AAN 004 PRESSURE PULSES CAN CAUSE FALSE ALARMS

Introduction

Oxygen Sensors are sensitive to pressure:

- the output from **partial pressure sensors** is 100% proportional to the ambient pressure; therefore changes in atmospheric pressure can produce false alarms. For example if the pressure increased by 15 kPa (i.e. 15% increase at an ambient pressure of 1 atmosphere) then the oxygen sensor output will increase by 15%: from 20.9% to 24% oxygen, causing the gas detector to alarm.

- The output from **mass flow controlled sensors** (including the Alphasense oxygen sensors) are not 100% proportional to the ambient pressure, showing a much reduced pressure effect: about 7% dependent; for example, a 15 kPa pressure change (i.e. 15% pressure increase) will cause the sensor output to increase by 7% of 15%: a 1.05% output increase from 20.9 to 21.1% oxygen, avoiding an alarm. However, mass flow oxygen sensors show transient behaviour when subjected to a rapid change in ambient pressure.

Rapid pressure changes can occur in several situations:

- If a portable safety instrument is placed in the trunk of the car and the lid is closed then the instrument will see a temporary positive pressure change.

- If a miner descends rapidly into a deep mine, the gas detector will see a rapid positive pressure pulse.

- If a technician or operator passes through an airlock then the gas detector will respond to a positive or negative pressure pulse.

- Hand aspirated or pumped samplers cause positive or negative pressure pulses.

Although mass flow controlled oxygen sensors show transient behaviour due to pressure pulses, good design and validation of the pressure pulse effect can minimise this problem.

Positive and Negative Pressures

A positive change in pressure leads to an almost instantaneous increase in the output from the oxygen sensor, decaying in a shape reminiscent of discharge of a capacitor. Negative pulses also show the same characteristic but are much smaller in magnitude and most alarms occur from positive pressure pulses.

Characteristics of a Positive Pressure Pulse

A positive pressure pulse can be characterised by two parameters:

- Pulse peak height (expressed by Alphasense as peak equivalent % oxygen)

- Time spent above 23% oxygen, which is a typical alarm level; this parameter assists designers in defining permissible time windows for ignoring pressure pulses. This time is specified for near-instantaneous pressure changes, but some applications create a ramped pressure step, such as a descent into a coal mine.

Sensor Technology House, 300 Avenue West, Skyline 120, Great Notley. Essex.CM77 7AA. UK
Tel: +44 (0) 1376 556700 - Fax: +44 (0) 1376 335899
Email: sensors@alphasense.com - Web: www.alphasense.com

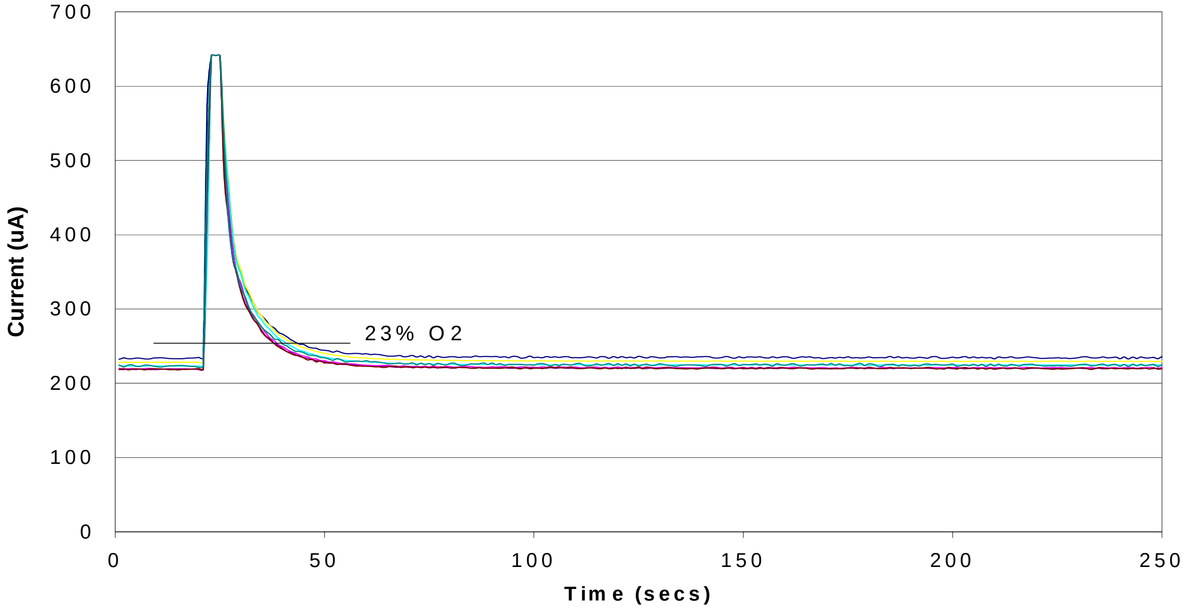

Figure 1. Response of Alphasense O2-A1 oxygen sensors when subjected to a 10 kPa instantaneous positive pressure step. Peak height is (640-220uA/220uA) 40% oxygen; and the time above 23% oxygen alarm level is 12 seconds. Note the sensor-to-sensor variability is small.

Alphasense Oxygen Sensors and Transient Pressure Behaviour

These characteristics listed below for Alphasense oxygen sensors can help instrument manufacturers design hardware and software to minimise alarms due to pressure changes.

1 Peak height is linearly dependent on the magnitude of the pressure change, for pressure pulses or steps up to 2 bar. Above 2 bar, peak height sensitivity is reduced.

2 Pressure changes less than 2kPa can be ignored.

3 The time in alarm (i.e. a reading greater than 23% oxygen) increases linearly with the magnitude of the pressure change.

4 Positive pressure changes cause peaks that have a peak height typically three times greater than troughs from negative pressure changes.

5 You should quantify the magnitude and rate of pressure changes for your applications in order to determine alarm time windows and expected peak heights.

6 Pressure changes are usually very fast (with the exception of descents into mines) - much faster than any expected change in oxygen concentration. This allows software intervention to determine whether a sensor output transient is due to a true oxygen change or a pressure change.

7 Sensors with higher output are less sensitive to pressure changes: the O2-E1 has the smallest peak height and the O2-A2 has the largest peak height.

Sensor Technology House, 300 Avenue West, Skyline 120, Great Notley. Essex.CM77 7AA. UK
Tel: +44 (0) 1376 556700 - Fax: +44 (0) 1376 335899
Email: sensors@alphasense.com - Web: www.alphasense.com