Cmd_Get_Pitch_Inverted)

Mux Value Hex (Decimal): 0x4B (75)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: If this CAN message is sent the unit will respond with if the Euler pitch is inverted relative to the quaternion output, the default is on so that the unit's default axis system is SEAJ670.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x4B** – Get Euler pitch inverted on or off

Set Euler Pitch Inverted on or off (0x4C_Cmd_Set_Pitch_Inverted)

Mux Value Hex (Decimal): 0x4C (76)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message configures if the unit's Euler pitch output is inverted relative to the quaternion output, the default is on so that the unit's default axis system is SEAJ670.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x4C** – Set Euler pitch inverted is on or off
4	Unsigned 8 bit integer	On or Off	0 = off 1 = on (default)

Euler Pitch Inverted on or off Response (0x4D_Resp_Pitch_Inverted)

Mux Value Hex (Decimal): 0x4D (77)

Type: Transmitted from unit

Frequency: NOT APPLICABLE

Description: This is the unit's response to a set or get Euler pitch inverted on or off command.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x4D** – Euler pitch inverted is on or off response
4	Unsigned 8 bit integer	On or Off	0 = off 1 = on (default)

Get Euler Roll Inverted on or off (0x4E_Cmd_Get_Roll_Inverted)

Mux Value Hex (Decimal): 0x4E (78)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: If this CAN message is sent the unit will respond with if the Euler roll is inverted relative to the quaternion output.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x4E** – Get Euler roll inverted on or off

Set Euler Roll Inverted on or off (0x4F_Cmd_Set_Roll_Inverted)

Mux Value Hex (Decimal): 0x4F (79)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message configures if the unit's Euler roll output is inverted relative to the quaternion output.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x4F** – Set Euler roll inverted is on or off
4	Unsigned 8 bit integer	On or Off	0 = off (default) 1 = on

Euler Roll Inverted on or off Response (0x50_Resp_Roll_Inverted)

Mux Value Hex (Decimal): 0x50 (80)

Type: Transmitted from unit

Frequency: NOT APPLICABLE

Description: This is the unit's response to a set or get Euler roll inverted on or off command.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x50** –Euler roll inverted is on or off response
4	Unsigned 8 bit integer	On or Off	0 = off (default) 1 = on

Get Euler Yaw Inverted on or off (0x51_Cmd_Get_Yaw_Inverted)

Mux Value Hex (Decimal): 0x51 (81)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: If this CAN message is sent the unit will respond with if the Euler yaw is inverted relative to the quaternion output.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x51** – Get Euler yaw inverted on or off

Set Euler Yaw Inverted on or off (0x52_Cmd_Set_Yaw_Inverted)

Mux Value Hex (Decimal): 0x52 (82)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message configures if the unit's Euler roll output is inverted relative to the quaternion output.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x52** – Set Euler yaw inverted is on or off
4	Unsigned 8 bit integer	On or Off	0 = off (default) 1 = on

Euler Yaw Inverted on or off Response (0x53_Resp_Yaw_Inverted)

Mux Value Hex (Decimal): 0x53 (83)

Type: Transmitted from unit

Frequency: NOT APPLICABLE

Description: This is the unit's response to a set or get Euler yaw inverted on or off command.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x53** –Euler yaw inverted is on or off response
4	Unsigned 8 bit integer	On or Off	0 = off (default) 1 = on

Get Euler Pitch Offset (0x54_Cmd_Get_Pitch_Offset)

Mux Value Hex (Decimal): 0x54 (84)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: If this CAN message is sent the unit will respond with the Euler pitch offset in degrees relative to the quaternion output.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x54** – Get Euler pitch offset in degrees

Set Euler Pitch Offset (0x55_Cmd_Set_Pitch_Offset)

Mux Value Hex (Decimal): 0x55 (85)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message configures the unit's Euler pitch offset in degrees relative to the quaternion output.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x55** – Set Euler pitch offset in degrees
4 - 7	Float 32 bit	Offset	-90 to +90 degrees (default = 0)

Euler Pitch Offset Response (0x56_Resp_Pitch_Offset)

Mux Value Hex (Decimal): 0x56 (86)

Type: Transmitted from unit

Frequency: NOT APPLICABLE

Description: This is the unit's response to a set or get Euler pitch offset command.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x56** –Euler yaw inverted is on or off response
4 - 7	Float 32 bit	Offset	-90 to +90 degrees (default = 0)

