R&D Air Quality CAN Sensor User Manual

Generation 1

Revision History

Revision	Comment	Author	Date
0.1	Creation of Document	Joe Holdsworth	18-Jul-20
1.0	First Release	Joe Holdsworth	26-Jul-20
2.0	Include pig tail variant and update casing	Joe Holdsworth	03-Jan-21
3	Update input voltage range	Claire Bishop	26/02/2024

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Contents

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System Overview

This CAN based Air Quality sensor measures:

- Absolute pressure from 200 to 5500 mBar (0.2 to 5.5 Bar)
- Air Temperature from -30 to 120 degrees C
- Volatile Organic Compounds (VOC) in ppb
- Equivalent CO2 (eCO2) in ppm **(HVAC Systems only!)**
- Hydrogen/H2 in ppm
- Absolute air water content in mg/m3
- Relative Humidity in %
- Dew point temperature in degrees C.

The unit features a replaceable air filter which helps to filter out particulates in increase the life of the sensor.

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 local air quality, for example it can be used in battery systems to detect early failures due to cell venting or vehicle HVAC systems.

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.

If the unit is too close to a source of smoke or ignition it can permanently damage the units sensors.

The CO2 sensor is equivalent CO2 and can be up to 15% error on full scale, it should only be used as an indication of CO2 as it is derived from the readings from the H2 sensor. The unit comes factory calibrated and re baselines itself every 10 minutes of power on time. The outputted value should be interpreted with care paying attention to the stated accuracy in the units specification section.

Units Specification

Sensor

Pressure Sensor	Range	0.2 to 5.5	Bar
	Resolution	0.0001	Bar
	Accuracy (0.2 to 0.3 Bar)	+-3	%FSS
	Accuracy (0.3 to 1.1 Bar)	0.0005	Bar
	Accuracy (1.1 to 5.5 Bar)	+-3	%FSS
	Max Update Rate	20	Hz
Air Temperature [1]	Range	-30 to 123	˚C
	Resolution	0.3	˚C
	Accuracy	+-1	˚C
	Max Update Rate	20	Hz
Volatile Organic Compounds (VOC's)	Range	0 to 65534	ppb
	Resolution	2	ppb
	Accuracy (Worse Case)	15 [3]	%
	Max Update Rate	20	Hz
Equivalent CO2 (eCO2)[2]	Range	0 to 65534	ppm
	Resolution	2	ppm
	Accuracy (Worse Case)	15 [3]	%
	Max Update Rate	20	Hz
H2	Range	0 to 1000	ppm
	Resolution	0.02	ppm
	Accuracy (Worse Case)	10[3]	%
	Max Update Rate	20	Hz
Absolute Humidity[4]	Range	0 - 35000	mg/m^3
	Resolution	70	mg/m3
	Accuracy (Worse Case)	3	%FSS
	Max Update Rate	20	Hz
Dew Point	Range	0-100	˚C
	Resolution	0.5	˚C
	Accuracy (Worse Case)	+-2	˚C
	Max Update Rate	20	Hz

TABLE 1 SENSOR PERFORMANCE

Environmental

Environment	Operating temperature	-20 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

Mass		30	grams
Dimensions	Height x Width x Length	22x40x45	mm

TABLE 2 ENVIRONMENTAL PERFORMANCE INFORMATION

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Electrical

CAN [5]	Baud Rates	1000, 500, 250	kbps
	Address Range[6]	1 (0x01) to 2042 (0x7FA). Default = 0x30A	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 [7]	06R-JWPF-VSLE-D
Crimp	SWPR-001T-P025
Pin Outs	

Wire Colour	Pin No.	Function
Brown	1	Not Used
Red	2	Supply Voltage
Black	3	Ground
Green	4	CAN High
White	5	CAN Low
Yellow	6	Factory Reset [8]

TABLE 4 CONNECTION INFORMATION

[1] Air Temperature Accuracy is dependent on installation, heat from the sensor itself can affect this

[2] eCO2 values are derived from H2 and should only be used in HVAC applications

[3] % of meas. value, sensor drift is 1.3% of measured value per year of operation, 90% of the sensors will be within the typical accuracy tolerance

[4] Humidity only valid from 0 to 80 degC IC temperature

[5] The default settings are 1000kbps and start address 778 (0x30A), the unit has no CAN termination

