

User Guide

SENSE2 Kit



Language:	English
Version:	8
Date:	20 July 2026
Publication N°	201-1034-8

CONTACT DETAILS

Tan Delta Systems plc
1 Carrera Court
Church Road
Dinnington
Sheffield UK
S25 2RG

Tel: +44 (0)845 094 8710
support@tandeltasystems.com

DEFINITIONS



WARNING: Risk of injury or death.



CAUTION: Risk of damage to objects



IMPORTANT: Important information

COPYRIGHT NOTICE

This manual and its content are copyright of Tan Delta Systems plc - © **2026 All rights reserved.**

This document may not be distributed, transmitted electronically or stored on any other website or other form of electronic retrieval system without express written permission of Tan Delta Systems, with the exception of printing or downloading (to local storage) for personal and non-commercial use only. The content also may not be exploited for commercial purposes without express written permission of Tan Delta Systems.

DISCLAIMER

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain. Always ensure the correct configuration, installation, and connection of the sensor in accordance with these instructions prior to any use.

The information contained within this manual affects your legal rights, responsibilities, and safety. Failure to read and follow any instructions and warnings contained within this document may result in a serious injury to yourself or others, damage to your Tan Delta Systems product(s), or damage to other objects.

By installing and using your Tan Delta Systems product(s), you are agreeing that you acknowledge and understand this disclaimer and warning.

Tan Delta Systems accepts no liability for damage, injury or any legal responsibilities incurred directly or indirectly from the use of this product. The user shall at all times observe safe and lawful practices including, but not limited to, those set out in this document and any associated reference documents.

AMENDMENT RECORD SHEET

Version Number	Amendment(s)	Issued by	Date
1	New document	S Rickards	29 November 2024
2	Corrected torque setting to 20 Nm	S Rickards	29 May 2025
3	Updated TD Config	S Rickards	09 June 2025
4	Further updates for latest TD Config functionality	S Rickards	24 September 2025
5	Replaced Cable DB with Cable SB (Fig. 1-1)	S Rickards	08 January 2026
6	Updated for new product codes in price book	S Rickards	05 February 2026
7	Sections 6, 7 & 10. Updates for new Modbus functionality	S Rickards	01 June 2026
8	Section 4.1. Corrected IP address to 192.168.4.1	S Rickards	20 July 2026

CONTENTS

1	SENSE2 Kit - Introduction	5
1.1	Product overview	5
1.2	Kit Contents	5
1.3	About this User Guide	5
2	Sensor Configuration	6
2.1	Set Up	6
3	Configuration in TD Config	9
3.1	Configuring a display using TD Config	9
4	OQDe-G2 Display Express - Using Insight	11
4.1	Connecting to Insight on the OQDe-G2	11
4.2	Connecting OQDe-G2 to Wireless Local Area Network (WLAN)	12
4.3	Using the Insight application	12
4.4	Finding the IP Address of OQDe-G2 on Wireless Local Area Network (WLAN)	17
4.5	Upgrading your Firmware	18
5	OQS/OQL Sensor Installation	19
5.1	Precautions	19
5.2	Choosing the Sensor Mounting Location	19
5.3	Fitting Method	20
5.4	Electrical Connection	20
6	OQDe-G2 Display Express Installation	22
6.1	Mounting	22
6.2	Connection	23
6.3	Modbus Output	24
6.4	Operation	26
7	OQDe-G2 - Understanding Data	27
7.1	Tan Delta Full Spectrum Holistic (FSH) Data	27
7.2	TD Config application	28
7.3	Insight	28
7.4	Dynamic Maintenance Optimisation (DMO)	29
7.5	Partially / Fully integrated sensors	29
8	OQS/OQL Sensor - Support	34
9	Sensor Cleaning & Maintenance	35
9.1	Cleaning Procedure – Using Odourless Kerosene	35
10	SENSE2 Kit - Support	36
10.1	Modbus Troubleshooting	37
11	Appendix 1 - Oil Condition Conversion Chart	38
12	Appendix 2 - Oil Temperature Analog Output	39
13	Software User Agreement	40

1 SENSE2 KIT - INTRODUCTION

📺 VIDEO TUTORIAL

For a video tutorial, showing the SENSE2 Installation process, visit the website below, or scan the QR code.

<http://oilconditionsoftware.com/installsense2>



➔ 1.1 Product overview

SENSE2 is a complete real-time oil condition analysis and equipment health monitoring kit that can be easily retrofitted onto any equipment.

It provides real-time oil condition analysis and monitoring.

The SENSE2 includes everything needed for a quick and easy installation on any equipment – no special training or skills are required.

➔ 1.2 Kit Contents

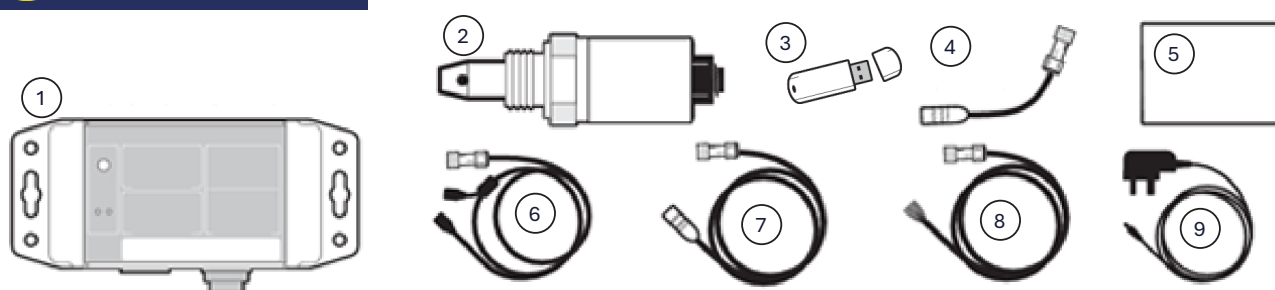


Fig. 1-1 SENSE-2 Kit Contents

Check that your kit contains the following items:

What's in the box? Product Code: SENSE2 Kit	
Item	Description
1	Display Express Unit (OQDe-G2)
2	Oil Quality Sensor OQS (or long-nosed version OQL)
3	Tan Delta Software USB
4	Adaptor Cable (CAB-M)
5	Quick Start Guide
6	Configuration Cable (CAB-J)
7	Sensor to Display Cable (CAB-SD)
8	Sensor to bare ends cable (CAB-SB)
9	Power Supply (for OQDe-G2)

➔ 1.3 About this User Guide

This User Guide provides details on how to configure, install, operate, and maintain the components of the SENSE2 Kit.

2 SENSOR CONFIGURATION



IMPORTANT:

You must configure the sensor to your specifications using Tan Delta Configuration Software **TD Config**.

TD Config is provided on the Tan Delta USB drive supplied with your Sensor.



NOTE:

The TD Config application **must** be installed on a windows PC or laptop.

TD Config **does not** operate on Mac devices or Chromebook devices.



2.1 Set Up



NOTE:

You will need Administrator privileges on your computer to Install the TD Config application.

Also, when TD Config has installed, we recommend that you connect the Configuration cable to the PC whilst Administrator privileges are still granted, so it will recognise the cable and install any drivers that are needed.

2.1.1 Install the TD Config application onto your PC / Laptop

TD Config is provided on the USB drive supplied with your SENSE2 Kit

Alternatively, it is available for download online at:

<http://oilconditionsoftware.com/installtdconfig>

- 1) Insert the Tan Delta USB drive into a USB port on your computer.
- 2) When prompted, select **Open folder** to view files.
- 3) Launch the **TDConfig_Installer** file and follow the instructions in the setup wizard.
- 4) When prompted, click on **Install**.
When installation is complete, **TD Config** is home page is displayed, as shown in Fig. 2-1.
- 5) Allow the PC/laptop to automatically update drivers, if needed.



NOTE:

If sensors are configured to Modbus/CANbus, you **must** open the software first, and then connect the Sensor.

2.1.2 Connect the OQS / OQL



NOTE:

The order in which you connect the cable and the sensor is important

- 1) First, Insert the USB end of cable **CAB-J** into a USB port on your PC/laptop.
- 2) Then, connect the free end of configuration cable **CAB-J** to the OQS, as shown in Fig. 2-2.
- 3) Once the home screen has loaded, select **Device Configuration** from the options on the home screen.



Fig. 2-2 Setting up a sensor for configuration

(Standard sensor shown)

2.1.3 Select the required configuration

The Device Configuration screen (Fig. 3-3) displays a list of configuration options.

- 1) If your sensor was supplied as part of a SENSE2 Kit, select the **SENSE2 - Sensor Kit** option.

or...

If your sensor was supplied as an individual item, select **OQS / OQL - Sensor only**.

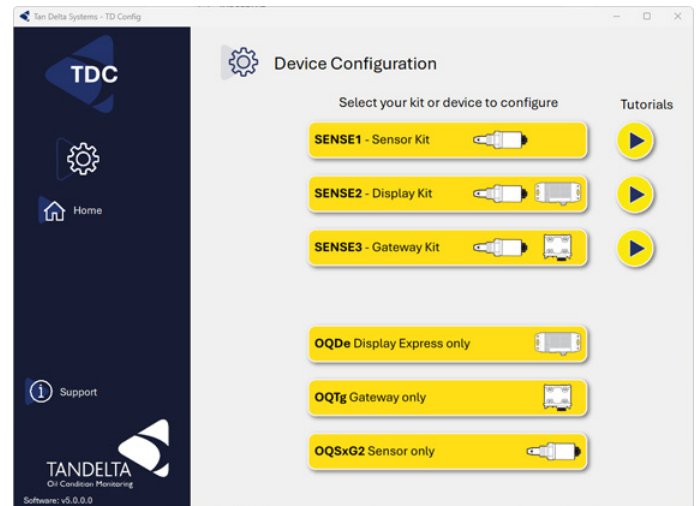


Fig. 2-3 Device Configuration selection screen

The SENSE2 Configuration screen will search for a suitable Cable and Sensor.

Once your Sensor is detected, the **Sensor Found** screen is displayed (Fig. 3-4).

- 2) Click on **Next**.

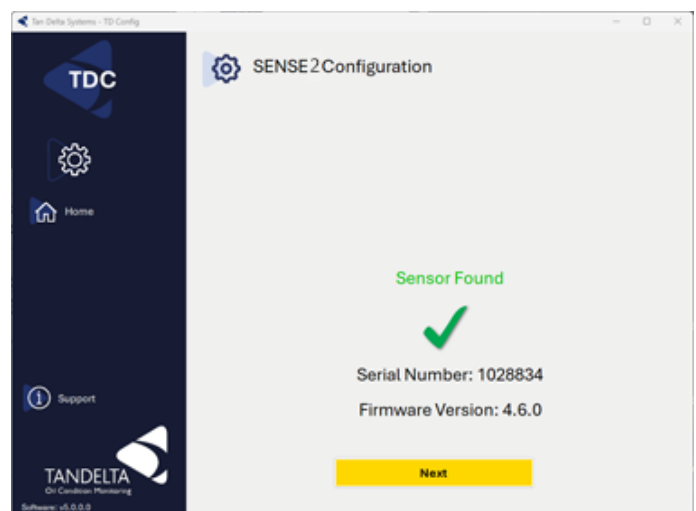


Fig. 2-4 TD Config sensor search

TD Config displays the Oil Database, as shown in Fig. 2-5.



NOTE:

If your oil is not displayed in the database, contact Tan Delta Support.

- 7) You can use the **Custom sensor name** option to give your sensor a name relevant to your application e.g. **Gearbox**.
- 8) You can re-order the list by clicking on the column headings e.g. **Manufacturer**, **Viscosity** etc.
- 9) Select the required oil from the database, then click on **Upload to Sensor**.