Get Euler Roll Offset (0x57_Cmd_Get_Roll_Offset)

Mux Value Hex (Decimal): 0x57 (87)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: If this CAN message is sent the unit will respond with the Euler roll offset in degrees relative to the quaternion output.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x57** – Get Euler roll offset in degrees

Set Euler Pitch Offset (0x58_Cmd_Set_Roll_Offset)

Mux Value Hex (Decimal): 0x58 (88)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message configures the unit's Euler roll offset in degrees relative to the quaternion output.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x58** – Set Euler pitch offset in degrees
4 - 7	Float 32 bit	Offset	-180 to +180 degrees (default = 0)

Euler Pitch Offset Response (0x59_Resp_Roll_Offset)

Mux Value Hex (Decimal): 0x59 (89)

Type: Transmitted from unit

Frequency: NOT APPLICABLE

Description: This is the unit's response to a set or get Euler roll offset command.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x59** –Euler yaw inverted is on or off response
4 - 7	Float 32 bit	Offset	-180 to +180 degrees (default = 0)

Get Euler Yaw Offset (0x5A_Cmd_Get_Yaw_Offset)

Mux Value Hex (Decimal): 0x5A (90)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: If this CAN message is sent the unit will respond with the Euler yaw offset in degrees relative to the quaternion output.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x5A** – Get Euler yaw offset in degrees

Set Euler Yaw Offset (0x5B_Cmd_Set_Yaw_Offset)

Mux Value Hex (Decimal): 0x5B (91)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message configures the unit's Euler yaw offset in degrees relative to the quaternion output**.**

Before setting this value make sure that the Euler output accuracy is high and yaw error is <1.0 deg.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x5B** – Set Euler yaw offset in degrees
4 - 7	Float 32 bit	Offset	-180 to +180 degrees (default = 0)

Euler Yaw Offset Response 0x5C_Resp_Yaw_Offset)

Mux Value Hex (Decimal): 0x5C (92)

Type: Transmitted from unit

Frequency: NOT APPLICABLE

Description: This is the unit's response to a set or get Euler yaw offset command.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x5C** – Euler offset in degrees response
4 - 7	Float 32 bit	Offset	-180 to +180 degrees (default = 0)

AHRS_EulerAngles (0x301 [default])

Default settings:

- CAN Start Address + 1 = (0x301 by default)
- Output is set to on
- Output rate is set to 4ms
- Axis system is SEA J670

CAN Message Output Rate Range: 4 to 100ms

Overview: This CAN message is used to output the unit's Euler pitch roll and yaw as well as the estimated error in the calculated yaw, yaw should equal the unit's bearing relative to magnetic north.

The Accuracy field is linked to the unit's LED

- Green LED = High Accuracy
- Blue LED = Medium to Unreliable

Layout:

Byte(s)	Data Type	Name	Description
0 – 1	Decimal 16 bit	Pitch	Pitch relative to Earth's surface Range from -180 to +180 degrees (unit will only use -90 to +90) Precision = 0.005 degrees
2-3	Decimal 16 bit	Roll	Roll relative to Earth's surface. Range from -180 to +180 degrees Precision = 0.005 degrees
4-5	Decimal 16 bit	Yaw/Bearing	Yaw/bearing relative to magnetic north Range from 0 to +360 degrees Precision = 0.005 degrees
6 [bits 0 to 1]	Unsigned 2 bit int	Accuracy	The Euler output overall estimated accuracy. 0 = unreliable 1 = low 2 = medium 3 = high
6 [bits 2 to 7] - 7	Unsigned 14 bit int	Estimated Yaw Error	The estimated error in the yaw output. Range 0 to +360 degrees Precision = 0.022 degrees

AHRS_Accelerometer (0x302 [default])

Default settings:

- CAN Start Address + 2 = (0x302 by default)
- Output is set to on
- Output rate is set to 4ms

CAN Message Output Rate Range: 4 to 100ms

Overview: This CAN message is used to output the unit's x, y, z acceleration in g. (1g = 9.81m/s^2)

Layout:

