R&D UDR GPS CAN Sensor – User Manual

Generation 1

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3-14-2021

Revision History

Revision	Comment	Author	Date
1	Creation of Document and first issue	Joe Holdsworth	14/03/2021
2	Revised voltage range	Claire Bishop	05/02/2024

Contents

System Overview

This standalone CAN based GPS/GNSS Untethered Dead Reckoning (UDR) sensor outputs date and time, latitude, longitude, altitude, Course Over Ground and speed at up to 20Hz.

The strength of UDR is that even with complete GPS/GNSS signal loss, the unit can provide continuous positioning by using inbuilt inertial sensors to estimate its location, speed etc. it requires no external input to do this.

The configurable CAN interface allows the unit to attach to almost any CAN bus. It features either a 6 pin IP67 connector or a 300mm pig tail connector and a SMA for an external active or passive GPS/GNSS antenna. The wide-ranging input voltage and the small size and mass of the unit allows easy interface into most vehicles.

What is Dead Reckoning?

Dead Reckoning is the process of determining current position by combining previously determined positional data with speed and heading. This sensor uses what is called Untethered Dead Reckoning (UDR) which calculates speed and heading (amongst many other points of data) through the use of an internal inertial measurement unit (IMU). The addition of an IMU allows the sensor to produce more accurate readings in between GNSS data refreshes.

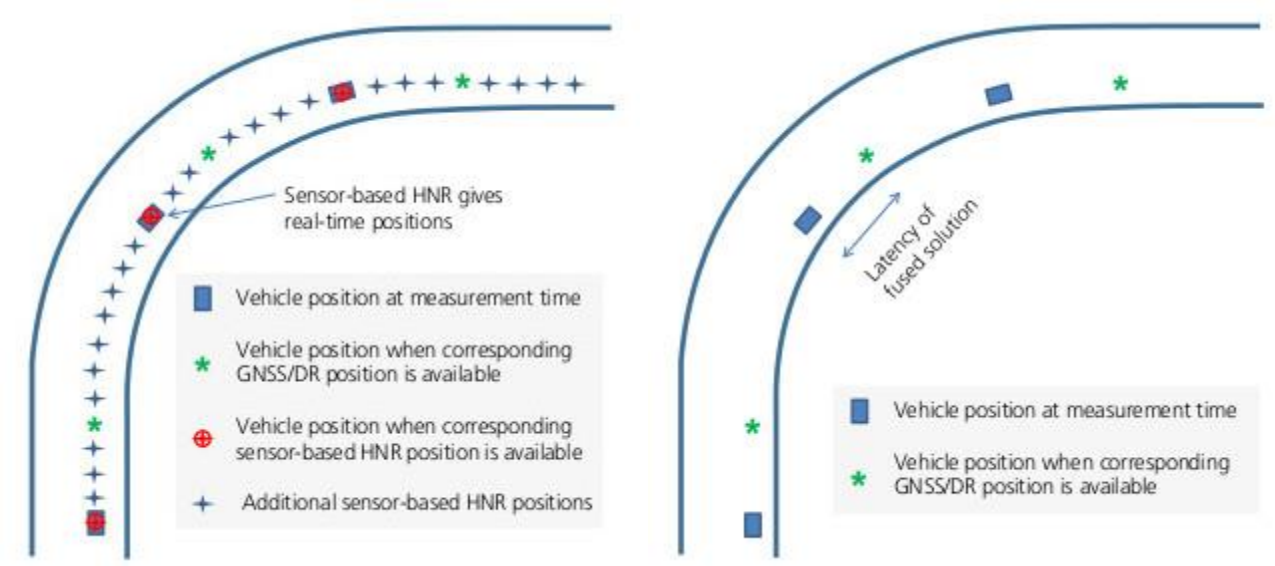


Illustration of Using an IMU with GNSS Data

Illustration of Using only GNSS Data Only

FIGURE 1 *ILLUSTRATION OF REFRESH RATE TO ACCURATELY DETERMINE POSITION. IMAGE COURTESY OF U-BLOX*

In addition, the module can also give accurate and useful GNSS data in areas where satellite connections are difficult to maintain, areas like the dense urban environments of major cities, tree cover, long tunnels and parking garages.

