TANDELTA OQSxG2 System Integration User Guide

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Getting Started Guide

OQSxG2 - System Integration

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Contents

1 PRE-INTEGRATION CHECKLIST

READ THIS GUIDE THOROUGHLY BEFORE MAKING ANY SYSTEM CHANGES

1.1 Essentials prior to Data Integration

- Refer to the Sensor Quick Start Guide for instructions on where and how to install the Sensor and check its outputs.
- Make sure that the OQSxG2 Sensor is installed correctly on your asset (engine, gearbox etc.).
- Make sure that the OQSxG2 Sensor has been configured using the CADS software with the correct oil profile for your application.

1.2 Communication Protocols

The following communication protocols are available:
Analog: 4-20 mA
Digital: Modbus, CANopen, J1939
Make sure that you are familiar with your chosen protocol, and able to make the changes described in this document.

2 INTERPRETING DATA FROM THE TAN DELTA SENSOR

This Getting Started Guide gives an overview of how measurement data from a Tan Delta Oil Quality Sensor (OQSxG2) can be integrated into your existing monitoring or telematics system The Sensor outputs the following:

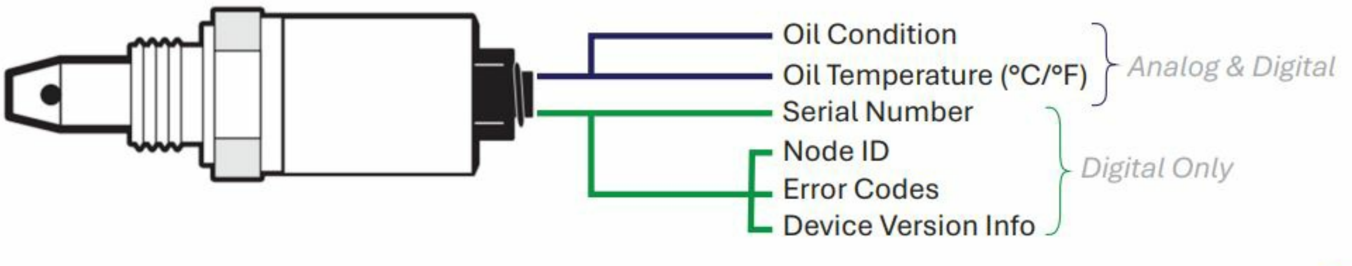


Fig. 2-1 Sensor Outputs

2.1 What is the Tan Delta Number? (TDN)

The Sensor expresses oil condition as a Tan Delta Number (TDN). The TDN scale extends from 1200 down to 0. Most clean oils start between 950 and 850 and will move down the scale as they degrade. Depending on the specific oil, the end of life (EOL) TDN will be between 600 and 300.

2.2 Warnings and Alarms

We recommend setting the following alerts based on the TDN output::

Alert	Value	Meaning
High Alarm	TDN ≥ 1100	Sensor is in air*
High Warning	TDN ≥ 975	Potential contamination*
Low Warning	TDN ≤ EOL + 10%	Oil is approaching EOL – monitor closely
Low Alarm	TDN ≤ EOL	Oil needs changing

*NOTE: If any alert is triggered immediately at an installation or oil change this indicates that either the wrong oil has been used, or the wrong oil profile applied to on the Sensor.

2.3 Visualising your readings

In addition to integrating the OQSxG2 Sensor outputs into your control system, it can be beneficial to visualise the sensor outputs graphically, on your Control Room screen or system display. Examples of Tan Delta's display platforms are shown on Page 5.

Tan Delta Display Examples As a guide, the examples below show how Sensor data is displayed visually on Tan Delta platforms.

Oil Quality Display Express OQDe Sensor data is show numerically on 7-segment displays, with an alert LED. In this case, we use additional proprietary analytics on board the display unit to generate event codes and calculate the remaining life of oil.

Fig. 2-2 Tan Delta OQDe readings and alarms display

TD Online Within our online platform, TD Online, radial dials display the TDN and temperature values, with the warning and alarm areas highlighted.

Fig. 2-3 TD Online radial dials

3 COMMUNICATION PROTOCOLS

The Tan Delta Sensor supports the following communication protocols to connect to your telematics or control system: Analog: 4-20 mA Digital: Modbus, CANopen, J1939

Fig. 3-1 below shows which pins are used for the analog and digital protocols.

