1 Introduction:

The fluorescence-based LuminOx oxygen sensor was designed as a low-cost alternative to galvanic and electrochemical oxygen sensors. Its main benefits over the existing technologies are:

- It contains no hazardous materials and is therefore RoHS and REACH compliant.
- It does not degrade or age during storage, even in high oxygen concentrations.
- Because it contains no liquid electrolytes, it can be used and stored at lower temperatures than other sensors.
- It has a longer operating life than other technologies.
- It is not affected by fast changes in pressure.

2 Theory of Operation:

The oxygen measurement technique is based upon the fluorescence quenching of an organometallic fluorescent dye (Ruthenium – "Ru") that is immobilized within in a gas permeable hydrophobic polymer. Due to an efficient metal-to-ligand charge transfer (MLCT) process the dye absorbs in the blue region of the visible spectrum and shows a strong fluorescence in the orange-red region. The presence of oxygen quenches the fluorescence intensity (Fig 1) as well as the fluorescence lifetime of the dye due to collisions of oxygen molecules with the dye in its excited state causing the fluorescent molecules to return to their ground state faster. Therefore, the more oxygen present, the larger the decrease in fluorescence intensity and lifetime.

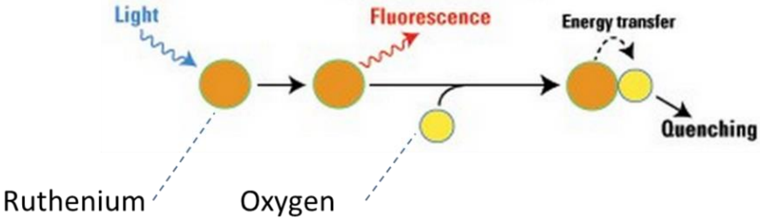

Fig 1 – Oxygen quenching of fluorescence

The change in the fluorescence intensity and lifetime (decay) of a fluorescent dye is directly proportional to the partial pressure of oxygen (ppO_2) – see Fig 2. The fluorescence decay measurement principle is passive, reversible and robust and no oxygen is consumed in the process. For this reason, the change in the fluorescence lifetime of a fluorescent dye with ppO2 leads to calibrated, miniaturised oxygen sensors that have a large dynamic range.

LuminOx also contains an optional barometric pressure sensor, which allows the sensor to calculate and output the O_2% in addition to the ppO_2.

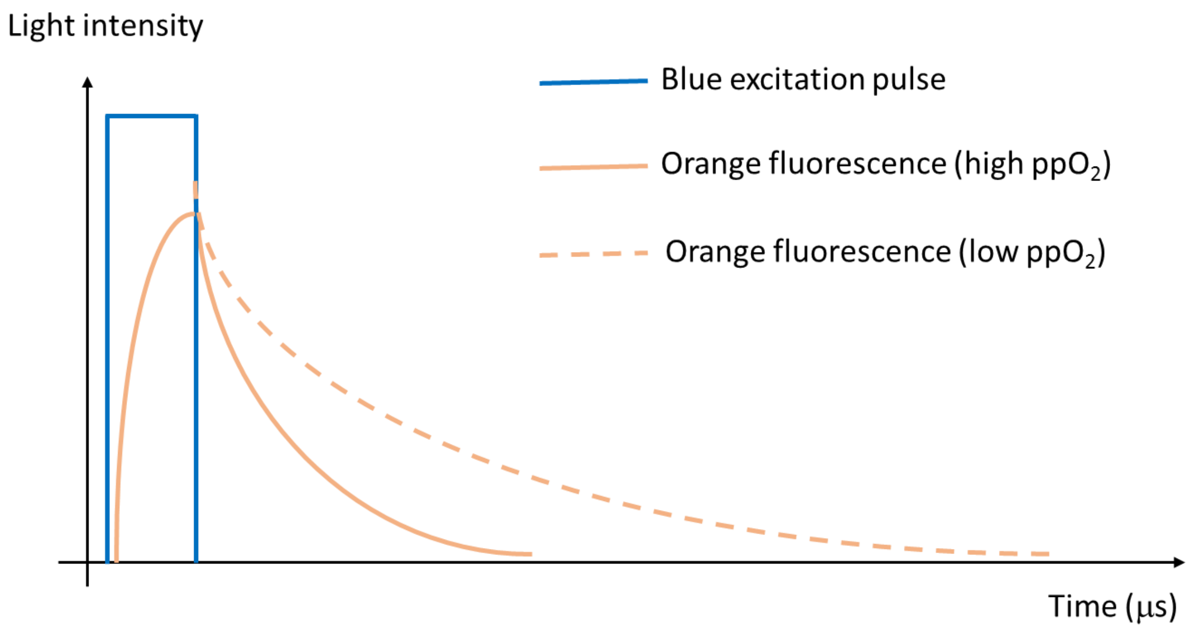

Fig 2 – Effect of ppO_2 on fluorescence decay

The fluorescence effect is strongly affected by temperature. For this reason, LuminOx contains a temperature sensor that, during calibration in our factory, is used to compensate the sensor's output as the temperature changes.