Max and Min Values

Sensor

Position accuracy	CEP (50%)	2.5	m
UDR Position Error	Typical Position Error after 60 seconds of no signal	<10	%
Acquisition	Cold starts	26	s
	Aided starts	3	s
	Reacquisition	1	s
Supported GNSS Constellations	GPS/QZSS L1 C/A		
	GLONASS L10F		
	BeiDou B1I		
	Galileo E1B/C		
Number of concurrent GNSS	3		
Position/COG/Speed Update Rate		20	Hz
UDR Inertial Sensors	accelerometers	+-4	g
	gyros	250	deg/s

TABLE 1 SENSOR PERFORMANCE

Environmental

Environment	Operating temperature	-40 to +80	˚C
	Dust and Water Ingress	IP65	
Mechanical Shock (Max Values)	Duration < 200µs	10000	G
	Duration < 1ms	2000	G
	Free Fall Distance	1.8	M

TABLE 2 ENVIRONMENTAL PERFORMANCE INFORMATION

Electrical

CAN [3]	Baud Rates	1000, 500, 250	Kbps
	Address Range[4]	1 (0x01) to 2042 (0x7FA) Default = 0x310	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] The default settings are 1000kbps and start address 768 (0x310), the unit has no CAN termination

[2] The unit uses 5 CAN address which are in consecutive order from address that the unit is set to

[3] This connector is not supplied with the unit

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

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

Electrical

Mating Connector

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

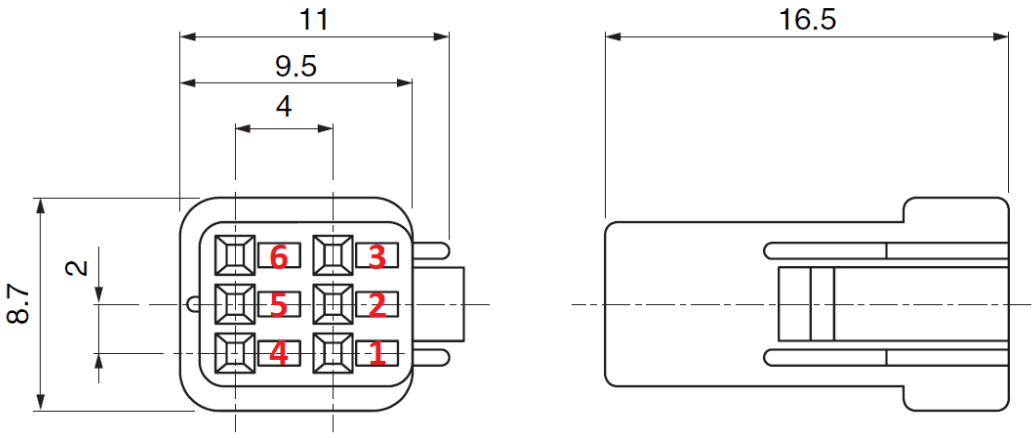


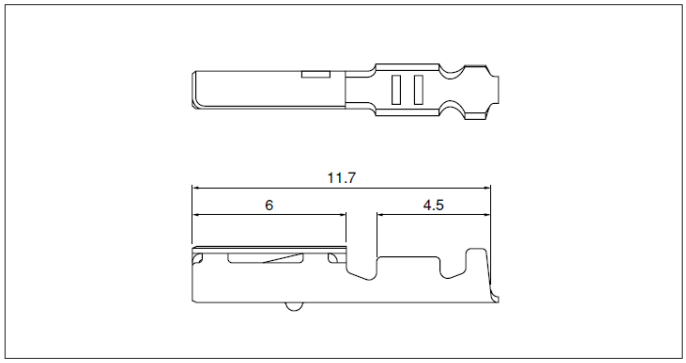
FIGURE 2 MATING CONNECTOR PIN NUMBERING (TOP DOWN VIEW)