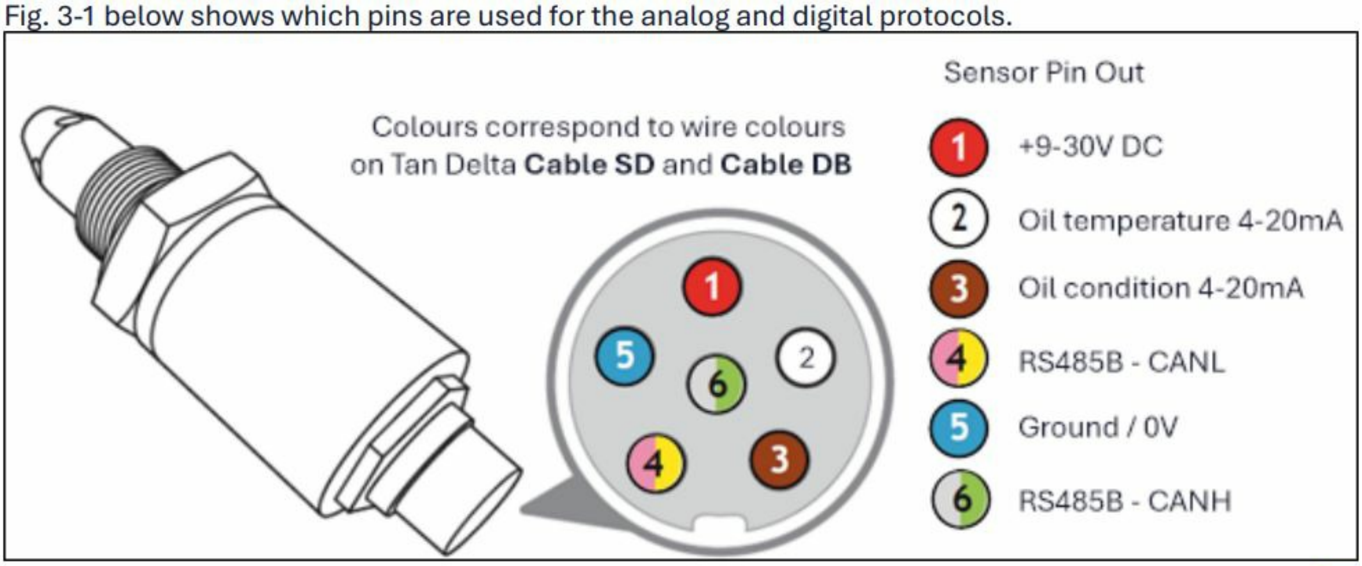


Fig. 3-1 Tan Delta Sensor pin out diagram

To configure the Sensor for your chosen protocol, connect it to your PC/Laptop using the Configuration Cable and the Tan Delta CADS software.

3.1 4-20 mA analog output

Refer to Fig. 3-1. The analog outputs are transmitted on Pin 3 (oil condition) and Pin 2 (oil temperature).
For Oil Condition, the range is 5-17 mA, and the conversion from mA to TDN is as follows:

Output	Pin	Calculation	Unit	Low	High
Oil Condition	3	= (mA -17) * -100	TDN	≥17 mA = 0 TDN	≤5 mA = 1200 TDN

For **Oil Temperature** the conversion from mA to °C and °F are as follows:

Output	Pin	Calculation	Unit	Low	High
Oil Temperature	2	°C = (mA * 10) – 70	°C	4 mA = - 30°C	20 mA = 130°C
		°F = (mA * 18) – 94	°F	4 mA = -22°F	20 mA = 266°F

3.2 Modbus RTU digital communication

The following key data outputs can be accessed via Modbus:

- Oil Temperature (°C)
- Oil Temperature (°F)
- Oil Condition (TDN)

  For a full explanation of the accessible queries and registers, see the User Guide.