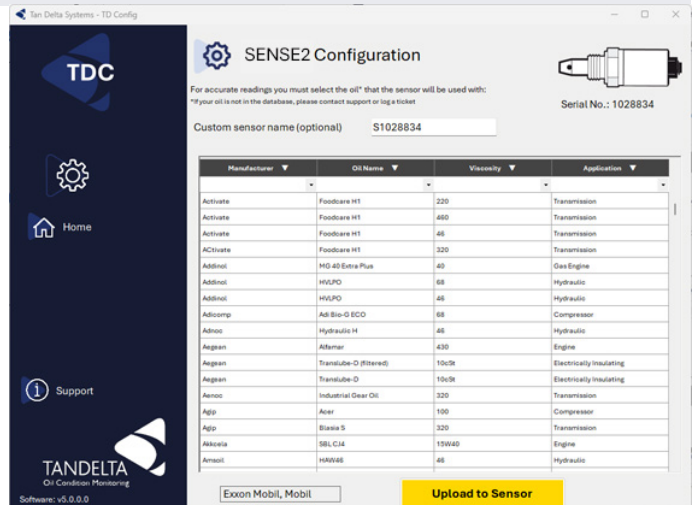


Fig. 2-5 Tan Delta oil database

TD Config will now write the configuration settings to the sensor.

This may take several minutes.

When the configuration is complete, the confirmation screen is displayed, as shown in Fig. 3-6.

Click on **Finish**.

You can now disconnect the sensor.

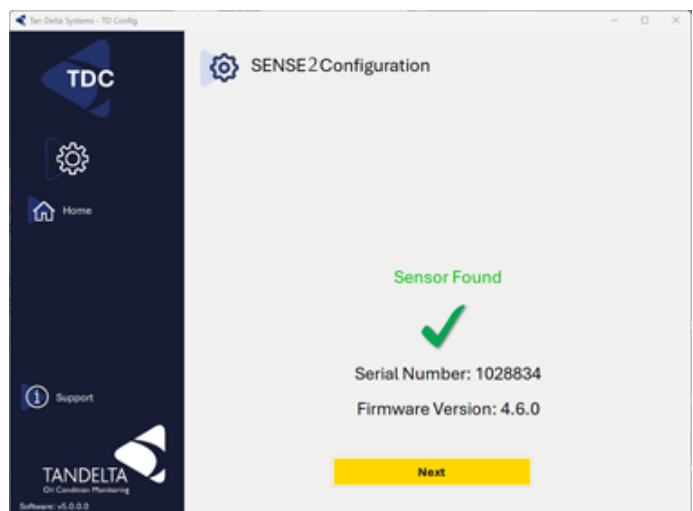


Fig. 2-6 Successful configuration

3 CONFIGURATION IN TD CONFIG



IMPORTANT:

You **must** configure the Sensor for use with the OQDe-G2 before configuring the OQDe-G2. This is done in **TD Config**. See the previous section of this User Guide for more information.



3.1 Configuring a display using TD Config

3.1.1 Connect the OQDe-G2

- 1) Refer to Fig. 3-1. Connect the OQDe-G2 to your computer to using cables **CAB-J** and **CAB-M**.
- 2) Connect the Mains Power Adapter lead to the power connector input on **CAB-J**, and connect the adapter to a mains supply.
- 3) Start the **TD Config** software.
- 4) If your display was supplied as part of a SENSE2 Kit, select the **SENSE2 - Display Kit** option.

Or...

If your display was supplied as an individual item, select **OQDe Display Express only**.

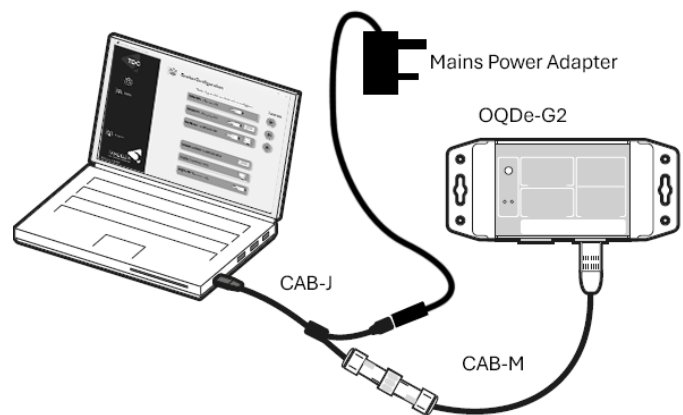


Fig. 3-1 OQDe-G2 selection screen in TD Config

TD Config displays details of the detected OQDe-G2 Display, as shown in Fig. 3-2.

- 5) Click on **Next**.

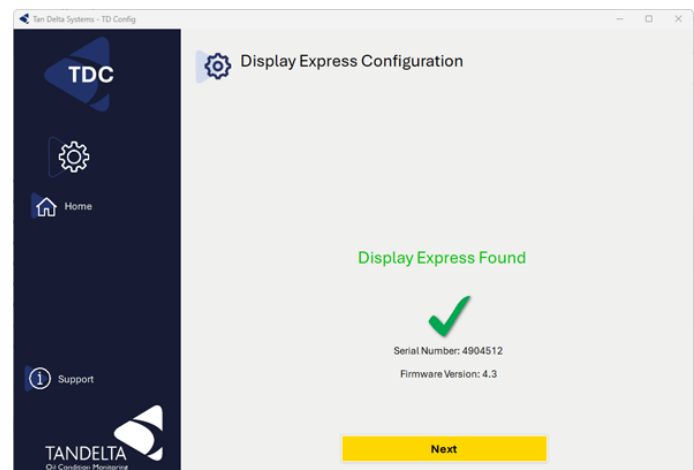


Fig. 3-2 Search results display

TD Config now displays the configuration options for you QQDe-G2 Display, as shown in Fig. 3-3.

- 6) Select the required application for the sensor connected to your display e.g. Engine, Hydraulics etc.
- 9) Click on **Next**.
TD Config now displays a final confirmation screen for the configuration you have specified, as shown in Fig. 3-4.
- 10) Click on **OK**, then click on **Next**.
TD Config now displays a confirmation that the configuration has been successful, as shown in Fig. 3-5.
- 11) Click on **Finish**
You can now disconnect the QQDe-G2 Display and use it with your sensor on your application.

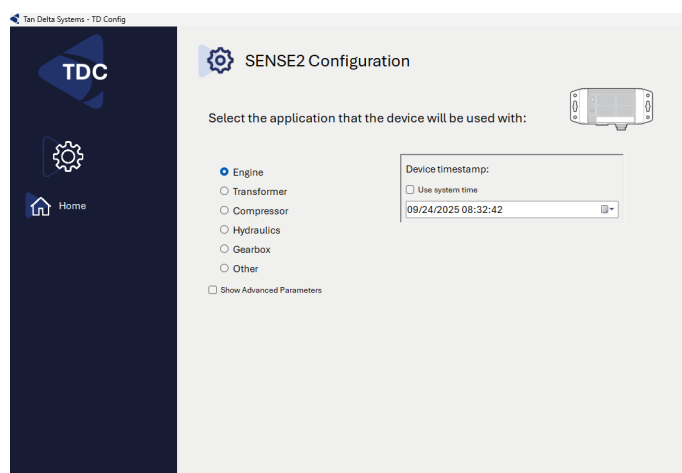


Fig. 3-3 QQDe Configuration options

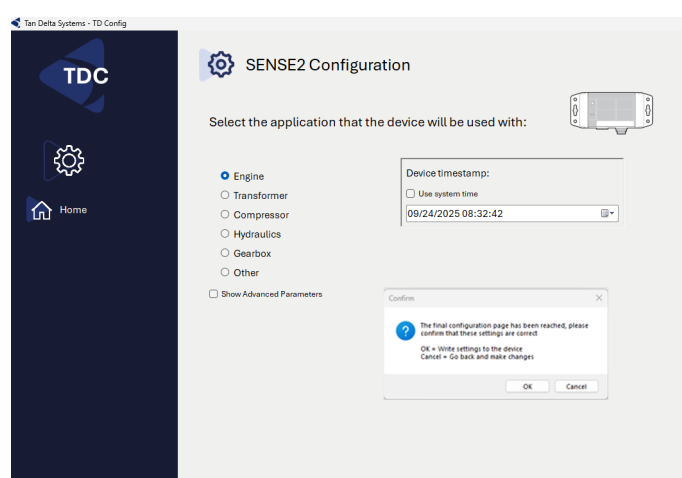


Fig. 3-4 QQDe-G2 Final Configuration screen

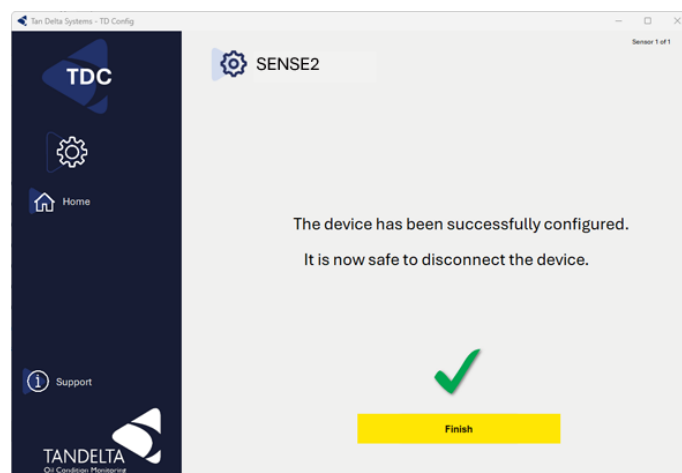


Fig. 3-5 QQDe-G2 Configuration successful

4 QQDe-G2 DISPLAY EXPRESS - USING INSIGHT

4.1 Connecting to Insight on the QQDe-G2

Insight is a web-based application allowing configuration of the QQDe-G2 and access to live and historic data, which can be downloaded via Wi-Fi.

To connect to Insight, first power up the QQDe-G2 using the power and data cable **CAB-SB**.

Connect cable **CAB-M** to the right hand on the display, then connect **CAB-SB** to **CAB-M**. The wiring schedule for cable CAB-SB is given in Section 6 of this User Guide.

Alternatively, connect the display to a Laptop or PC using cables **CAB-J** and **CAB-M** as shown in Fig. 4-1. The device will power on automatically and the Power LED will illuminate green.

Within a few seconds, the Wi-Fi Hotspot will start broadcasting and the Wi-Fi LED will also illuminate blue.

You can now connect to the QQDe-G2 using Wi-Fi via any PC, Tablet or Mobile Device.

Simply search for nearby devices. The default SSID of the QQDe-G2 is **TanDelta QQDe-G2** and password is **password**.

This will create a local network between the device and the display.

Once connected, you are ready to connect to Insight.

For first time set-up you can either scan the QR code on the device, or use your preferred Internet browser, and navigate to the IP address **192.168.4.1**.

If the device has been connected to an external Wi-Fi network the IP address will have changed. If you have forgotten the new IP address, you can find it by connecting to the QQDe-G2 using the TD Config software (See the configuration process section) - the IP address will be displayed when TD Config detects the device.

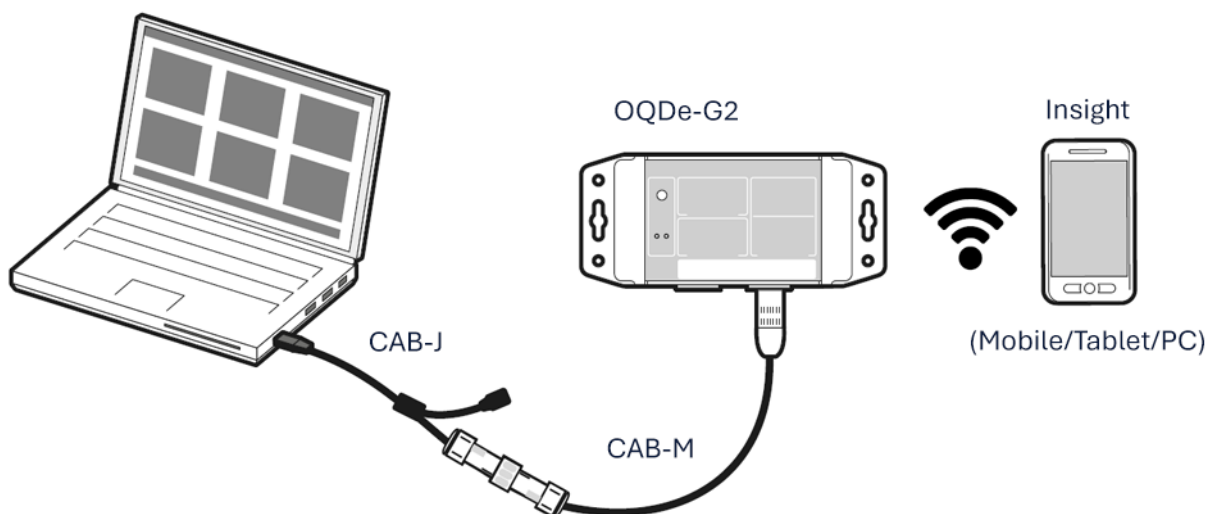


Fig. 4-1 Connecting to the QQDe-G2 via Wi-Fi Hotspot



IMPORTANT:

If you purchased your QQDe-G2 as a stand alone product, and **not** as part of an SENSE2 Kit, cables are **not** supplied.