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 3 CONNECTOR CRIMP DETAILS

CAN Termination

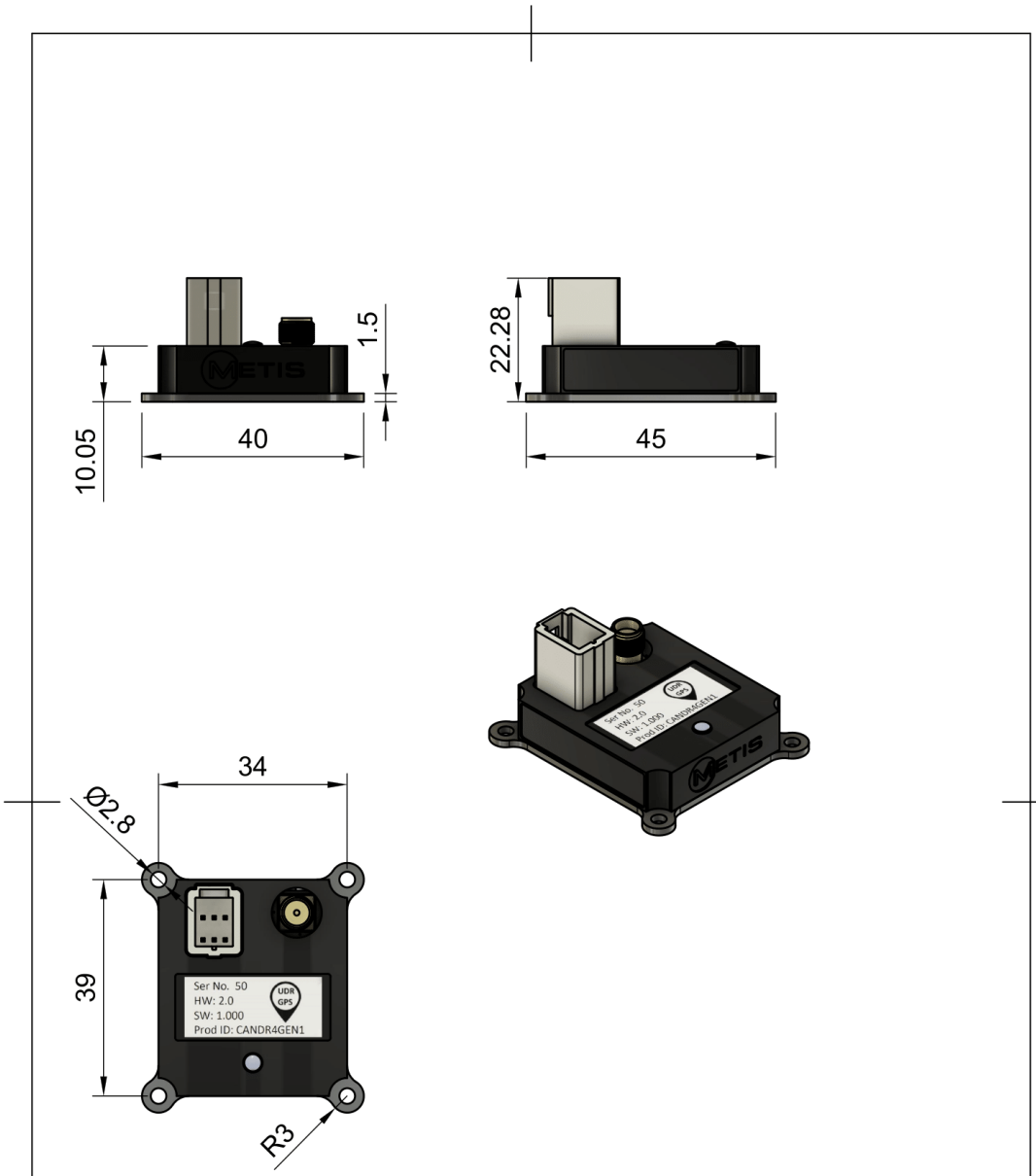
The unit does not have a termination resistor.