Byte(s)	Data Type	Name	Description
0 – 1	Decimal 16 bit	X Acceleration	Forward Acceleration relative to Earth's surface (+g is forward) Range from -8 to +8 g Precision = 0.00024 g
2-3	Decimal 16 bit	Y Acceleration	Sideways Acceleration relative to Earth's surface (+g is right) Range from -8 to +8 g Precision = 0.00024 g
4-5	Decimal 16 bit	Z Acceleration	Vertical Acceleration relative to Earth's surface (+g is down) Range from -8 to +8 g Precision = 0.00024 g
6 [bits 0 to 1]	Unsigned 2 bit int	Accuracy	The calibration accuracy of the accelerometers. 0 = unreliable 1 = low 2 = medium 3 = high

AHRS_Gyro (0x303 [default])

Default settings:

- CAN Start Address + 3 = (0x303 by default)
- Output is set to on
- Output rate is set to 4ms

CAN Message Output Rate Range: 4 to 100ms

Overview: This CAN message is used to output the unit's x rotation, y rotation and z rotation in degrees/second.

Layout:

Byte(s)	Data Type	Name	Description
0 – 1	Decimal 16 bit	X Rotation	Rotation Around X axis (positive is clockwise relative to +tive g direction) Range from -2000 to +2000 degrees/second Precision = 0.61 degrees/seconds
2-3	Decimal 16 bit	Y Rotation	Rotation Around Y axis (positive is clockwise relative to +tive g direction) Range from -2000 to +2000 degrees/second Precision = 0.61 degrees/seconds
4-5	Decimal 16 bit	Z rotation	Rotation Around Z axis (positive is clockwise relative to +tive g direction) Range from -2000 to +2000 degrees/second Precision = 0.61 degrees/seconds
6 [bits 0 to 1]	Unsigned 2 bit int	Accuracy	The calibration accuracy of the gyros. 0 = unreliable 1 = low 2 = medium 3 = high

AHRS_Mag (0x304 [default])

Default settings:

- CAN Start Address + 4 = (0x304 by default)
- Output is set to off
- Output rate is set to 10ms

CAN Message Output Rate Range: 10 to 100ms

Overview: This CAN message is used to output the unit's x, y and z axis magnetic field strength in micro Tesla (µT).

Layout:

Byte(s)	Data Type	Name	Description
0 – 1	Decimal 16 bit	X Axis Magnetic Field Strength	X axis Magnetic Field Strength Range from -1300 to +1300 µT Precision = 0.04 µT
2-3	Decimal 16 bit	Y Axis Magnetic Field Strength	Y axis Magnetic Field Strength Range from -1300 to +1300 µT Precision = 0.04 µT
4-5	Decimal 16 bit	Z Axis Magnetic Field Strength	Z axis Magnetic Field Strength Range from -1300 to +1300 µT Precision = 0.04 µT
6 [bits 0 to 1]	Unsigned 2 bit int	Accuracy	The calibration accuracy of the magnetometer. 0 = unreliable 1 = low 2 = medium 3 = high

AHRS Quaternion (0x305 [default])

Default settings:

- CAN Start Address + 5 = (0x305 by default)
- Output is set to off
- Output rate is the same as the Euler angles output rate
- If the any of the Euler axis system is inverted or an offset is applied this does not alter the quaternion output.

CAN Message Output Rate Range: 5 to 100ms

Overview: This CAN message is used to output the unit's i, j, k and real component of the calculated Quaternion output.

Layout:

Byte(s)	Data Type	Name	Description
0 – 1 [bits 0-3]	Decimal 12 bit	i	i term of the quaternion output Range from -1 to +1 Precision = 0.00049 µT
1[bits 4-7] - 2	Decimal 12 bit	j	j term of the quaternion output Range from -1 to +1 Precision = 0.00049 µT
3 – 4 [bits 0-3]	Decimal 12 bit	k	k term of the quaternion output Range from -1 to +1 Precision = 0.00049 µT
4 [bits 4-7] - 5	Decimal 12 bit	real	Real term of the quaternion output Range from -1 to +1 Precision = 0.00049
6 [bits 0 to 1]	Unsigned 2 bit int	Accuracy	The calibration accuracy of the magnetometer. 0 = unreliable 1 = low 2 = medium 3 = high
6 [bits 2 to 7] - 7	Unsigned 14 bit int	Estimated Yaw Error	The estimated error in the yaw output. Range 0 to +6.282798 radians Precision = 0.000383 radians

List of Tables

List of Figures

End of Document