These are supplied separately – see the **Cable** section of our website.

For **Configuration**, you will need 1 x **CAB-J** CAB-M.

For **Installation**, you will require 1 x **CAB-SD**, 1 x **CAB-M**, and 1 x **CAB-DB**.

4.2 Connecting OQDe-G2 to Wireless Local Area Network (WLAN)

The OQDe-G2 supports connection to a Wireless Local Area Network. To connect to your WLAN, you must first connect to the OQDe-G2 via Wi-Fi Hotspot.

- 1) Connect to the OQDe-G2 via Wi-Fi Hotspot (See Section 4.1).
- 2) Open the Insight application, using the IP Address **192.168.4.1**.
- 3) Click on the **Settings** screen
- 4) In the **Wi-Fi Network SSID** box, type in the SSID of your WLAN, click **Apply**.
- 5) In the **Wi-Fi Password** box, type in the **Password** of your WLAN, click Apply.
- 6) The OQDe-G2 will need to reboot - you will be asked to accept an automatic reboot. This might take a few seconds. A pop-up message will display that the reboot will change the IP address.
- 7) Note down the new IP address, which will be automatically assigned to the OQDe-G2 when it is first connected to the network.
- 8) Once connected, use your preferred Internet Browser on your network connected device and type in the new IP address of the OQDe-G2 into the address bar. This will take you to the Insight application for the device.

192.168.4.1 says

The device will be assigned a new IP address after reboot.
Please check your router's DHCP client list or use CADs to confirm the new IP address.

OK

4.3 Using the Insight application

Using the top navigation bar, you can select the various screens within Insight: **Status**; **Data Log**, **Settings**.

You can also change the units displayed in Insight for **Oil Temperature** (°C or °F) and **Oil Condition** (TDN or %LF).

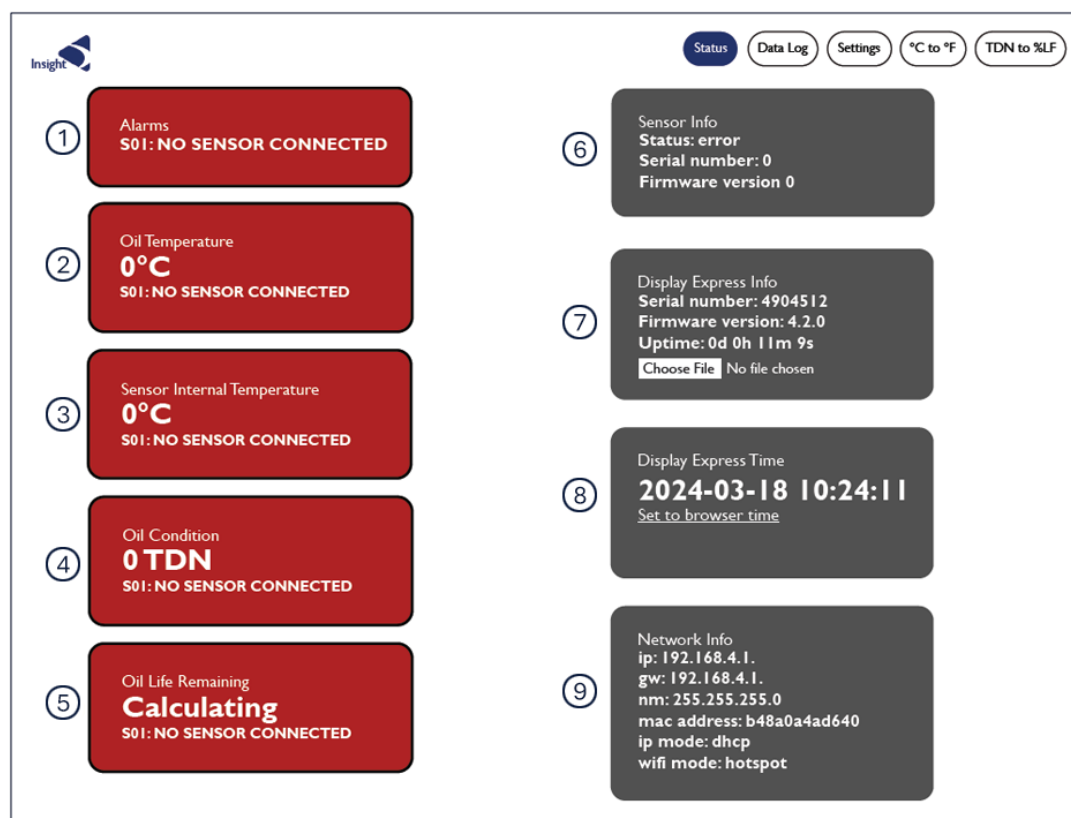


Fig. 4-2 Insight Status screen

4.3.1 Status screen

The first screen you will be presented with on Insight is the Status screen as shown in Fig. 4-2.

Each box displays different information regarding the state of the QQDe-G2.

① **Alarms**

The Alarms box will display all Checks or Alerts corresponding to the Event Codes listed in Section 6.5 of this User Guide.

If accessing for the first time, there may be an Alert triggered (S01) as there is still no sensor connected to the device. This can be ignored, or you can connect an OQSxG2 Sensor at this point which will remove the Alert.

② **Oil Temperature**

Displays the temperature of the Oil as measured by the Sensor.

③ **Sensor Internal Temperature**

Displays the internal temperature of the Sensor.

④ **Oil Condition**

Displays the Oil Condition in either Tan Delta Number (TDN) or Loss Factor (%LF).

With no Sensor connected to the device, the Oil Condition will display as 0 TDN or 45 %LF on Insight.

On the QQDe-G2 unit, the Oil Condition will display as - - - - until a configured Sensor is connected to the QQDe-G2.

⑤ **Oil Life Remaining**

The Oil Life Remaining (OLR) will remain as **Calculating...** on Insight for the first 14 days of the device being connected to a configured Sensor which is submerged in oil.

On the QQDe-G2 unit the OLR will display as - - - during this period.

After this point, both the QQDe-G2 and Insight will display the true OLR in days.

This figure will get more accurate as the oil moves towards its end of life.

⑥ **Sensor Info**

If a Sensor is connected, you will see the Sensor Info box populated with the Serial Number and Firmware Version.

⑦ **Display Express Info**

Displays the Serial Number and Firmware version of the QQDe-G2, along with Uptime, which is the length of time for which the QQDe-G2 has been powered on.

The QQDe-G2 firmware can be updated manually if required by selecting **Upgrade firmware**, then selecting the firmware file from the PC / mobile device storage.

⑧ **Display Express Time**

Shows the time that the QQDe-G2 clock is set to currently.

It can be set to the time of the browser you are using to view Insight.



NOTE:

This will affect the Timestamps on the Datalogs from the point it is changed.

⑨ Network Info

Displays IP/Gateway/Netmask, as well as the MAC address of the OQDe-G2, the IP mode, and the Wi-Fi mode (Hotspot or WLAN).

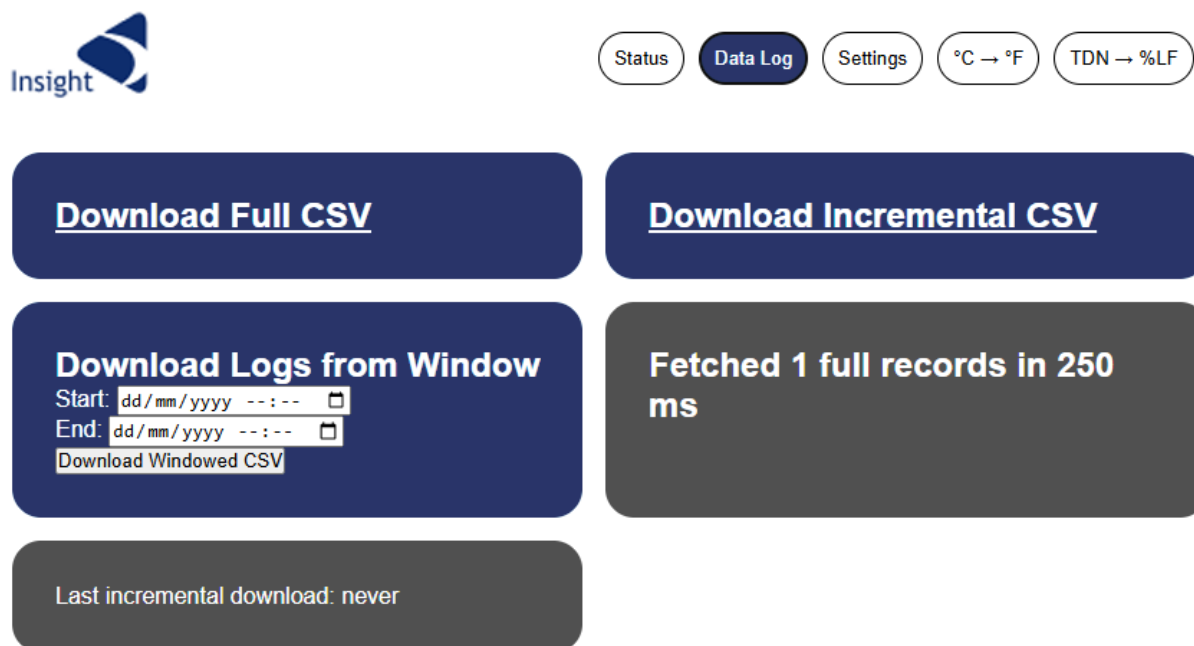


Fig. 4-3 Insight Data Log screen

4.3.2 Data Log Screen

The OQDe-G2 has an internal clock and logs real-time oil quality readings.

Data logs can be downloaded here as a CSV file. See Fig. 4-3.

To clear all historic Data Logs, go to:

> Settings >

Clear Datalog >

Set to TRUE >

Click Apply >

Reboot device by disconnecting/reconnecting.

The Datalog will clear upon reboot and can take several minutes depending on the number of data logs.

4.3.3 Settings screen – Configuring the OQDe-G2

The **Settings** screen (Fig. 4-4) is where you can configure the OQDe-G2.



IMPORTANT:

Configure the OQDe-G2 prior to installation on site.

If you have a network with multiple OQDe-G2 Displays, each display will need a unique IP address. You can set the IP address on the Insight screen shown in Fig.4-5.