Mechanical

Mounting

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

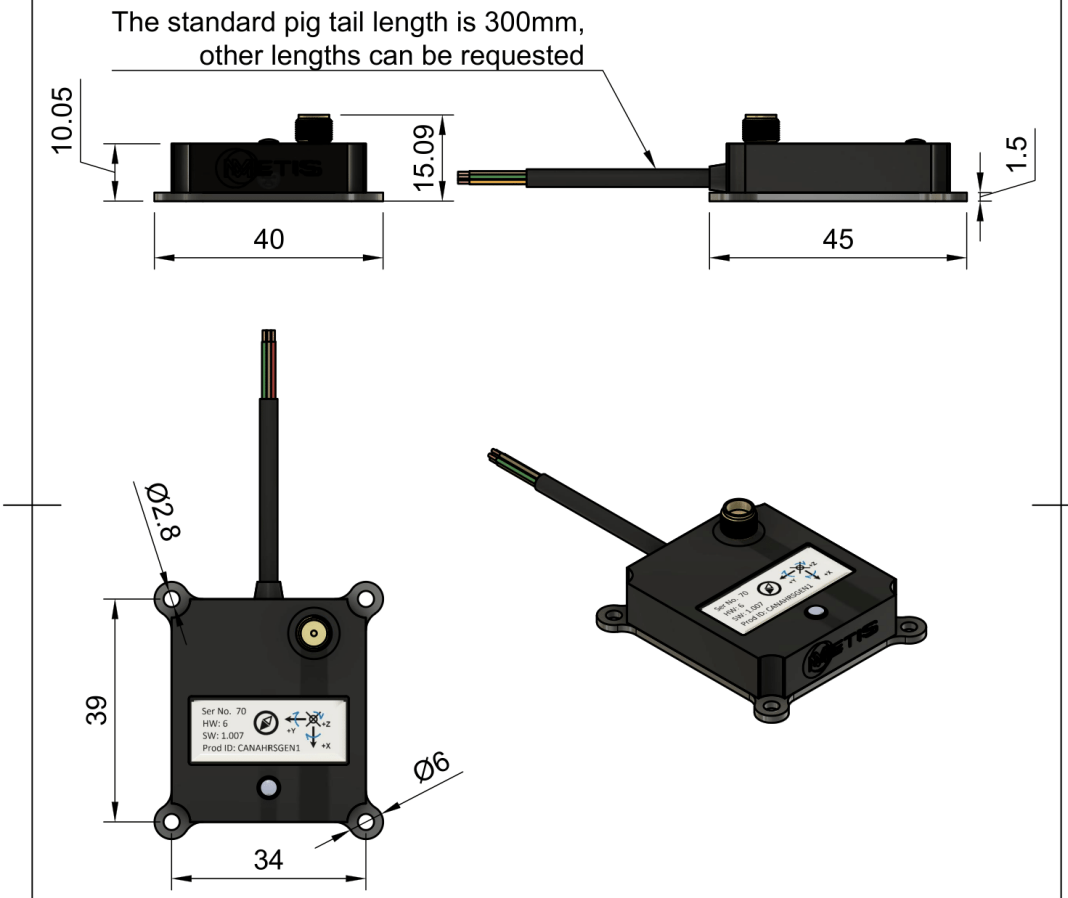
JWPF Dimensions



Dept.	Technical reference	Created by		Approved by	
Mech	Dimentions	JJH	25/06/2020	JJH	25/06/2020
All Measurements in millimeters Tolerence: +-0.05mm		Document type Reference		Document status Released	
		Title Untethered Dead Reckoning JWPF		DWG No. ENG-MEC-DRW-CANUDRGEN1	
				Rev. 1	Date of issue 25/06/2020	Sheet 1/1

FIGURE 4 JWPF SENSOR DIMENSIONS

Pigtail Dimensions



Dept.	Technical reference	Created by	Approved by
Mech	Dimentions	Joe Holdsworth 07/01/2021	JJH 07/01/2021
All Measurements in millimeters Tolerence: +-0.05mm		Document type: Reference	Document status: Released
		Title: Untethered Dead Reckoning Pigtail	DWG No.: ENG-MEC-DRW-CANUDRGEN1-PTXX
			Rev. 1 / Date of issue 07/01/2021 / Sheet 1/1

FIGURE 5 PIGTAIL SENSOR DIMENSIONS

Installation

Install into vehicle with the sensors's axis (on the label) aligned as closely as possible with the vehicle axis. The unit's label should point towards the front of the vehicle. Solidly mount and minimise vibration to the sensor as much as possible.

Ensure that the GPS antenna is rigidly mounted to the same structure that the sensor is mounted to, this is so GPS antenna movements (rotation and acceleration) match that of the UDR's internal IMU. If these differ then the UDR will not be able to calibrate. To achieve calibration, ideally locate the antenna and sensor as close to each other as possible.