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

[7] This connector is not supplied with the unit

[8] 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
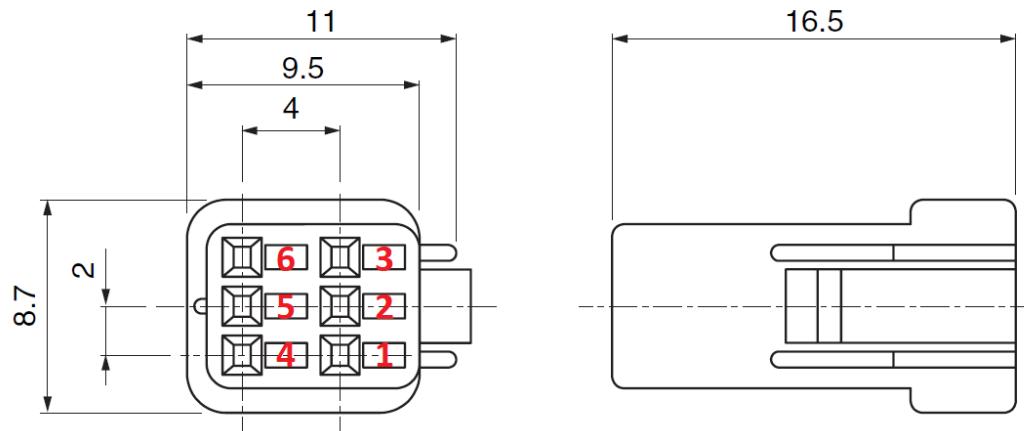
FIGURE 1 MATING CONNECTOR PIN NUMBERING (TOP DOWN VIEW)

Crimps
Crimp Part No.: SWPR-001T-P025

Crimp Tool Part No.: WC-JWPF

12" Pre-Crimped Cable Part No.: AJWPFJWPF22K305R
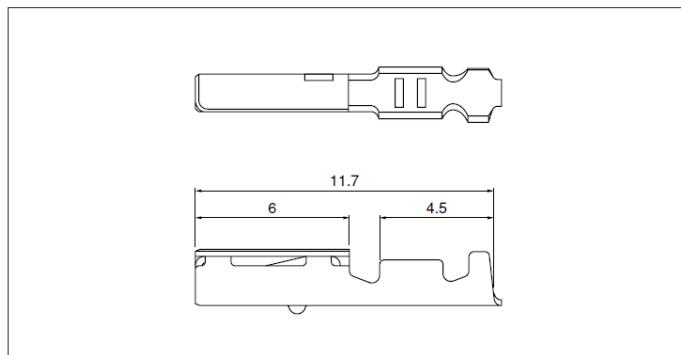
Model No.	Applicable wire		Insulation O.D (mm)	Q'ty / reel
	mm²	AWG#		
SWPR-001T-P025	0.13~0.33	26~22	1.4~1.7	8,200

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.