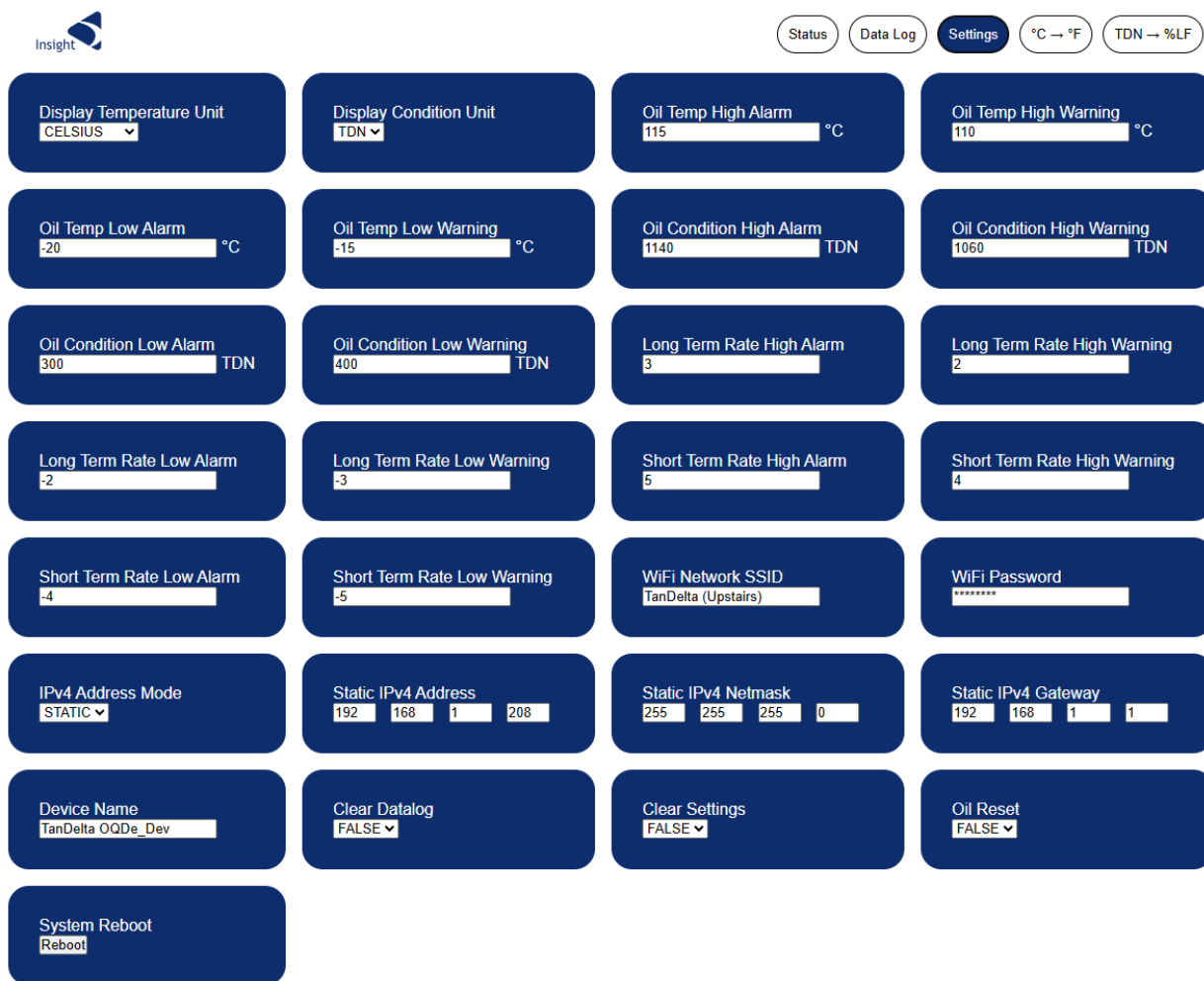


NOTE:

Configure the OQDe-G2 via Insight or using TD Config.

There are older Bluetooth versions of the OQDe-G2 which are configurable via TD Config only.

Fig. 4-5 shows the parameters that are configurable on the OQDe-G2, and the default values set on the device.



The screenshot shows the 'Settings' tab of the OQDe-G2 configuration interface. It features a grid of 28 blue buttons, each representing a configurable parameter. The parameters are organized into four columns and seven rows. The first row includes 'Display Temperature Unit' (set to CELSIUS), 'Display Condition Unit' (set to TDN), 'Oil Temp High Alarm' (set to 115 °C), and 'Oil Temp High Warning' (set to 110 °C). The second row includes 'Oil Temp Low Alarm' (set to -20 °C), 'Oil Temp Low Warning' (set to -15 °C), 'Oil Condition High Alarm' (set to 1140 TDN), and 'Oil Condition High Warning' (set to 1060 TDN). The third row includes 'Oil Condition Low Alarm' (set to 300 TDN), 'Oil Condition Low Warning' (set to 400 TDN), 'Long Term Rate High Alarm' (set to 3), and 'Long Term Rate High Warning' (set to 2). The fourth row includes 'Long Term Rate Low Alarm' (set to -2), 'Long Term Rate Low Warning' (set to -3), 'Short Term Rate High Alarm' (set to 5), and 'Short Term Rate High Warning' (set to 4). The fifth row includes 'Short Term Rate Low Alarm' (set to -4), 'Short Term Rate Low Warning' (set to -5), 'WiFi Network SSID' (set to TanDelta (Upstairs)), and 'WiFi Password' (set to *****). The sixth row includes 'IPv4 Address Mode' (set to STATIC), 'Static IPv4 Address' (set to 192 168 1 208), 'Static IPv4 Netmask' (set to 255 255 255 0), and 'Static IPv4 Gateway' (set to 192 168 1 1). The seventh row includes 'Device Name' (set to TanDelta OQDe_Dev), 'Clear Datalog' (set to FALSE), 'Clear Settings' (set to FALSE), and 'Oil Reset' (set to FALSE). A 'System Reboot' button is located at the bottom left.

Parameter	Options	Default
Display Temperature Unit	°Celsius or °Fahrenheit	°Celsius
Display Oil Condition Unit	Tan Delta Number (TDN) or %Loss Factor (%LF)	Tan Delta Number (TDN)
Wi-Fi Network SSID	Any value	
Wi-Fi Password	Any value	password
IPv4 Address Mode	DHCP or Static	DHCP
Static IPv4 Address	Any numerical value	192 168 1 168
Static IPv4 Netmask	Any numerical value	255 255 255 0
Static IPv4 Gateway	Any numerical value	192 168 1 1
Device Name (also appears as SSID)	Numbers and letters	TanDelta OQDe
Clear Datalog	TRUE or FALSE	FALSE
Clear Settings	TRUE or FALSE	FALSE

Fig. 4-5 Default Parameters and Configuration Options



NOTE:

It is **not** recommended to clear settings, but instructions are given overleaf.

To clear all Settings, go to:

> Clear Settings>

Set to TRUE >

Click Apply >

Reboot device by disconnecting/reconnecting.

4.2.4 Application Settings

By default, the Oil Condition Warning and Alarm levels are set to that of a Diesel Engine. However, every application is unique, and some adjustments may help optimise the system.

For some common applications, illustrative warning and alarm values are shown in Fig. 4-6.

Any value below 4 mA indicates a fault.

	Engine (e.g. Diesel)	Gas Engine	Hydraulic	Compressor	Transmission
High Alarm	5.6 mA (1140 TDN)	5.6 mA (1140 TDN)	6.4 mA (1060 TDN)	7.7 mA (1050 TDN)	6 mA (1100 TDN)
High Warning	6.4 mA (1160 TDN)	6.4 mA (1160 TDN)	7 mA (1000 TDN)	7 mA (1000 TDN)	7 mA (1000 TDN)
Condition OK					
Low Warning	13 mA (400 TDN)	9.4 mA (760 TDN)	9.4 mA (760 TDN)	10.5 mA (650 TDN)	10 mA (700 TDN)
Low Alarm	14 mA (300 TDN)	10.4 mA (660 TDN)	10.4 mA (660 TDN)	11 mA (600 TDN)	12 mA (500 TDN)

Fig. 4-6 Generic Warnings / Alarms (Inc 4 - 20 mA)

Alternatively, if a bespoke solution is required, we recommend logging data for one oil change cycle, or six to eight weeks, and then sending the data to support@tandeltasystems.com.

We can then advise you on your application settings.



4.4 Finding the IP Address of QQDe-G2 on Wireless Local Area Network (WLAN)

Once connected to your WLAN, to access Insight, you will need the IP address of the QQDe-G2 to access settings or download datalogs.

This will no longer be 192.168.4.1 because the device is no longer connected via Hotspot. To find the new IP address of the QQDe-G2, connect via TD Config:

- 1) Connect QQDe-G2 to your Laptop/PC via Cables J and M (Figure 25).
- 2) On the Laptop/PC launch TD Config and wait for the home screen to load.
- 3) Once the home screen has loaded, select Configure **SENSE2 - Display Kit**.

Follow the steps on screen until your QQDe-G2 is detected. The screen will show the **Serial Number** and **IP Address** of the QQDe-G2 (See Fig. 3-7).

- 4) Make a note of the IP Address, close TD Config.
- 5) Open your browser and navigate to the IP Address of the device to access Insight.

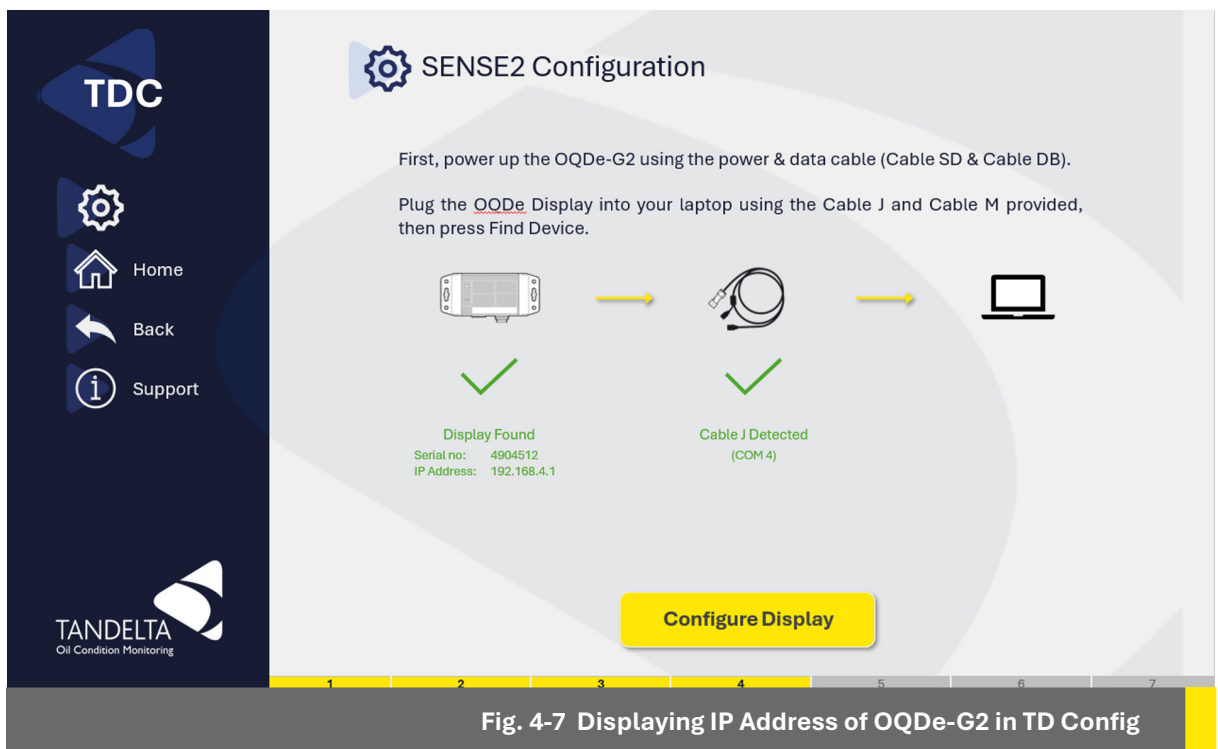


Fig. 4-7 Displaying IP Address of QQDe-G2 in TD Config

4.5 Upgrading your Firmware

Insight provides a facility to upgrade the display firmware from a provided file. This can be done using a PC or mobile device, provided the firmware file is available on that device.

Firmware is upgraded from the Status screen by selecting **Upgrade firmware** then selecting the firmware file from the PC / mobile device storage.

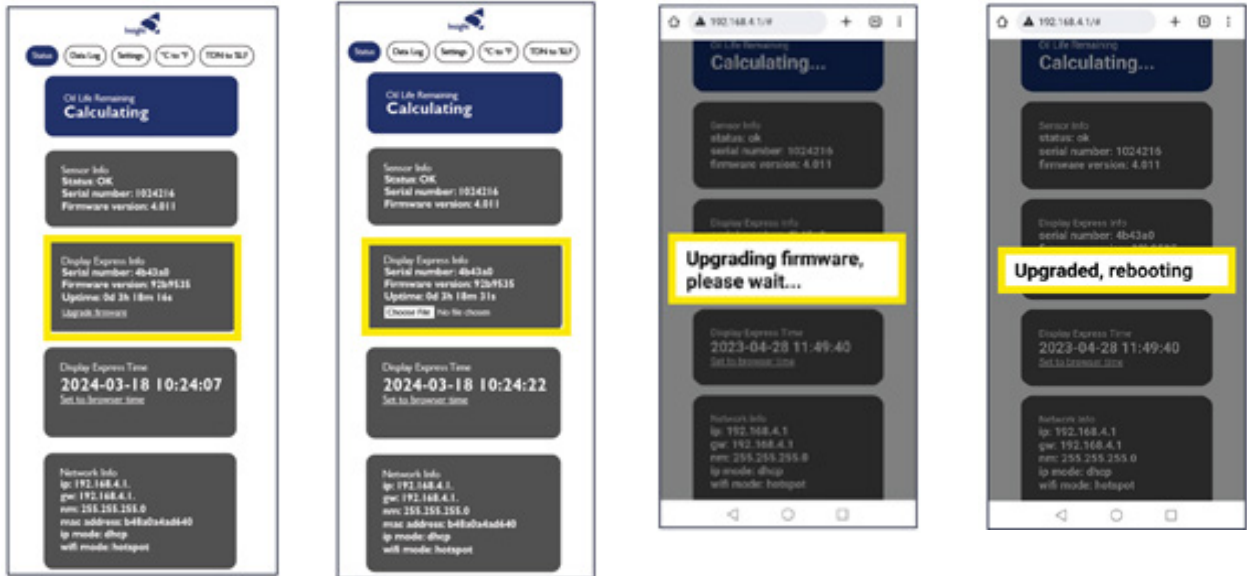


Fig. 4-8 Firmware upgrade sequence

5 OQS/OQL SENSOR INSTALLATION

5.1 Precautions

Read these instructions before installing the oil quality sensor.