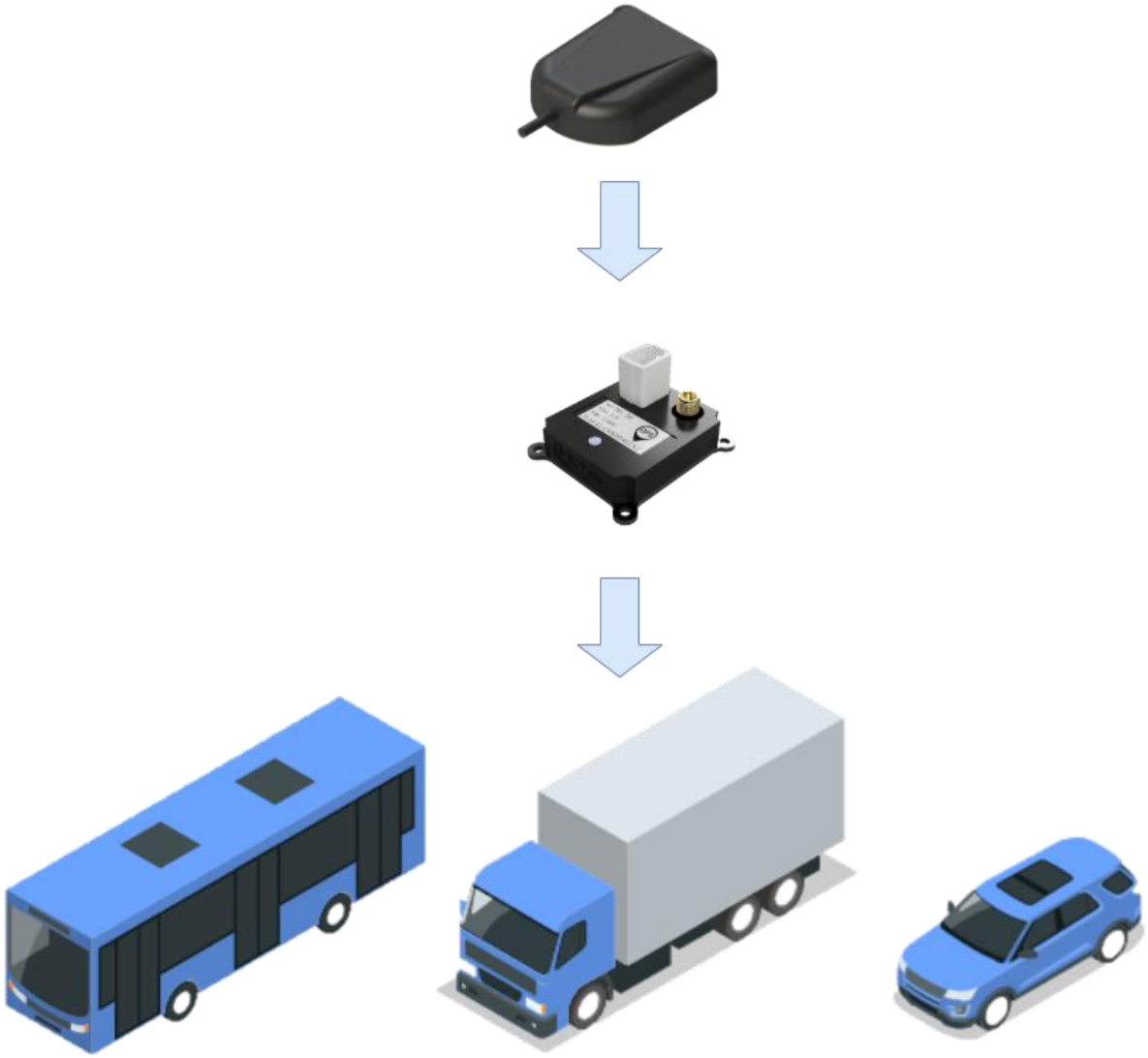


FIGURE 6 SUGGESTED MECHANICAL INSTALLATION ORIENTATION

Notes on Install

It is important to mount the sensor rigidly and close to antenna otherwise the sensor may never calibrate, or dead reckoning may not work correctly.

Sensor Calibration

Calibration

In order to calibrate, a few movements with the vehicle must be performed whilst maintaining good GNSS reception. It is important that the sensor is firmly fixed to the vehicle.

1. First, the car needs to be stationary with the engine turned on;
2. Secondly, the car must do at least one left and right hand turn >=90 degrees;
3. Lastly, the car must reach a speed over 30 kph (20 mph).

Once the sensor is calibrated it will not need calibrating again unless it is moved within the vehicle. If the sensor mount location is moved the sensor will automatically recalibrate itself as it will recognize GNSS movement will no longer match the onboard IMU output.

If UDR is not calibrated, position update from GNSS alone is 2Hz, please see Table 5 LED status.

Status LED

FIGURE 7 STATUS LED LOCATION

LED Colour	Blink Pattern	Meaning	Position update rate
White	1Hz	Factory Reset	NA
Red	1Hz	CAN Internal Error	NA
Red	2Hz	UDR Internal Error	NA
Blue	1Hz	No GNSS or 2D Fix and Dead Reckoning not calibrated	NA
Green	1Hz	Dead Reckoning mode (no GNSS)	up to 20Hz
Blue	solid	GNSS 3D fix, Dead Reckoning not calibrated	up to 2 Hz
Green	solid	GNSS 3D fix and Dead Reckoning calibrated	up to 20Hz

TABLE 5 LED STATUS

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 s ource 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.