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	Joe Holdsworth 31/12/2020		JJH 31/12/2020		
All Measurements in millimeters Tolerence: +-0.05mm		Document type Reference		Document status Released		
		Title Air Quality JWPF Assembly		DWG No. ENG-DRW-CANAQGEN1-JWPF		
				Rev. 1	Date of issue 31/12/2020	Sheet 1/1
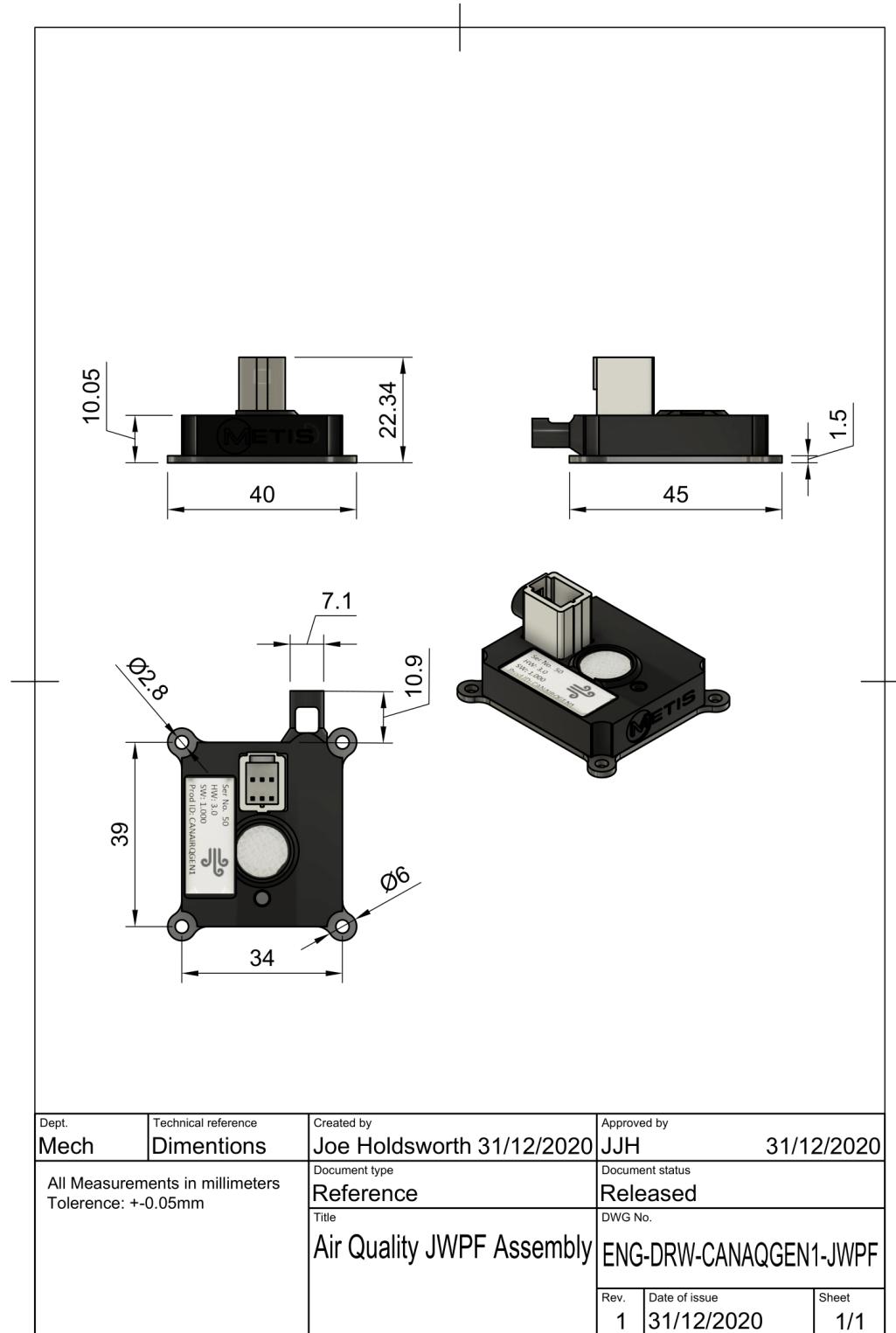
FIGURE 3 JWPF SENSOR DIMENSIONS