The sensor is robust, however it can be damaged by mistreatment.

The following must be noted:

- Install the sensor into the equipment **before** making electrical/wiring connections.
- Make sure that the fittings being used correspond with the sensor thread size
- Tighten to no more than 20 Nm with a 32 mm spanner.
Do not over tighten.
- Do not attempt to screw or tighten the sensor using the body. Always use the “Hex” head with the correct size spanner (32 mm).
- Refer to Fig. 5-1. To prevent vibration having any adverse effects to the cable/sensor connectors, the cable must either be mounted on the same plane as the sensor, or have a loop fitted to absorb vibration.
- Do not twist the cable relative to the sensor head.
- Keep away from sharp edges which may cut into the cable.
- Do not bend the cable excessively, minimum bend radius = 50 mm (2 inches).
- Where possible, keep the cable away from sources of heat, (such as an engine block), and electrical interfaces.
- Oil pressure must not exceed 70 bar.

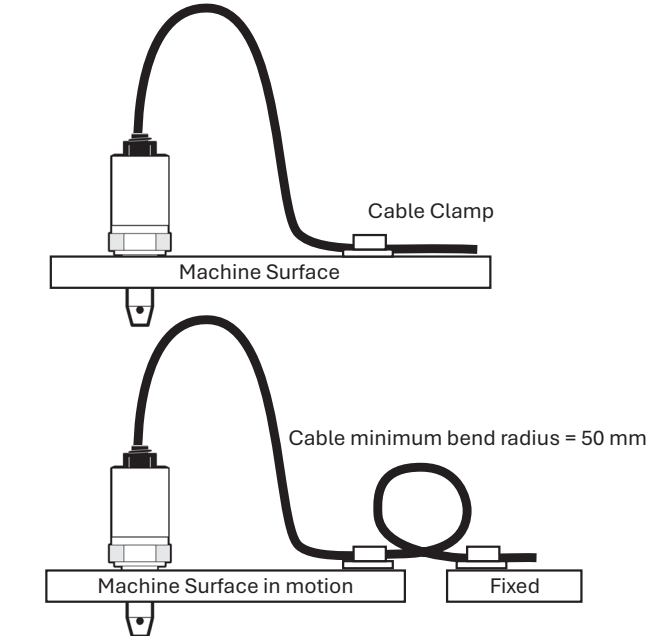


Fig. 5-1 Cable Fitting

5.2 Choosing the Sensor Mounting Location

The performance of the sensor will be enhanced through careful consideration of the mounting location.

Refer to Fig. 5-2.

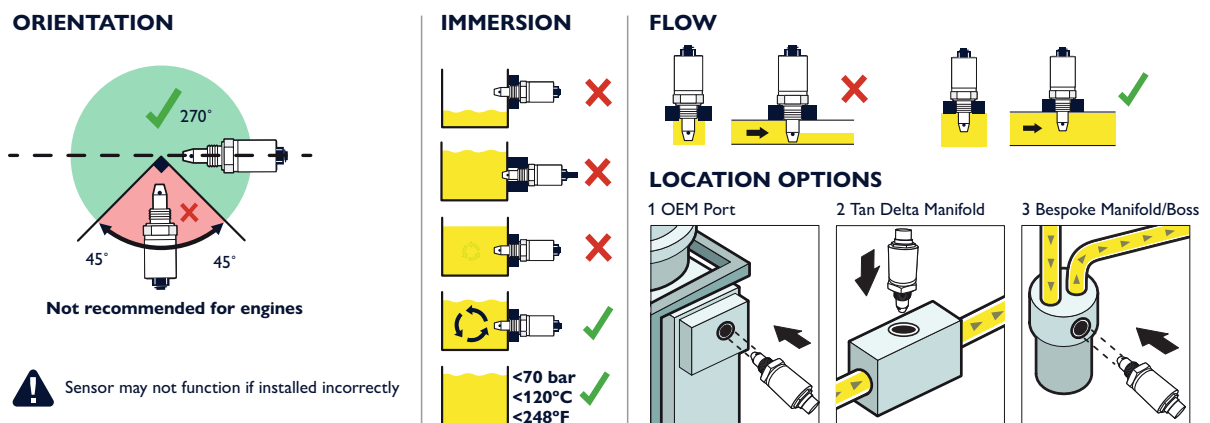


Fig. 5-2 Choosing a mounting location for the Sensor

Follow these guidelines.

- The Sensor must, if possible, be mounted in a horizontal position.
- Whenever possible, the sensor **should not** be mounted in the bottom of a sump, as the sensor head may become restricted which will prevent correct operation.
- Dynamic oil flow is necessary: do not mount in places where the oil is likely to stagnate or be static; The oil in the sensor needs to be representative of the whole system.
- The sensor nose must remain immersed in the oil at all times.
- When the oil quality sensor is mounted in a pipeline, make sure that the sensor will not restrict flow.
- For maximum performance when mounting the oil quality sensor in a lubrication system, make sure that the sensor is located prior to the oil filters, oil coolers etc. This ensures that the oil is representative of the whole system.

→ 5.3 Fitting Method

- Use a 32 mm Torque-adjustable spanner for installation.
- Decide on an appropriate location for the sensor head installation.
- Drain the lubricant sufficiently to allow the sensor to be fitted.
- Install the sensor head into the selected location/position. Torque to 20 Nm, being careful not to over-tighten.
- Route the cable, fixing it with cable ties at appropriate intervals.
- Avoid sharp edges and hot surfaces.
- Connect the sensor to the chosen interface.

→ 5.4 Electrical Connection

5.4.1 Power Supply

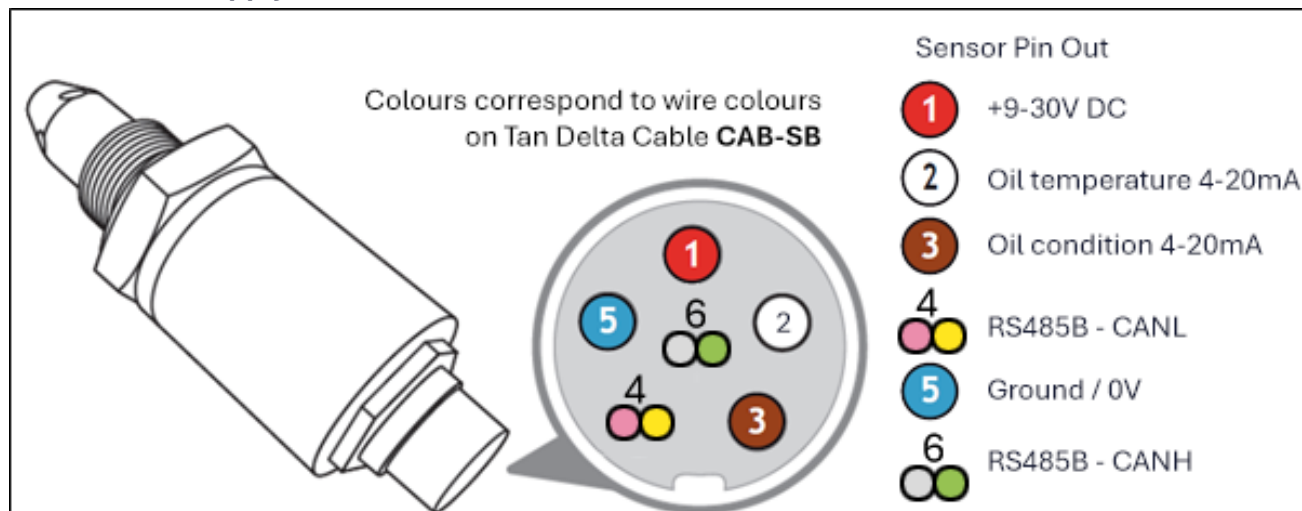


Fig. 5-3 OQSx-G2 cable connector pin out & Tan Delta cable schedule

5.4.2 Connecting the sensor to your system

If the sensor is not used as part of either a SENSE2 or SENSE3 kit, we recommend using a Tan Delta Sensor to Bare Ends cable (**Cable SB** – various lengths available). Refer to Fig. 5-3 for the bare end wire connection details.

Align and slot in the 6-pin connector and then tighten the connector screw-cap.



NOTE:

To prevent possible damage, it is recommended that any unused cable ends are insulated.

5.4.3 Data Output

You can use the output from Pins 2 and 3 to provide an analog indication of the oil temperature and condition on other, third party, data acquisition and control systems.

Oil condition is output on Pin 3 and is linearly scaled from 4 mA to 20 mA.

This can easily be converted to the TDN using the table in Appendix .

A clean oil should provide an output of about 8 mA.

For some common applications, illustrative the warning and alarm values are shown in Fig. 5-4.

Any value below 4 mA or above 20 mA indicates a fault.

	Engine (e.g. Diesel)	Gas Engine	Hydraulic	Compressor	Transmission
High Alarm	5.6 mA (1140 TDN)	5.6 mA (1140 TDN)	6.4 mA (1060 TDN)	7.7 mA (1050 TDN)	6 mA (1100 TDN)
High Warning	6.4 mA (1160 TDN)	6.4 mA (1160 TDN)	7 mA (1000 TDN)	7 mA (1000 TDN)	7 mA (1000 TDN)
Condition OK					
Low Warning	13 mA (400 TDN)	9.4 mA (760 TDN)	9.4 mA (760 TDN)	10.5 mA (650 TDN)	10 mA (700 TDN)
Low Alarm	14 mA (300 TDN)	10.4 mA (660 TDN)	10.4 mA (660 TDN)	11 mA (600 TDN)	12 mA (500 TDN)

Fig. 5-4 Generic Warnings / Alarms (Inc 4 - 20 mA)

5.4.4 Using the Oil Temperature analog output

The analog output on pin 2 provides a linearly scaled measure of Oil Temperature in °C as follows:

- 4 mA = -30 °C
- 20 mA = +130 °C

Refer to Appendix 2.

6 QQDe-G2 DISPLAY EXPRESS INSTALLATION

6.1 Mounting

The QQDe-G2 has a flange on either side with mounting holes to allow it to be fixed to any suitable flat surface.

Once your QQDe-G2 is correctly configured, you need to mount it using the flanges on the sides.



Fig. 6-1 QQDe-G2 Mounting Dimensions

Make sure that the following environmental specifications are not exceeded in the proposed location.

Protection Rating	IP67
Enclosure Type:	Rugged, polycarbonate machined housing with mounting flanges
Temperature (Operating)	-30C to +65C
Temperature (Storage)	-30C to +70C
Pressure (Ambient)	1 bar +/- 150mbar
Chemical Exposure (Splash)	Water, Mineral and Synthetic Oils



6.2 Connection

6.2.1 Connecting the Oil Quality Sensor

Refer to Fig. 6-2. Connect the Oil Quality Sensor (OQS/OQL) to the left-hand connector on the QQDe-G2 using a Sensor to Display Cable, **CAB-SD**.

CAB-SD is available in 2, 5, 10, 15, 25, 50, and 100 m lengths as standard.

Align and slot in the 6-pin connector and then tighten the connector screw-cap.

Refer to the **Set Up and Calibration** section of the Sensor User Guide for more information.