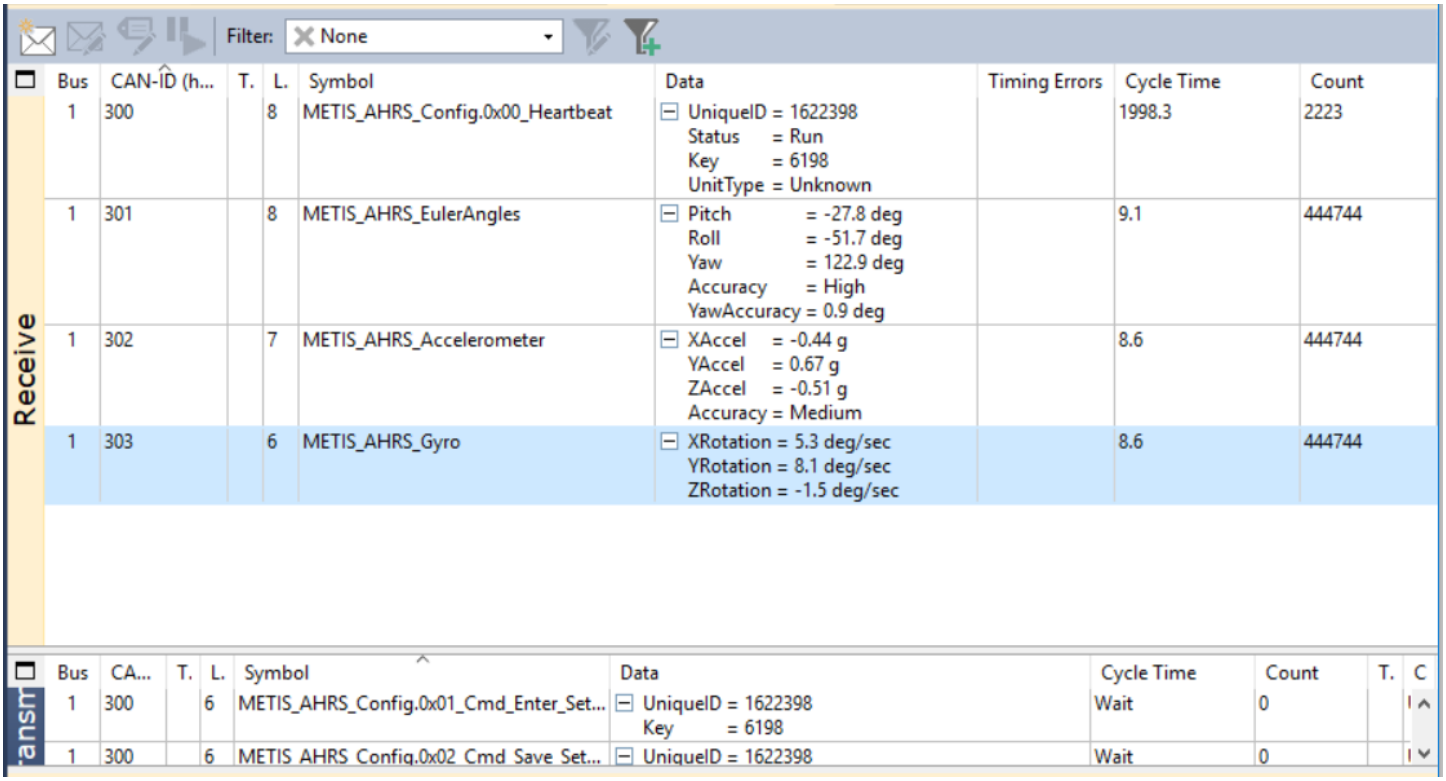


FIGURE 8 DEFAULT CAN MESSAGE OUTPUT

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.

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): 0x310 (784)

CAN Message Summary

The unit uses up to 5 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 (Deciaml)	**Message Name**	**Description**	**Frequency Sent from Unit**	**Frequency To Unit**	**Default On or Off**
0x310 (784)	DR_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
0x311 (785) [1 + Config Address]	DR_Lat_Long	Latitude and Longitude in decimal degrees	500ms (default) to 50ms	NA	On
0x312 (786) [2 + Config Address]	DR_AltSpeedCOG	Altitude (m), Speed (m/s), Course Over Ground (degrees), Satellite Count, Unit Mode, Position Dilution Of Precision/PDOP	500ms (default) to 50ms	NA	On
0x313 (787) [3 + Config Address]	DR_Date_Time	Date and time	1000ms	NA	On
0x314 (787) [4 + Config Address]	DR_IMU_Sensor_Status	Details on IMU sensor status	1000ms	NA	Off

TABLE 6 CAN MESSAGE OUTPUT SUMMARY

IMU Config (0x310[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 7: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. [2]
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.[2]
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 8 CONFIGURATION MESSAGE TYPES

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

[2] Sleep mode not available on this model.

Heartbeat (0x00_Heartbeat)

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

Type: Transmitted from unit

Frequency: 1000ms

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 IMU 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 maxIMUm start address, but this will actually be determined by the number of CAN addresses used up by the unit. MaxIMUm 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 maxIMUm start address, but this will actually be determined by the number of CAN addresses used up by the unit. MaxIMUm start address = 2047 – number of CAN addresses used.

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.

UDR Settings

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

Get Position Update Rate (x30_Cmd_Get_Pos_Update_Rate_Hz)

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 Hz of the units position and speed messages.