Pigtail Dimensions
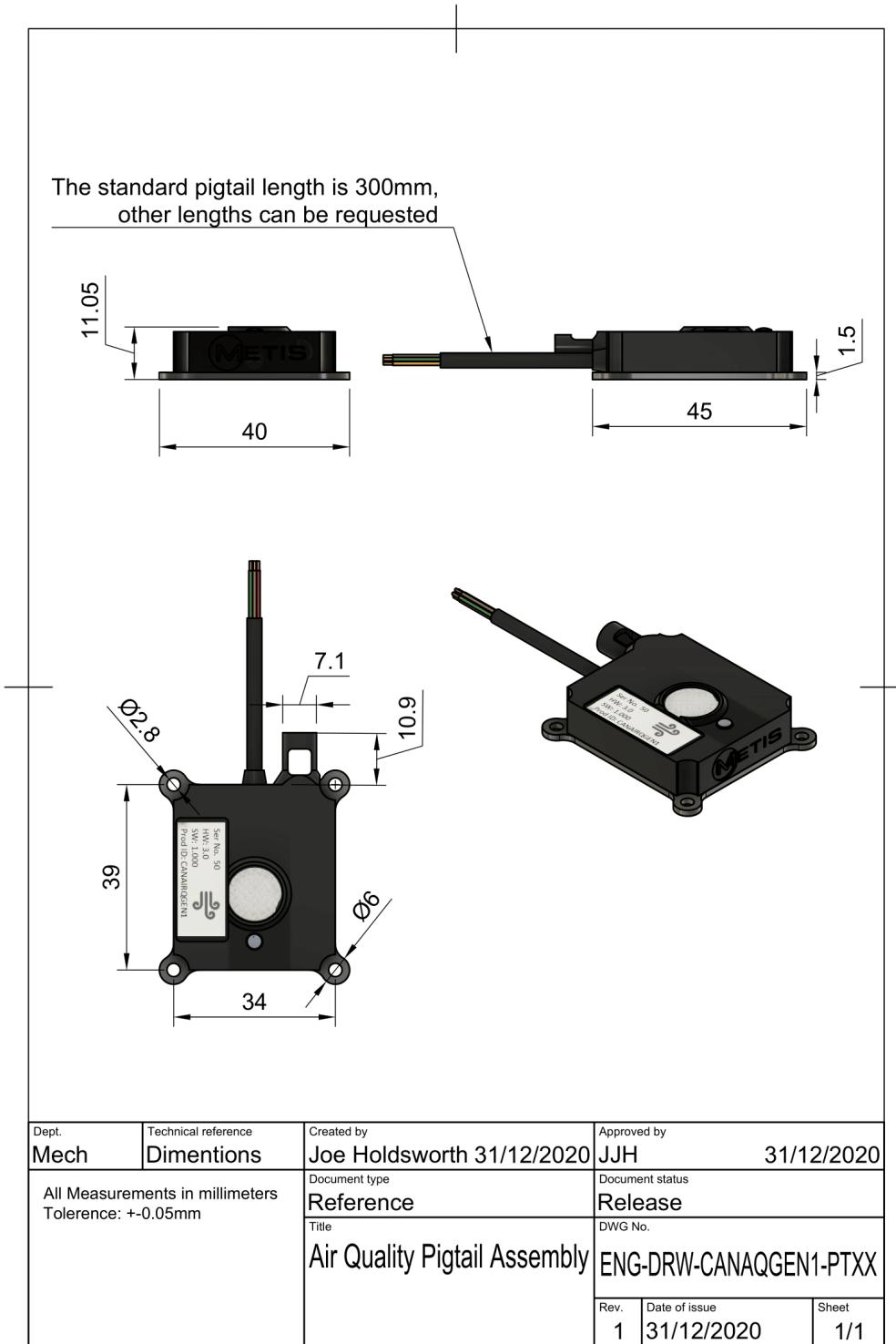
FIGURE 4 PIGTAIL SENSOR DIMENSIONS

Suggested Installation

Install at least 1m away from source of flame and soot, otherwise the unit can be permanently damaged. Replace the filter if it becomes dirty, the circular air filter has an adhesive backing that allows it to be peeled off and replaced. Please request additional filters if required from info@metisengineering.com.

FIGURE 5 MECHANICAL INSTALLATION ORIENTATION

The accuracy of the air temperature sensor is sensitive to how the unit its mounted, the unit produces a small amount of heat, convected heat from the sensor or if the heat is not conducted away from the sensor will lead to an offset in the air temperature vs real air temperature. The temperature sensors value can be offset by configuring it via a CAN message

To avoid convected heat the unit should be mounted flat, if the unit is mounted on its side the air temperature sensor should be mounted pointing down.

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.

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 received into the CAN tool.

Start the CAN interface on the Computer.

The CAN Heartbeat message will appear from the unit and other CAN Devices that may be on the bus. If not, then check the following;

1. The unit has power
2. The settings are correct
3. The CAN bus is terminated correctly
4. CAN high and low lines are the correct way round

Figure 5 shows the default message output from the unit. Please take note of the Unique ID value and the Key value. These will be required 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.