The top-level specification of the Modbus communication used is below:

Hardware Interface:	RS485 multi-drop
Communication Specifications	8 bits, no parity, 9600 baud rate
Operating Mode:	Slave mode with a configurable Node ID (default ID of 1). Will not transmit any data except in response to a command from the master
Communication Mode:	Modbus RTU protocol which uses RS485 in Hex mode
Data Format:	Tan Delta returns all real (non-integer) values as 16 bit signed integers with the value multiplied by 100 (decimal), in 2's compliment format. e.g. a temperature of 34.14 °C would be returned as 3414 decimal (0D56 hex). For negatives, -12.34 would be returned as -1234 decimal (FB2E hex). NOTE: The register data and CRC check are packaged as two bytes, with the contents right justified. i.e. second byte contains the high-order bits, and the first contains the low order bits

Message Format:

Start	3.5 Characters
Address	8 Bits
Function	8 Bits
Data	16 Bits
CRC	16 Bits
Start	3.5 Characters

Key Registers:

All information required from the Sensor is kept in registers, the key registers are as follows:

Parameter	Register Decimal	Register Hex	Access
Oil Temperature (C)	0	00	Read Only
Oil Condition	2	02	Read Only
Oil Temperature (F)	4	04	Read Only
Node ID	11	0B	Read / Write

Communication Formats

Query:
Read single register example reading oil condition:

Query: 01 04 00 00 00 02 71CB

01	Node ID (01 is Default)
04	Function (0x04) is "Read Single Register"
00	n/a
00	n/a
00	n/a
02	Register address (Oil Condition)
71CB	CRC Check

01 04 00 00 00 02 71CB

Response:

The register data is packaged as two bytes, with the contents right justified. The first byte contains the high-order bits, and the second contains the low order bits.

For example, if the above query was returning an oil condition of **875**:

Response: 01 04 02 6B03 D601

01	Node ID (01 is Default)
04	Function (0x04) is "Read Single Register"
02	Byte Count
6B03	Oil Condition (036B hex = 0875 decimal)
D601	CRC Check

01 04 02 6B03 D601

Writing to the Register:

Below is an example of re-writing the Node ID, from the default of 01, to 04.

NOTE: when performing a write function, the response is simply an echo of the query.

Query: 01 06 00 0B 00 04 F9CB

01	Node ID (01 is Default)
04	Function (0x06) is "Write Single Register"
00	n/a
0B	Register address (Node ID)
00	n/a
04	New Node ID (04)
F9CB	CRC Check

01 06 00 0B 00 04 F9CB

3.3 CANbus digital communication

The Sensor uses a full CAN controller specified to conform with CAN 2.0B. Communication on CANbus can be done via CANOpen or J1939. The following key data outputs can be accessed via CANbus:

- Oil Temperature (°C)
- Oil Temperature (°F) (CANOpen only)
- Oil Condition (TDN)

For a full explanation of the accessible queries and registers, see the User Guide.
The physical CANbus specification is as follows:

Supply voltage:	+9 to +30 V d.c.
Current consumption:	50mA max. when quiescent, 100mA max. with CAN active 30-40mA typical
CAN physical layer:	2 wire interface @ 5V d.c. voltage levels a/c to ISO 11898 Short circuit protected
Bus termination:	External

CANOpen
CANOpen Specification:

CAN bitrate:	125kbit/s, 11 bit identifier
Protocol types:	CANOpen DS301, Device Profile DS404
CANOpen Type:	NMT Slave
COB ID:	Pre-defined connection set, SDO
Node ID:	Object (specific entry – read/write, default 1)

The key registers required for integration on this protocol are listed below:

NOTE for each output parameter there are two register entries.

F32 provides a floating point output, whereas I32 provides an integer output."

Index (HEX)	Sub Index	Name	Type	Access	Default Setting	Comment
1001	00	Error Register	U8	Read Only	0x00	0 = no error 1 = error Error types: B0 = Global Error B1 = n/a B2 = n/a B3 = Temperature Error B4 = CAN Communication Error B5 = Oil Condition Error B6 = n/a B7 = n/a
4001	00	Sensor Address	U8	Read / Write	0x01	Node-ID
6130	01	AI Input PV1	F32	Read Only	0x03	Oil Temperature (C)
6130	03	AI Input PV3	F32	Read Only	0x03	Oil Condition
6130	04	AI Input PV4	F32	Read Only	0x03	Oil Temperature (F)
9130	01	AI Input PV1	I32	Read Only	0x03	Oil Temperature (C)
9130	03	AI Input PV3	I32	Read Only	0x03	Oil Condition
9130	04	AI Input PV4	I32	Read Only	0x03	Oil Temperature (F)