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 position update rate

Set Position Update Rate (x31_Cmd_Set_Pos_Update_Rate_Hz)

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 Hz of the position and speed messages.

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	1Hz to 4Hz (2Hz is default)

Position Update Rate Response (x32_Resp_Pos_Update_Rate_Hz)

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** – rotation update rate response message
4 - 5	Unsigned 16 bit integer	Update Rate	1Hz to 4Hz (2Hz is default)

Get Lat Long CAN message output on or off (x3F_Cmd_Get_Lat_Lon_On)

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 Lat Long 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 Lat Long CAN message setting on or off

Set Lat Long CAN message output on or off (x40_Cmd_Set_Lat_Lon_On)

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

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message configures if the unit's Lat Long 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 Lat Long message on or off
4	Unsigned 8 bit integer	On or Off	0 = off (default) 1 = on

Lat Long CAN message output on or off Response (x41_Resp_Lat_Lon_On)

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

Type: Transmitted from unit

Frequency: NOT APPLICABLE

Description: This is response to a set or get Lat Long 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	**0x41** – Lat Long on/off response message
4	Unsigned 8 bit integer	On or Off	0 = off (default) 1 = on

Get SOG and COG CAN message output on or off (x42_Cmd_Get_Alt_SOG_COG_On)

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 SOG and COG 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 message setting on or off

Set SOG and COG CAN message output on or off (x43_Cmd_Set_Alt_SOG_COG_On)

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

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message configures if the unit's SOG and COG 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 message to on or off
4	Unsigned 8 bit integer	On or Off	0 = off 1 = on (default)

SOG and COG CAN message output on or off Response (x44_Resp_Alt_SOG_COG_On)

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 SOG and COG 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** –on or off response message
4	Unsigned 8 bit integer	On or Off	0 = off 1 = on (default)

Get Date Time CAN message output on or off (x45_Cmd_Get_Date_Time_On)

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 Date Time 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 message setting on or off

Set Date Time CAN message output on or off (x46_Cmd_Set_Date_Time_On)

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

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message configures if the unit's 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 message is on or off
4	Unsigned 8 bit integer	On or Off	0 = off 1 = on (default)

Gyro Date Time message output on or off Response (x47_Resp_Date_Time_On)

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 Date Time 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** – on or off response message
4	Unsigned 8 bit integer	On or Off	0 = off 1 = on (default)

Get IMU Status on or off (x4B_Cmd_Get_IMU_Sensor_Status_On)

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 IMU sensor status message is on or off. Default is 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	**0x4B** – Get message on or off

Set IMU Status on or off (x4C_Cmd_Set_IMU_Sensor_Status_On)

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

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message configures if the unit's IMU sensor status message is sent. Default is 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	**0x4C** – Set message is on or off
4	Unsigned 8 bit integer	On or Off	0 = off 1 = on (default)

IMU Status on or off Response (x4D_Resp_IMU_Sensor_Status_On)

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 IMU status 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** – Message is on or off response
4	Unsigned 8 bit integer	On or Off	0 = off 1 = on (default)

Get Dynamic Model for DR (x4E_Cmd_Get_Dynamic_Model)

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 the dynamic model used my the Dead Reckoning.

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 dynamic model

Set Dynamic Model for DR (x4F_Cmd_Set_Dynamic_Model)

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

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message configures they dynamic model used for dead reckoning.

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 dynamic model

4	Unsigned 8 bit integer	Dynamic Model	0="Portable",
			2="Static", // Antenna does not move, fixed location
			3="Pedestrian",
			4="Automotive",
			5="Sea",
			6="Airborne +-1g",
			7="Airborne +-2g",
			8="Airborne +-4g",
			9="Wrist",
			10="Bike"

Dynamic Model Response (x50_Resp_Dynamic_Model)

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 dynamic model 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** –Set Get Dynamic Model response

4	Unsigned 8 bit integer	Dynamic Model	0="Portable",
			2="Static", // Antenna does not move, fixed location
			3="Pedestrian",
			4="Automotive",
			5="Sea",
			6="Airborne +-1g",
			7="Airborne +-2g",

			8="Airborne +-4g", 9="Wrist", 10="Bike"

Get Hours Offset (x54_Cmd_Get_Hrs_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 hours offset to the date time 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	**0x54** – Get hours offset

Set Hours Offset (x55_Cmd_Set_Hrs_Offset)

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

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message configures the unit's hours offset in the date time 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	**0x55** – Set Euler pitch offset in degrees
4	Signed 8 bit integer	Offset	-12 to +12

Hours Offset Response (x56_Resp_Hrs_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 hours 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	Signed 8 bit integer	Offset	-12 to +12

DR_Lat_Long (0x311 [default])

Default settings:

- CAN Start Address + 1 = (0x311 by default)
- Output is set to on
- Output rate is set to 4Hz
- CAN Message Output Rate Range: 1 to 20Hz

Overview: This CAN message is used to output the unit's latitude and longitude in decimal degrees.