NOTE:

The right-hand connector can be used to connect an QQDe-G2 to a Laptop/PC by RS485 using Cables **CAB-M** and **CAB-J** in conjunction

The QQDe-G2 can also be connected to other devices for remote monitoring purposes by using a combination of Cables **CAB-M** and **CAB-SB**.

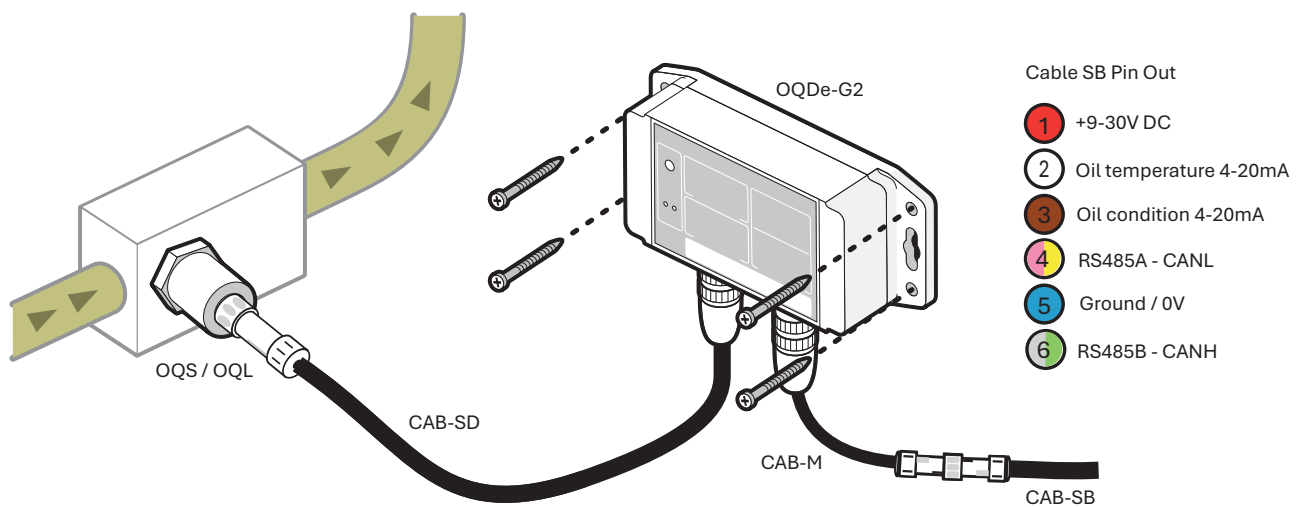


Fig. 6-2 QQDe-G2 Installation and Connection

6.2.2 Using the Analog Output

Refer to Fig. 6-3. Analog outputs measuring oil quality and oil temperature are looped through the QQDe-G2 from the OQS/OQL.

You can use these outputs to provide analog indication of the oil temperature and condition on other, third party, data acquisition and control systems.

If you want to connect to the QQDe-G2 via 4-20 mA in order to read the Oil Condition and Oil Temperature Data, connect a suitable power supply (9-30 Vdc, at least 100 mA) to the Red wire (power) and Blue wire (ground) on Cable CAB-SB.

Using the Oil Condition analog output

Oil condition is output on the black wire and is linearly scaled from 4 mA to 20 mA.

This can easily be converted to the TDN or % Loss Factor scale using the table in the Appendix 1.

A clean oil should provide an output of about 8 mA.

For some common applications we, recommend the warning/alarm settings in Fig. 3-6.

Any value below 4mA or above 20 mA indicates a fault.

Using the Oil Temperature analog output

The analog output on the white wire provides a linearly scaled measure of Oil Temperature in °C between -30°C (4 mA) and +130°C (20 mA) – see Appendix 2.

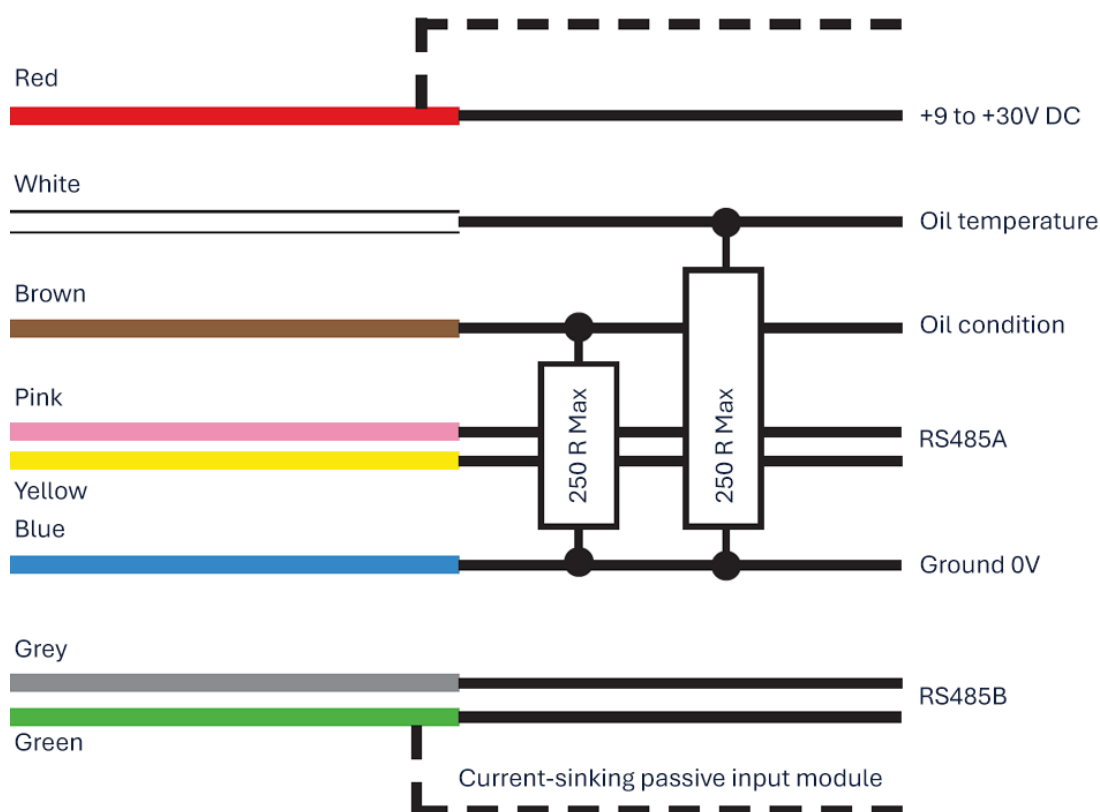


Fig. 6-3 Wiring diagram for OQDe-G2 Power Supply and Data output (4-20 mA)



6.3 Modbus Output

6.3.1 Serial Settings

Display Express	Modbus Master
Protocol	Modbus RTU
Device role	Display Express is the Modbus slave/server
Slave ID	1
Baud rate	9600
Data bits	8
Parity	None
Stop bits	1
Flow control	None

6.3.2 Supported Modbus Functions

Function Code	Name	Supported
0x03	Read Holding Registers	Yes
0x04	Read Input Registers	Yes

The same register map is exposed through both function `0x03` and function `0x04`.
Writes are not supported.

6.3.3 Register addressing

The firmware uses zero-based Modbus register addresses.

Some Modbus tools display register numbers using '30001' / '40001' style notation instead.

Firmware address	Input register notation	Holding register notation
0x0000	30001	40001
0x0001	30002	40002
0x0002	30003	40003
0x0003	30004	40004
0x0004	30005	40005
0x0005	30006	40006

Example settings for tool e.g. ModbusMAT

Tool Field	Value
Slave ID	1
Function	04 – Read Input Registers
Offset	1
Length	6
Scan rate	1000 ms

6.3.4 Register Map

Address	Register notation	Name	Data type	Scaling / interpretation
0x0000	30001 / 40001	Oil Condition	Signed 16-bit integer	TDN x 10
0x0001	30002 / 40002	Oil Temperature	Signed 16-bit integer	Degrees X x10
0x0002	30003 / 40003	Active events	30003	40003
low word	Unsigned 16-bit bitfield	Event bits 0-15	30004	40004
0x0003	30004 / 40004	Active events	30005	40005
high word	Unsigned 16-bit bitfield	Event bits 16-31	30006	40006
0x0004	30005 / 40005	Previous 24h events		
low word	Unsigned 16-bit bitfield	Event bits 0-15 seen in the previous 24hrs		
0x0005	30006 / 40006	Previous 24h events high word	Unsigned 16-bit bitfield	Event bits 16-31 seen in the previous 24hrs



6.4 Operation

6.4.1 Switching On



IMPORTANT:

The OQDe-G2 **MUST** be connected to a configured Sensor which is submerged in oil otherwise the OQDe-G2 will not function as intended.

Make sure that you have configured the OQDe-G2 and OQS/OQL, and connected them correctly as described previously in this of the User Guide

To begin operation:

- 1) Switch on the power supply. The green power LED is illuminated.
The OQDe-G2 starts an initial self-test period lasting approximately one minute.
- 2) The display now creates a starting point of maximum remaining life (in operating hours) instantaneously on start-up, clamped at 1000 for insight and 999 for the physical display.
This figure will get more accurate as the oil moves towards its end of life.

7 QQDe-G2 - UNDERSTANDING DATA

7.1 Tan Delta Full Spectrum Holistic (FSH) Data

Dynamic Maintenance Optimisation (DMO) is the method by which the data can be used to optimise the maintenance intervals for the lubricating oil in the application.

Changing the oil at an interval determined by the QQDe-G2 means that you are only changing the oil when you need to, not at a predetermined schedule when the oil may still be in a useable condition.

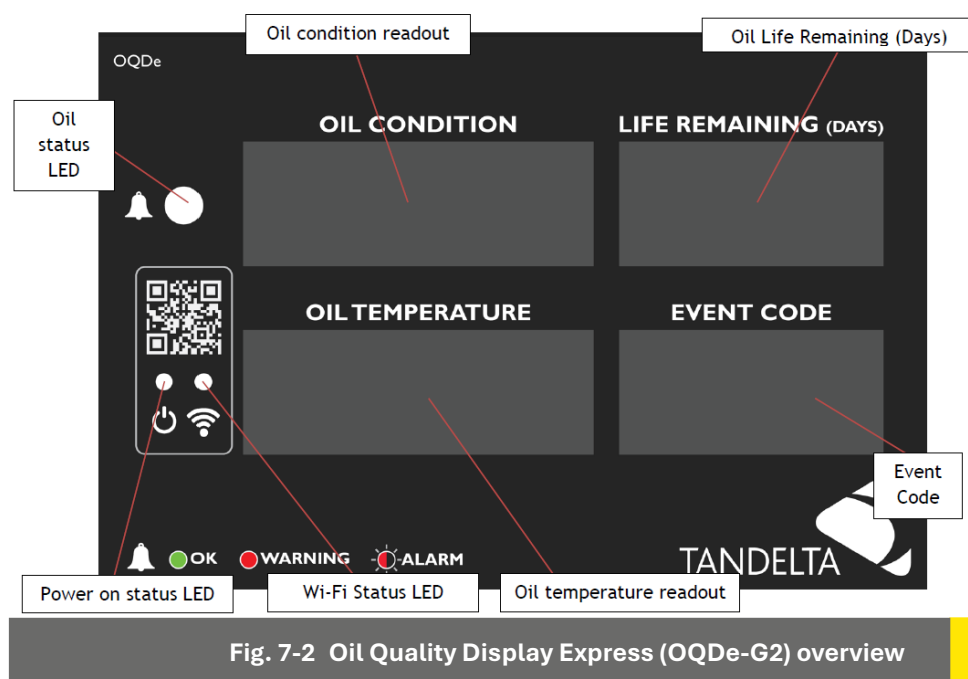
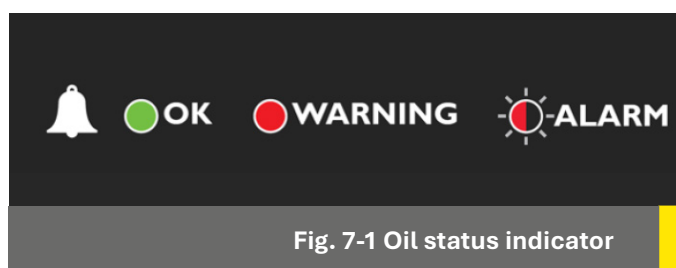
The QQDe-G2 is a powerful tool for instant data display, providing a visual display of the holistic oil condition as well as the current Oil Condition value, Oil Temperature and Oil Life Remaining (OLR).