Figure 3 shows a schematic of the sensor's construction. Figure 4 shows how the incorporation of a pressure sensor makes LuminOx (green line) extremely insensitive to changes in pressure (blue line). This is not the case for two other galvanic oxygen sensors (EC1 and EC2) made by other manufacturers. The pressure pulse makes them both produce a very large error which takes a long time to recover. LuminOx, however, only reacts slightly and recovers very quickly.

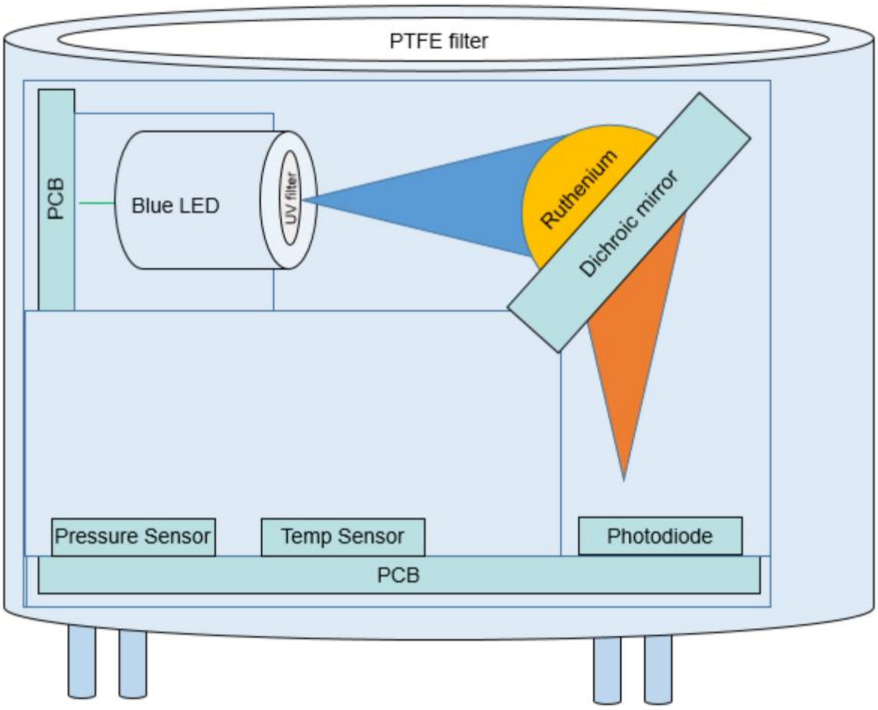

Fig 3 – Sensor construction

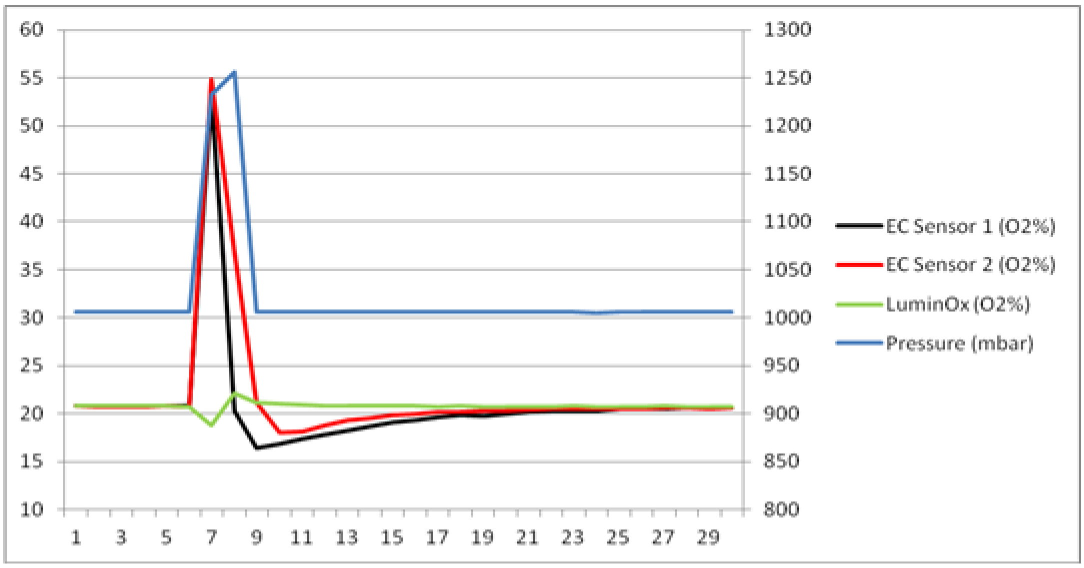

Fig 4 – Effect of 250mbar Pressure Pulse at 21% O2

3 Applications:

Typical applications for the LuminOx Optical Oxygen Sensor are;

- Oxygen detection
- Portable equipment
- Breathing apparatus
- Oxygen Inerting
- Medical
- Lab equipment
- Agriculture
- Incubation
- Fire prevention
- Nitrogen gas generators
- Fruit storage and transportation
- Gas analysers
- Altitude training equipment