Layout:

Byte(s)	Data Type	Name	Description
0 – 3	Decimal 32 bit	Latitude	Latitude in decimal degrees
4-7	Decimal 32 bit	Longitude	Longitude in decimal degrees

DR_AltSpeedCOG (0x312 [default])

Default settings:

- CAN Start Address + 2 = (0x312 by default)
- Output is set to on
- Output rate is set to 4Hz

CAN Message Output Rate Range: 4 to 20Hz

Overview: This CAN message is used to output the unit's speed, altitude, course over ground and fix status

Layout:

Byte(s)	Data Type	Name	Description
0 – 1	Decimal 16 bit	Altitude	Altitude relative to sea level in meters Range from -100 to + 6453.5m Precision = 0.1m
2-3	Decimal 16 bit	Course Over Ground (COG)	Course over ground in degrees Range from 0 to 360 degrees Precision = 0.1 degree
4-5	Decimal 16 bit	Speed	Speed in m/s Range from 0 to 6553.5 m/s Precision = 0.1 m/s

6 [bits 0 to 2]	Unsigned 3 bit int	Dead Reckoning Mode	The units fix status
			0="No Fix", // no gps and DR not calibrated
			1="Dead Reckoning",
			2="2D Fix",
			3="3D Fix",
			4="GNSS + Dead Reckoning"

6[bits 3 to 7]	Unsigned 5 bit int	Satellite Count	The number of satellites locked to Max is 31
7	Unsigned 5 int	Positional Dilution Of Precision (PDOP)	Unitless number that indicates positional accuracy 1 Ideal — Highest possible confidence level to be used for applications demanding the highest possible precision at all times. 1-2 Excellent — At this confidence level, positional measurements are considered accurate enough to meet all but the most sensitive applications. 2-5 Good — Represents a level that marks the minimum appropriate for making accurate decisions. Positional measurements could be used to make reliable in-route navigation suggestions to the user. 5-10 Moderate — Positional measurements could be used for calculations, but the fix quality could still be improved. A more open view of the sky is recommended. 10-20 Fair — Represents a low confidence level. Positional measurements should be discarded or used only to indicate a very rough estimate of the current location. >20 Poor — At this level, measurements are inaccurate by as much as 300 meters with a 6-meter accurate device (50

			DOP × 6 meters) and should be discarded.

DR_Date_Time (0x313 [default])

Default settings:

- CAN Start Address + 3 = (0x313 by default)
- Output is set to on
- Output rate is set to 1000ms

CAN Message Output Rate Range: 1000ms

Overview: This CAN message is used to output the unit's date and time.

Layout:

Byte(s)	Data Type	Name	Description
0 – 1	Unsigned 16 bit	Year	Max 65535
2	Unsigned 8 bit	Month	
3	Unsigned 8 bit	Day	
4	Unsigned 8 bit	Hour	0 to 24
5	Unsigned 8 bit	Minutes	
6	Unsigned 8 bit	Seconds	

DR_IMU_Sensor_Status (0x314 [default])

Default settings:

- CAN Start Address + 5 = (0x314 by default)
- Output is set to off
- Output rate is 1Hz
- CAN Message Output Rate Range: 1Hz only

Overview: This CAN message is used to output the unit's IMU sensor status, this is intended for debugging.

Layout:

Byte(s)	Data Type	Name	Description
0	Unsigned Integer 8 bit	Sensor Number	Indicates which IMU sensor the status is for, 1 to 3 is Accelerometers, 4 to 6 is gyros, 7 is temperature
1	Unsigned Integer 8 bit	Sensor Type	1 is Accelerometer, 2 is Gyro, 3 is temperature
2 [bit 0]	Boolean	Sensor is used	
2 [bit 1]	Boolean	Sensor is ready	
2 [bit 2]	Boolean	Sensor bad measurement	
2 [bit 3]	Boolean	Sensor is bad tag	
2 [bit 4]	Boolean	Sensor missed measurement	
2 [bit 5]	Boolean	Noisy measurement	
3 [bits 0-3]	Unsigned Integer 4 bit	Total sensor count	
3 [bits 4 to 7]	Unsigned Integer 4 bit	Fusion Mode	
4	Unsigned 8 bit int	Calibration status	
5	Unsigned 8 bit int	Time status	
6	Unsigned 8 bit int	Sensor frequency	
7	Unsigned 8 bit int	IMU Version	

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