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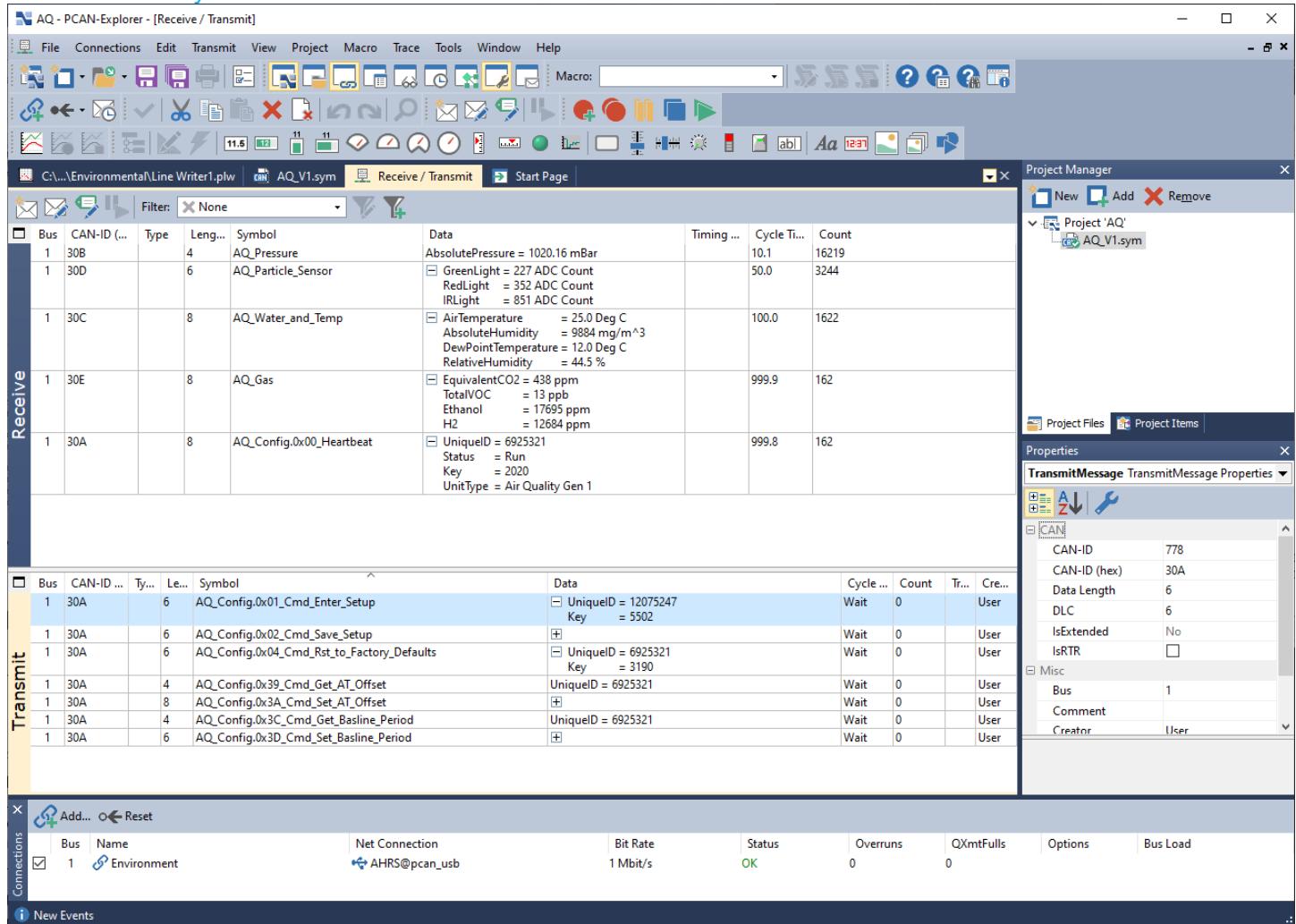
FIGURE 6 DEFAULT CAN MESSAGE OUTPUT

To change any settings move to step 3. If not required move to step 6 and calibrate the device.

Step 3: 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 an 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 the unit can be configured.

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 the 'Cancel Setup' command or power cycle the device.

Step 4: 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 has been received.

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

Step 5: Reset to Factory Defaults
To restore factory settings connect the factory reset pin to the power supply voltage and then power cycle the device.

If CAN communication is present a factory reset command can be sent to the unit.

Step 6: Calibrate the Sensors
The unit comes factory calibrated. The only parameter that may need re calibrating is the measured air temperature. This can be done through the CAN interface and is described AQ Settings section.

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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): 0x30A (778)

CAN Message Summary

The unit uses up to 4 CAN message ID's.