Using the display alone to review the oil condition is simple:

- If the oil status indicator is **green**, then the oil is still in a good useable condition.
- If the oil status indicator is **red**, you should be planning to carry out an oil change at the earliest opportunity.
- If the oil status indicator is **flashing red**, the machine should not be used, and the oil should be changed immediately.

In addition to the oil status indicator, the Oil Condition value can be viewed and checked to see the current oil condition against the standard table shown in Appendix 1.

Oil temperature and OLR are also viewable on the QQDe-G2.



7.2 TD Config application

Data can also be accessed from the QQDe-G2 using **TD Config** to either view whilst connected to the display through the in-built graphing screens, or to download to analyse and interrogate offline.

NOTE

Fig. 7-3 shows data for a sensor tested out of oil.



Fig. 7-3 TD Config data display

7.3 Insight

Insight uses any internet-enabled device to access, via Wi-Fi, the data collected by the QQDe-G2. Live data can be viewed in **Insight** in real time, or historical data logs can be downloaded as a CSV file.

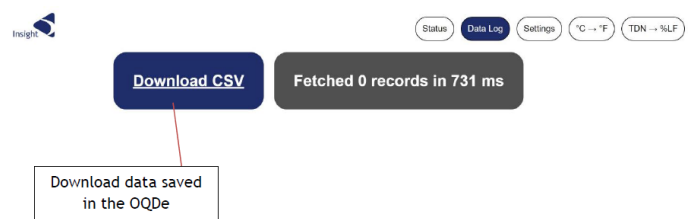


Fig. 7-4 Insight data log screen

7.4 Dynamic Maintenance Optimisation (DMO)

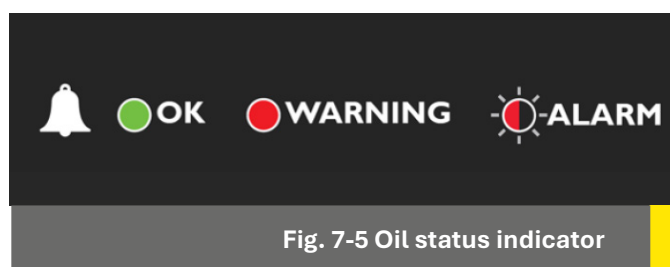
Dynamic Maintenance Optimisation (DMO) is the method by which the data can be used to optimise the maintenance intervals for the lubricating oil in the application.

Changing the oil at an interval determined by the Tan Delta Sensor means you are only changing the oil when you need to, not at a predetermined schedule when the oil may still be in a usable condition.

In this section we will demonstrate the methods by which DMO can be implemented.

The QQDe-G2 displays DMO through using an LED indicator.

- If the oil status indicator is **green**, then the oil is still in a good usable condition.
- If the oil status indicator is **red**, you should plan to carry out a maintenance intervention the earliest opportunity.
- If the oil status indicator is **flashing red**, the machine should not be used, and the oil should be changed immediately.



7.5 Partially / Fully integrated sensors

7.5.1 Analog Integration

Sensors integrated into third party solutions can feed data directly into these systems either using Analog signals or Digital Signal protocols.

For more information on the available communication protocols, please contact Tan Delta Support.

Oil condition is output in analog format on Pin 3 and is linearly scaled from 4mA to 20mA.

This can easily be converted to the TDN or Loss Factor scale using the table provided in Appendix 1.

A clean oil should provide an output of about 8mA.

For some common applications we recommend the warning/alarm settings shown in Fig. 7-6.

	Engine (e.g. Diesel)	Gas Engine	Hydraulic	Compressor	Transmission
High Alarm	5.6mA (1140 TDN)	5.6mA (1140 TDN)	6.4mA (1060 TDN)	6.7mA (1050 TDN)	6mA (1100 TDN)
High Warning	6.4mA (1060 TDN)	6.4mA (1060 TDN)	7mA (1000 TDN)	7mA (1000 TDN)	7mA (1000 TDN)
Condition OK					
Low Warning	13mA (400 TDN)	9.4mA (760 TDN)	9.4mA (760 TDN)	10.5mA (650 TDN)	10mA (700 TDN)
Low Alarm	14mA (300 TDN)	10.4mA (660 TDN)	10.4mA (660 TDN)	11mA (600 TDN)	12mA (500 TDN)

Fig. 7-6 Generic Warning / Alarms (inc 4-20mA)

Any value below 4mA or above 20 mA indicates a fault.

The analog output on pin 2 provides a linearly scaled measure of Oil Temperature in °C between -30°C (4mA) and +130°C (20mA) – See Appendix 2.

The third-party systems using a 4-20mA analog signal should be configured using the table shown in Fig. 7-6 as a guide, and may subsequently be fine-tuned with the assistance of Tan Delta Support.

Fig. 7-6 details the logic that can be applied to installations into third-party systems to determine various event variables.

If your Display Express or third-party device allows this level of customisation, you may wish to utilise some of the detailed algorithm logic to provide warnings or alarms through the third-party display / system.

Event Code	Meaning	Action	Check/Alert
---	n/a	All OK	n/a
S01	n/a	No Sensor Connected - Please Connect the Sensor.	A
S02	n/a	Sensor Not Configured - Configure the Sensor via TD Config	A
S03	n/a	Display Not Configured - Configure the Display via Insight	A
S04	n/a	New Sensor Detected	n/a
E01	Current Temperature $\geq$ Temp High Warning Level	Oil Temperature High - Check Regularly	C
E02	Current Temperature $\geq$ Temp High Alarm level	Oil Temperature Very High - Immediate Action Required	A
E03	Current Temperature $\leq$ Temp Low Warning level	Oil Temperature low - Check Regularly	C
E04	Current Temperature $\leq$ Temp Low Alarm Level	Oil Temperature Very Low - Immediate Action Required,	A
E05	Current Oil Condition $\geq$ Oil Condition High Warning Level	Oil Condition Too High - Check Regularly	C
E06	Current Oil Condition $\geq$ Oil Condition High Alarm Level	Oil Condition Very High - Immediate Action Required.	A
E07	Current Oil Condition $\geq$ Oil Condition Low Warning Level	Oil Near End Of Life - Check Regularly	C
E08	Current Oil Condition $\leq$ Oil Condition Low Alarm Level	Oil At End Of life - Immediate Action Required	A
E09	Current Oil Condition $\geq$ 1200 TDN	Sensor In Air - Immediate Action Required	A
E11	Accelerated Oil Wear Detected (Warning)	Oil Quality degrading at an accelerated rate - Check Regularly	C
E12	Accelerated Oil Wear Detected (Alarm)	Oil Quality degrading at an accelerated rate - Immediate Action Required	A
E13	Water / Coolant Contamination (Warning)	Water or Coolant contamination detected - Check Regularly	C
E14	Water / Coolant Contamination (Alarm)	Water or Coolant contamination detected - Immediate Inspection Required	A
E15	Fuel Dilution Detected (Warning)	Fuel contamination detected - Check Regularly	C
E16	Fuel Dilution Detected (Alarm)	Fuel contamination detected - Inspect for Cause	A
E17	Oil Change Detected	Oil Change detected - Confirm with Maintenance Team	n/a

Fig. 7-7 Data Logic Table

7.5.2 Modbus integration

Scaling Examples

Raw register value	Meaning
Oil condition '12490'	1249.0 TDN
Oil Temperature '266'	26.6 °C
Oil Temperature '-55'	-5.5 °C

Event Bitfields

The events registers are bitfields.

To check whether an event is active:

```
Bool active = (event_mask & (1UL << event_number)) != 0;
```

The full 32-bit active event mask is:

```
uint32_t active_events =  
    ((uint32_t)active_events_high << 16) | active_events_low;
```

The full 32-bit previous 24h event mask is:

```
uint32_t previous_24h_events =  
    ((uint32_t)previous_24h_events_high << 16) | previous_24h_events_low;
```

Event Decode Table

Event number	Register word	Bit value in that word	Full 32-bit mask	Event name	Display code / meaning
0	None	0	0	TD_EVENT_NONE	No Event
1	Low	2	2	TD_EVENT_LOW_POWER	L01
2	Low	4	4	TD_EVENT_NO_SENSOR	S01
3	Low	8	8	TD_EVENT_SENSOR_UNCONFIGURED	S02
4	Low	16	16	TD_EVENT_DISPLAY_UNCONFIGURED	S03
5	Low	32	32	TD_EVENT_NEW_SENSOR_FOUND	S04
6	Low	64	64	TD_EVENT_OIL_TEMP_HIGH_WARN	E01
7	Low	128	128	TD_EVENT_OIL_TEMP_HIGH_ALARM	E02
8	Low	256	256	TD_EVENT_OIL_TEMP_LOW_WARN	E03
9	Low	512	512	TD_EVENT_OIL_TEMP_LOW_ALARM	E04
10	Low	1024	1024	TD_EVENT_SENSOR_IN_AIR	E09
11	Low	2048	2048	TD_EVENT_OIL_CONDITION_HIGH_WARN	E05
12	Low	4096	4096	TD_EVENT_OIL_CONDITION_HIGH_ALARM	E06
13	Low	8192	8192	TD_EVENT_OIL_CONDITION_LOW_WARN	E07
14	Low	16384	16384	TD_EVENT_OIL_CONDITION_LOW_ALARM	E08
15	Low	32768	32768	TD_EVENT_SENSOR_INCORRECT_PROFILE	E10
16	High	1	65536	TD_EVENT_ACCEL_OIL_WEAR_WARN	E11
17	High	2	131072	TD_EVENT_ACCEL_OIL_WEAR_ALARM	E12
18	High	4	262144	TD_EVENT_WATER_COOLANT_CONT_ALARM	E13
19	High	8	524288	TD_EVENT_FUEL_DILUTION_WARN	E14
20	High	16	1048576	TD_EVENT_FUEL_DILUTION_ALARM	E15
21	High	32	2097152	TD_EVENT_OIL_CHANGE	E16
22	High	64	4194304	TD_EVENT_OIL_RESET	E18
23	High	128	8388608	TD_EVENT_ROC_LOW_WARN	E19
24	High	256	16777216	TD_EVENT_ROC_LOW_ALARM	E20

For event numbers 0 to 15, check the low word.

For event numbers 16 to 31, check the high word using:

```
uint16_t high_word_bit = 1U << (event_number - 16);
```

Bitfield Example

If the Modbus registers read:

Register	Value
Active events low word	7168
Active events high word	24

Then:

$$7168 = 1024 + 2048 + 4096$$

Low-word events:

Bit value	Event
1024	E09 sensor in air
2048	E05 oil condition high warning
4096	E06 oil condition high alarm

And:

$$24 = 8 + 16$$

High-word events:

Bit value	Event
8	E14 fuel dilution warning
16	E15 fuel dilution alarm

Recommended Poll

For a simple integration, poll all six registers together:

Field	Value
Slave ID	1
Function	0x04 Read Input Registers
Start address	0x0000
Quantity	6

Polling once per second is suitable for most display/integration purposes.

The sensor readings themselves update at the Display Express sensor polling rate.

8 OQS / OQL SENSOR - SUPPORT

Issue	Possible cause	Checks	What to do if the check fails...
No Output from the sensor Analog Outputs	Power Issue?	Make sure that the power supply is 9-30V DC	Make sure sensor earth connection is properly made.
			Contact Tan Delta Support
No Output from the sensor Digital Outputs	Power Issue?	Make sure that the power supply is 9-30V DC	Make sure sensor earth connection is properly made.
			Contact Tan Delta Support
	Communication issue	Check communication with TD Config using Configuration Cable (CAB-J)	Connect in the correct order: TD Config looking for sensor > Connect CAB-J (ID COM port) > Connect Sensor
			Contact Tan Delta Support
	Cable Issue	Check cable connections are correct	Check the cable for damage
			Disconnect the sensor and receiving device / system, check the cable for continuity
			Check the cable for shorts across wire cores
			Contact Tan Delta Support
Sensor analog output implausible	Connection / integration issue	Is the receiving device / system current sensing?	Install a resistor in parallel to the receiver device (not to exceed 250 R)
Sensor output implausible	Oil condition high (above 1200 TDN)	Sensor nose is in air	Immerse sensor nose in oil continually
			Check that the correct oil profile is being used
	Oil Condition extremely high (above 1500 TDN)	Contact Tan Delta Support	
	Oil Condition low (Below 300 TDN)	Oil likely to be very worn or contaminated	Change Oil
	Oil condition extremely low (Below 0 TDN)	Oil likely to be highly contaminated	Change Oil
	Oil condition extremely low (Below -1000 TDN)	Has sensor got an oil profile loaded?	Configure sensor with an oil profile
			Sensor possibly in water or contaminated with metallic particles. Clean sensor and investigate source of contamination
			Contact Tan Delta Support
Sensor output unstable (Noisy or unreadable)	Incorrect oil profile being used	Check oil profile is correct	Contact Tan Delta Support
	Air / cavitation	Install sensor where it will be continually immersed in oil with no air bubbles	Contact Tan Delta Support
	Heavy contamination	Replace Oil & investigate the source of the contamination	Contact Tan Delta Support

9 SENSOR CLEANING & MAINTENANCE



CAUTION:

For accurate results during testing, it is vitally important to do any test using a clean sensor.
Any oil residue from a previous test **MUST** be removed.