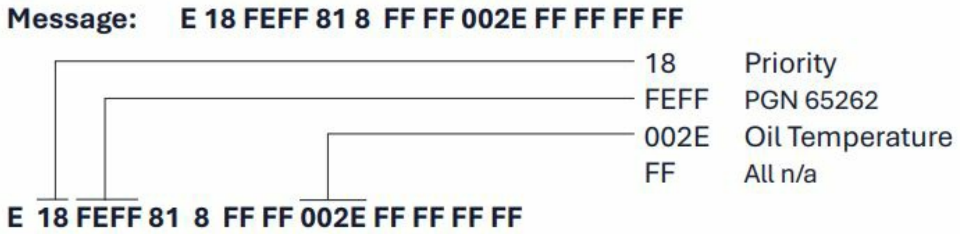
CAN Communication without CANOpen:

The Sensor can be used in CAN networks without full CANOpen functionality.
The Sensor can also operate in a network without a CANOpen Master, by setting the Sensor to "SelfStarting Mode".
For detailed descriptions of the above processes, see the full Integration User Guide on our website:
www.tandeltasystems.com/downloads

J1939
J1939 Specification:

CAN bitrate:	250 kbit/s (default), 500 kbit/s (configurable), 29 bit identifiers
Protocol types:	J1939-DA August 2018, J1939-21 October 2018 and J1939-82 June 2015
Address Capability:	Single Address Capable (not Arbitrary Address Capable) with Command Configurable Addressing; it does not support Service Configurable or Self-Configurable Addressing
Industry Group:	5
Function:	46 (decimal)
Manufacturer Code:	952 (decimal)
Available PGNs:	PGN 65262 (0xFEEE) Engine Temperature: here used for Oil Temperature PGN 65279 (0xFEFF) Operator Indicators: here used for Oil Condition PGN 65240 (0xFED8) Commanded Address
J1939 Name/Address:	Address will be 0x50002E0077000000 plus the Sensor serial number.

Operation and Messaging:
On start-up, the Sensor will broadcast its J1939 Name/Address. Data is usually shown as little-endian, so the bytes will have to be reversed to get the above address. The Sensor will then begin automatic asynchronous data transmission, sending Oil Temperature and Oil Condition PGNs every 10s, as below:
E 18 FEFF 81 8 FF FF 002E FF FF FF FF
E 18 FEFF 81 8 FF FF FFFF FF 01 50 FF

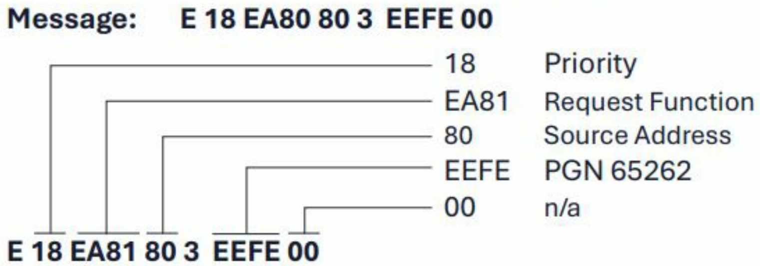


PGN 65262 (0xFEEE) reports Oil Temperature in bytes 3 and 4 according to J1939_DA201808