Default CAN Address Hex (Decimal)	Message Name	Description	Frequency Sent from Unit	Frequency To Unit
0x30A (778)	AQ_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
0x30B (779) [1 + Config Address]	AQ_Pressure	Absolute pressure output	10ms	NOT APPLICABLE
0x30C (780) [2 + Config Address]	AQ_Water_and_Temp	Absolute humidity, dew point, relative humidity output, air temp	100ms	NOT APPLICABLE
0x30D (771) [3 + Config Address]	AQ_Gas	H2, Ethanol, VOC, eCO2	50ms	NOT APPLICABLE

TABLE 5 CAN MESSAGE OUTPUT SUMMARY

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AQ Config (0x30A[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 in grey cells 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

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Byte(s)	Data Type	Name	Description
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.

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

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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 unit responds 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 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

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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

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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.

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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** – Software version response
4 - 7	Float 32bit	Software Version	The unit reported software version.

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CAN Unit Types

Unit Type Value Hex(decimal)	Unit Name	Description
0x00 (0)	Unknown	
0x80 (128)	Standard AHRS Gen 1	Standard Attitude Heading Reference System
0x81 (129)	Air Quality Gen 1	Air Quality Sensor

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AQ Settings

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

Get Gas Update Rate (0x30_Cmd_Get_Gas_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 for the gas 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	**0x30** – Get unit's gas update rate

Set Gas Update Rate (0x31_Cmd_Set_Gas_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 Gas 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 gas update rate
4 - 5	Unsigned 16 bit integer	Update Rate	1000ms to 10000ms (1000ms is default)

Gas Update Response (0x32_Resp_Gas_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 gas 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** – gas update response message
4 - 5	Unsigned 16 bit integer	Update Rate	1000ms to 10000ms (1000ms is default)

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Get Water and Temperature Update Rate (0x33_Cmd_Get_W_and_T_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 water and temperature 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 water and temperature update rate

Set Water and Temperature Update Rate (0x34_Cmd_Set_W_and_T_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 water and temperature 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 water and temperature update rate
4 - 5	Unsigned 16 bit integer	Update Rate	100ms to 1000ms (100ms is default)

Water and Temperature Update Response (0x35_Resp_W_and_T_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 water and temperature 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** – water and temperature update rate response message
4 - 5	Unsigned 16 bit integer	Update Rate	100ms to 1000ms (100ms is default)

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Get Pressure Update Rate (0x36_Cmd_Get_Pressure_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 pressure value.

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 pressure update rate

Set Pressure Update Rate (0x37_Cmd_Set_Pressure_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 pressure 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 pressure update rate
4 - 5	Unsigned 16 bit integer	Update Rate	10ms to 1000ms (10ms is default)

Pressure Update Response (0x38_Resp_Pressure_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 pressure 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	10ms to 1000ms (10ms is default)

Get Gas CAN message output on or off (0x3C_Cmd_Get_Gas_Msg_On)
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 gas 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 gas CAN message setting on or off

Set Gas CAN message output on or off (0x3D_Cmd_Set_Gas_Msg_On)
Mux Value Hex (Decimal): 0x3D (61)

Type: Sent to unit

Frequency: NOT APPLICABLE

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

Gas CAN message output on or off Response (0x3E_Resp_Gas_Msg_On)
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 gas 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** – gas message on or off response message
4	Unsigned 8 bit integer	On or Off	0 = off 1 = on (default)

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Get Water and Temperature CAN message output on or off (0x3F_Cmd_Get_W_and_T_Msg_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 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 water and temperature CAN message setting on or off

Set Water and Temperature CAN message output on or off (0x40_Cmd_Set_W_and_T_Msg_On)

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

Type: Sent to unit

Frequency: NOT APPLICABLE

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

Water and Temperature CAN message output on or off Response (0x41_Resp_W_and_T_Msg_On)

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

Type: Transmitted from unit

Frequency: NOT APPLICABLE

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

Get Pressure CAN message output on or off (0x42_Cmd_Get_Pressure_Msg_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 pressure 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 pressure message setting on or off

Set Pressure CAN message output on or off (0x43_Cmd_Set_Pressure_Msg_On)
Mux Value Hex (Decimal): 0x43 (67)

Type: Sent to unit

Frequency: NOT APPLICABLE

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

Pressure CAN message output on or off Response (0x44_Resp_Pressure_Msg_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 pressure 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** – pressure on or off response message
4	Unsigned 8 bit integer	On or Off	0 = off 1 = on (default)

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Get Air Temperature Offset (0x54_Cmd_Get_AT_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 current configured Air temperature offset value in degrees C.