To clean the sensor:

- 1) Clean any excess oil from the end of the sensor with absorbent paper.
- 2) Remove the remaining oil by spraying Loctite 7063 cleaner into each of the four holes at the end of the sensor, and all over the outside of the tip.
- 3) Give a general exterior wash on both sides as shown in Fig. 9-1.
- 4) Give a longer blast into the centre hole (2 seconds).
- 5) Give the sensor a sharp shake to dislodge any solvent remaining around the electrode.
- 6) Leave to dry for at least 1 minute.



Fig. 9-1 Cleaning the Sensor



*Loctite 7063 Solvent Cleaner Recommended

Other low residue cleaners may also be suitable, please refer to your distributor for more information. See Section 5.1.



NOTE:

The sensor does not require cleaning once it has been installed, unless the application is relatively high in particulate contamination.



9.1 Cleaning Procedure – Using Odourless Kerosene

- 1) Unplug and remove the sensor then use absorbent paper to wipe off the excess oil from the sensor tip and thread.
- 2) Attach a bottle adaptor to a sample bottle and pour in approximately 15ml of kerosene.
- 3) Screw in the sensor and shake vigorously for 2 minutes to ensure the kerosene washes up around the tip of the sensor.
- 4) Remove the sensor from the adaptor and shake rigorously over the absorbent paper to dislodge any excess kerosene.
- 5) Leave to dry for a few minutes.

10 SENSE2 KIT - SUPPORT

Issue	Possible cause	Checks	What to do if the check fails...
No lights on the display	Power Issue?	Make sure that the power supply is 9-30V DC	Make sure sensor earth connection is properly made.
			Contact Tan Delta Support
Display shows unrecognised / unreadable text	Configuration issue	Configure the display using TD Config. The display must be powered on using the provided universal power supply when configuring.	Contact Tan Delta Support
Cannot connect to display using TD Config	Display circuitry damaged	If the display is not recognised by TD Config, it is possible that the communication circuitry may be damaged through an incorrect installation.	Contact Tan Delta Support
Display shows event code S01	No Sensor connected	Connect sensor	Configure sensor using TD Config for use with Display Express
			If sensor won't communicate, sensor may be damaged. Contact Tan Delta Support
			If sensor does communicate, but you still get S01, display may be damaged. Contact Tan Delta Support
Display shows event code S02	Sensor not configured	Configure sensor using TD Config	Contact Tan Delta Support
Display shows event code S03	Display not configured	Configure display using TD Config	Contact Tan Delta Support
Display shows event code S04	New Sensor Detected		
Display shows event code E## (i.e E01 to E18)	Refer to the Event Code table in this User Guide for more information		
Short term negative decay rate event codes appear following an oil change	Oil change has not been logged in the display	Connect to the display using Insight and use the "oil change" function to log an oil change,	Contact Tan Delta Support
Display shows "---" days remaining for long periods of time	Oil condition is not changing sufficiently to calculate the remaining days until oil change	Check oil is moving in the system, if a hydraulic or gear application, this is normal as oil will condition may be quite static or stable for a long period of time.	Contact Tan Delta Support
Cannot connect to Insight page	Not connected to display hotspot	Connect your PC / mobile device to the WiFi hotspot made by the display	Contact Tan Delta Support
	Hotspot password has been changed	Contact installer to check hotspot password setting	Contact Tan Delta Support
	IP address for Insight has been changed	Connect Display to TD Config via Cables CAB-M and CAB-J. When connected, TD Config will show the current set IP address of the display.	Contact Tan Delta Support



10.1 Modbus Troubleshooting

Symptom	Checks
No response from Display Express	Wait at least 10 seconds after power-up before polling.
No response from Display Express	Confirm TDConfig did not connect during the first 10 seconds . If it did, power cycle the Display Express.
No response from Display Express	Confirm serial settings are `9600`, `8`, `None`, `1`.
No response from Display Express	Confirm slave ID is `1`.
No response from Display Express	Swap RS485 A/B.
No response from Display Express	Try function `0x03` if the Modbus tool has trouble with function `0x04`.
Register values appear shifted	Check whether the Modbus tool expects zero-based address `0` or register notation `30001` / `40001`.
Oil Condition or temperature reads '0'	Confirm a sensor is connected and the Display Express has received a valid sensor reading.
Active event value is non-zero	Decode it using the event bitfield table in Section 7.5.2.

11 APPENDIX 1

→ Oil Condition Conversion Chart

The table below gives illustrative and guideline figures only.

For further advice on setting your alarms, contact our support team

www.tandeltasystems.com/support/

Number Format

TDN = Always 4 digits

Conversion

4 - 20 mA to TDN = (mA - 17) * -100

4 - 20 mA	TDN	Alarm Setting
<4		
4 mA	1200	High Alarm
5 mA	1200	
6 mA	1100	High Warning
7 mA	1000	
8 mA	0900	
9 mA	0800	
10 mA	0700	
11 mA	0600	
12 mA	0500	
13 mA	0400	Low Warning
14 mA	0200	Low Alarm
15 mA	0200	
16 mA	0100	
17 mA	0000	
18 mA	0000	
19 mA	0000	
20 mA	0000	

12 APPENDIX 2

 Oil Temperature Analog Output

The table below shows how the Oil Temperature output (4 - 20 mA) converts to temperature.

The conversion from mA to °C and °F is as follows:

Output	Pin	Calculation	Unit	Low	High
Oil Temperature	2	$^{\circ}\text{C} = (\text{mA} * 10) - 70$	$^{\circ}\text{C}$	4 mA = - 30 $^{\circ}\text{C}$	20 mA = 130 $^{\circ}\text{C}$
		$^{\circ}\text{F} = (\text{mA} * 18) - 94$	$^{\circ}\text{F}$	4 mA = -22 $^{\circ}\text{F}$	20 mA = 266 $^{\circ}\text{F}$

OQS 4-20 mA value	Temperature Conversion	
	$^{\circ}\text{C}$	$^{\circ}\text{F}$
20	130	266
19.5	125	257
19	120	248
18.5	115	239
18	110	230
17.5	105	221
17	100	212
16.5	95	203
16	90	194
15.5	85	185
15	80	176
14.5	75	167
14	70	158
13.5	65	149
13	60	140
12.5	55	131
12	50	122
11.5	45	113
11	40	104
10.5	35	95
10	30	86
9.5	25	77
9	20	68
8.5	15	59
8	10	50
7.5	5	41
7	0	32
6.5	-5	23
6	-10	14
5.5	-15	5
5	-20	-4
4.5	-25	-13
4	-30	-22
<4	Fault	

13 SOFTWARE USER AGREEMENT

**IMPORTANT:**

Please read carefully before using the Software.

Your use of this computer program is subject to the terms and conditions of the following Software User Agreement. If you do not wish to accept these terms and conditions, do not install or use this Software and please return this Software to the place you obtained it for refund.

LICENSE AGREEMENT, RESTRICTIONS ON USE

Use:

This is a license agreement between you (the entity to whom this software is provided) and Tan Delta System PLC ("Licensor"). This agreement permits you to Use each program furnished directly or indirectly from Licensor, either by Licensor or its authorized distributors ("Distributors") including any Copies thereof and any supporting materials and any related updated programs or program portions ("Software"). The term "Copies" means any duplications, reproductions, transcriptions of any Software, either in whole or in part and by any means whatsoever including electronic, mechanical, and manual processes.

The term "Use" means copying any portion of any Software or using any Software, but only in connection with the analysis, specification, use, installation, repair, sale of products through Licensor or its Distributors.

Restrictions:

You will have a non-transferable and non-exclusive right to Use the Software. You may make Copies of the Software provided that any such Copies are made solely for your Use or for archival or back-up and no other purposes.

No right to Use, print, copy or display the Software, in whole or in part, is granted except as expressly provided in this agreement. You will not reverse engineer, disassemble or decompile the Software.

You agree to reproduce and include any and all copyright notices, software user agreements notices and terms and conditions, trademarks and other legends in and on every Copy of the Software.

Ownership:

Title and ownership of the Software and Copies thereof shall at all times exclusively remain in Licensor or its designee.

You will obtain no greater right in and to the Software than a right in the nature of the License limited to the Use of any such Software and subject to compliance with all of the terms and conditions contained in this Agreement.

To the extent that the Software becomes deliverable under any U.S. Government funded prime contract or subcontract, (i) you acknowledge and agree that this Software represent "commercial computer software" as defined in the DoD Federal Acquisitions Regulation Supplement (DFARS) § 525.227-7014 (a)(I), and (ii) the Government's right in connection with the Software will be limited in accordance with the terms and conditions of this Agreement consistent with the policies stated in DFARS Sub-part 227.7202.

Modifications:

Modifications or enhancements made by Licensor to any Software may be made available to you at the sole option of Licensor or its Distributors.

If the Software is modified by you or merged into other program materials processed or used solely by you,

Licensor and its Distributors shall not have any liability or incur any expense or be affected in any way by any such modification or merger, even if such modification or merger results in the formation of an updated or new work.

Rather, such Software, in its modified or merged form, shall continue at all times to be the sole and exclusive property of Licensor and shall be subject to all provisions of this Agreement.

WARRANTY**Limited warranty:**

Licensor warrants that (a) the original Software will perform substantially in accordance with the accompanying written materials for a period of ninety (90) days from the date of receipt; and (b) any hardware accompanying the Software will be free from defects in materials and workmanship under normal use and service for a period of one (1) year from receipt date.

Any implied warranties on the Software and the hardware are limited only to ninety (90) days and one (1) year respectively.

The limited warranty applies to the original Software and not to any copies made by you or others from the original Software or copies thereof.

Customer remedies:

Licensor's entire liability and your exclusive remedy shall be, at Licensor's option either (a) return of the price paid or (b) repair or replacement of the Software or hardware that does not meet Licensor's limited warranty and that is returned to the Licensor with a copy of your receipt.

The limited warranty is void if failure of the Software or hardware has resulted from accident, abuse, or misapplication of the original hardware and Software only and in no case shall the limited warranty apply to any copies of the original Software.

Any replacement Software shall be warranted for the remainder of the original warranty period or for thirty (30) days, whichever is longer.

No other warranties:

Licensor disclaims all other warranties, either express or implied, including but not limited to implied warranties of merchantability and fitness for a particular purpose, with respect to the Software, any accompanying written material, any accompanying hardware, and any services for any of the foregoing.

No other liability:

In no event will Licensor or its agents or suppliers or Distributors be liable for any direct or indirect damages whatsoever (including without limitation, damages for negligence, strict liability, breach of contract, loss of business profits, business interruption, loss of business information, or pecuniary loss) arising out of the use of, or inability to use or failure to deliver the Software or any defects therein, even if the Licensor has been advised of the possibility of such damages.

In no event shall the aggregate liability of Licensor, its agents, suppliers and distributors exceed an amount equal to the price paid for the Software license. This Software is to be used for indication purposes only.

**IMPORTANT:**

If you do not accept the terms and conditions of this license do not install or use the Software.

Tan Delta Systems Plc

1 Carrera Court
Church Road
Dinnington
Sheffield
UK
S25 2RG

Tel: +44 (0)845 094 8710
support@tandeltasystems.com

 www.tandeltasystems.com