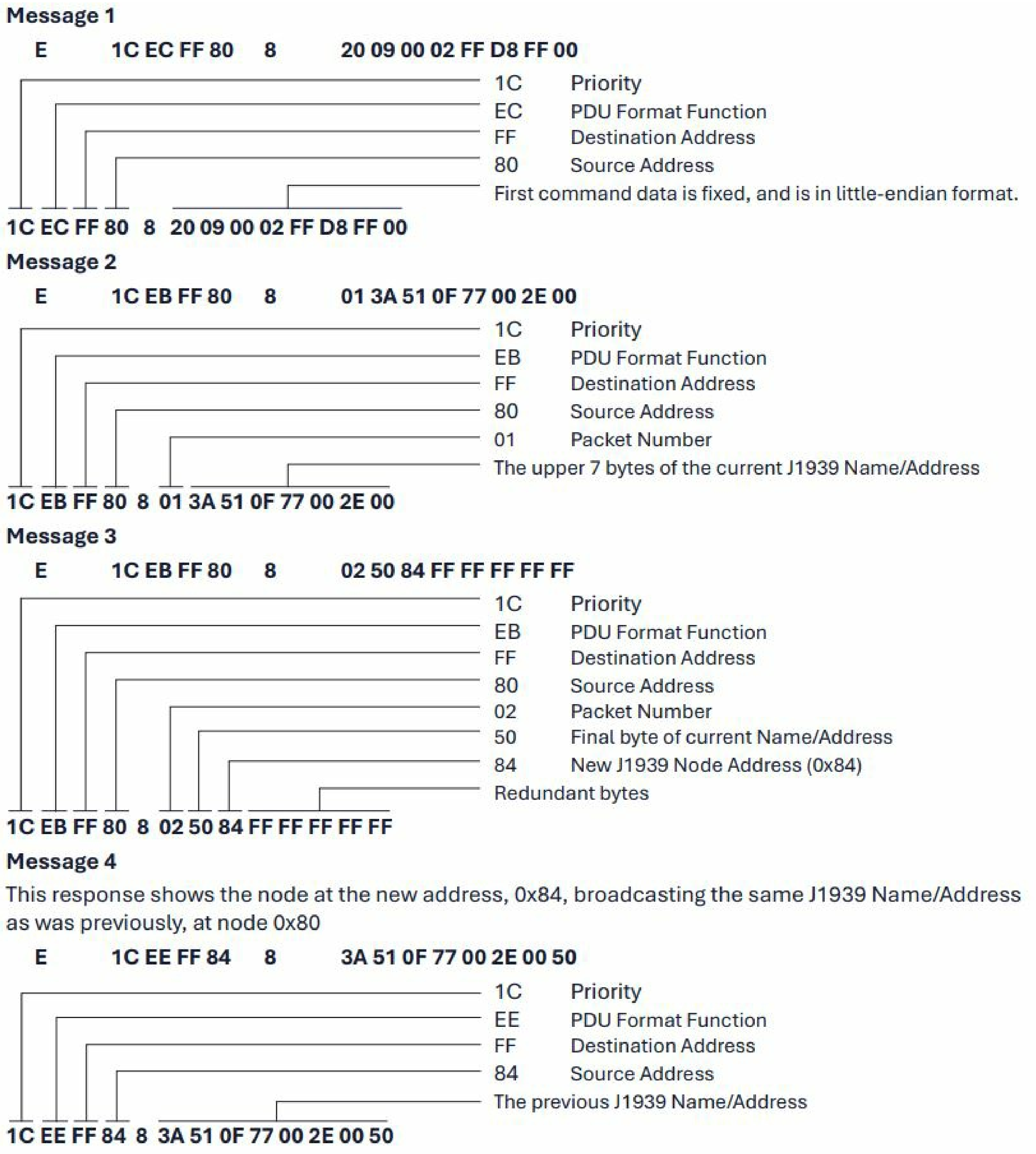
PGN 65279 (0xFEFF) reports Oil Condition in byte 6 and byte 7. These values are reported as unsigned integers, with an offset of +30 on the temperature so 0x002E = 0d46 reports an oil temperature of 46-30 = 16C.

These values may also be requested over the J1939 bus, using the below PGN messages – in the below example, Oil Temperature and Oil Condition are requested consecutively, by back-to-back requests of PGN 65262 and 65279 respectively:

E	18 EA81 80	3	EEFE 00
E	18 EA81 80	3	FEFE 00
E	18 FEEE 81	8	FFFF 00 2E FF FF FF FF
E	18 FEFF 81	8	FFFF FF FF FF 01 50 FF



Node Address Change:
The 1939 Node Address may be changed by an external node by sending 3 messages to PGN 65240 using the Command Address function. The messages are shown below:
This example changes the Node Address of 50002E00770F513A to Node Address 0x84 Message 4 (below) shows the node at the new address, 0x84, broadcasting the same J1939 Name/Address as was previously, at node 0x80)



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Documents / Resources

	TANDELTA OQSxG2 System Integration [pdf] User Guide OQSxG2, OQSxG2 System Integration, OQSxG2, System Integration, Integration

References

- User Manual