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 unit's air temperature offset in deg C

Set Air Temperature Offset (0x55_Cmd_Set_AT_Offset)
Mux Value Hex (Decimal): 0x55 (85)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message configures the unit's Air Temperature offset value, this is so the user can calibrate the air temperature reading that is out put on CAN.

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 unit's air temperature offset in deg C
4 - 7	Float	Deg C	-20 to 20 deg C

Air Temperature Offset Response (0x56_Resp_AT_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 air temperature 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** – units current offset value in deg C
4 - 7	Float	Deg C	-20 to 20 deg C (default = -6)

Get Baseline Period (0x5D_Cmd_Get_Basline_Period)
Mux Value Hex (Decimal): 0x5D (93)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: If this CAN message is sent the unit will respond with the time in seconds between reading a baseline value for the gas sensors.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x5D** – Get unit's Baseline period in seconds

Set Baseline Period (0x5E_Cmd_Set_Basline_Period)
Mux Value Hex (Decimal): 0x5E (94)

Type: Sent to unit

Frequency: NOT APPLICABLE

Description: This message configures the unit's between which baseline readings are taken for the gas sensors.

Layout:

Byte(s)	Data Type	Name	Description
0 – 2	Unsigned 24 bit integer	Unique ID	Unique ID
3	Unsigned 8 bit integer	Message Type	**0x5E** – Set unit's accelerometer update rate
4 - 5	Unsigned 16 bit integer	Seconds	60 to 10000 seconds (default = 1200)

Baseline Period Response (0x5F_Resp_Basline_Period)
Mux Value Hex (Decimal): 0x5F (95)

Type: Transmitted from unit

Frequency: NOT APPLICABLE

Description: This is the unit's response to a set or get baseline period.

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** – Accelerometer update rate response message
4 - 5	Unsigned 16 bit integer	Update Rate	60 to 10000 seconds (default = 1200)

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AQ_Pressure (0x30B [default])

Default settings:

- CAN Start Address + 1 = (0x30B by default)
- Output rate is 10ms

Overview: This CAN message is used to output the unit's absolute pressure reading in millibar, it is extremely accurate between 300mbar and 1200mbar.

Layout:

Byte(s)	Data Type	Name	Description
0 – 3	Float	AbsolutePressure	Measures from 200mbar to 5500 mbar

AQ_Water_and_Temp (0x30C [default])

Default settings:

- CAN Start Address + 2 = (0x30C by default)
- Output rate is 100ms

Overview: This CAN message is used to output the unit's air water content and air temperature information.

Layout:

Byte(s)	Data Type	Name	Description
0 – 1	Unsigned16 bit	AbsoluteHumidity	Absolute humidity Measured from 0 – 65535 mg/m^3
2 - 3	Decimal 9 bit	RelativeHumidity	Relative humidity 0 to 105%
4 - 5	Decimal 9 bit	AirTemperature	Air temperature -30 to 225 Deg C
6 - 7	Decimal 9 bit	DewPointTemperature	Dew point temperature - Temperature at which condensation will start forming on an object which is at this temperature.

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AQ_Gas (0x30D [default])

Default settings:

- CAN Start Address + 3 = (0x30D by default)
- Output rate is set to 1000ms

Overview: This CAN message is used to output the unit's gas measurement values of equivalent CO_2 (eCO_2), Volatile Organic Compounds (VOC), Ethanol and Hydrogen. (ethanol and hydrogen values are used to calculate eCO_2 and VOC values)

Layout:

Byte(s)	Data Type	Name	Description
0 – 1	Unsigned 16 bit	Ethanol	Ethanol in parts per million 0 – 1000 ppm
2 – 3	Unsigned 16 bit	H2	Hydrogen parts per million 0 – 1000 ppm
4 – 5	Unsigned 16 bit	EquivalentCO2	Equivalent CO2, equivalent means its referenced against a base line, these senors baseline are factory calibrated, the sensor automatically baselines itself every 10 minutes.
6 – 7	Unsigned 16 bit	TotalVOC	Total Volatile Organic Compounds parts per billion 0 – 65535 ppb

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