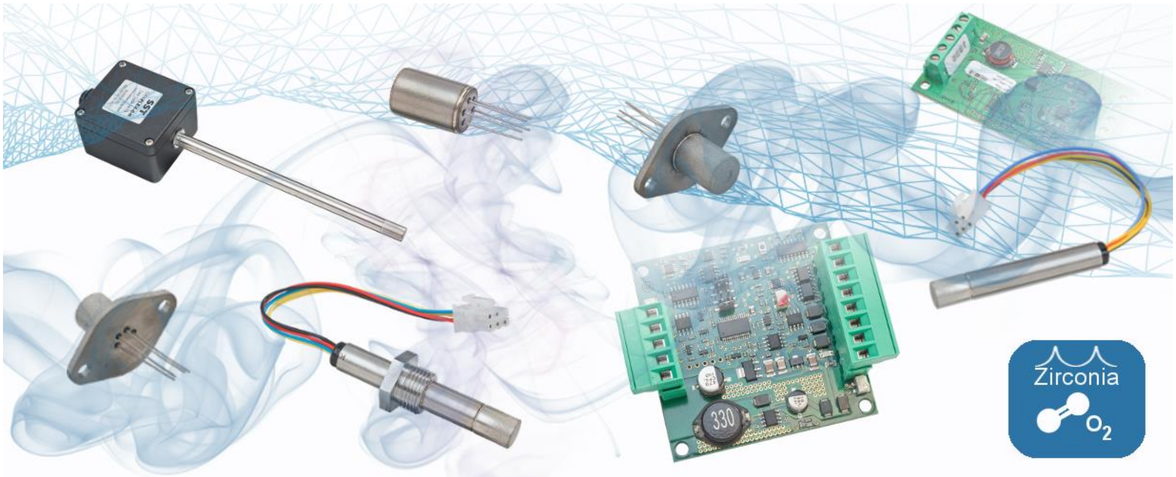
O_2 SENSORS – Zirconium Dioxide (ZrO_2) Software & Hardware Design Guide

This document describes the recommended software and hardware requirements to control and analyse data from SST Sensing's range of zirconium dioxide oxygen sensors.



NOTE: A good understanding of *AN-0043, Zirconium Dioxide (ZrO_2) Oxygen Sensor Operating Principle and Construction Guide* (which explains how the sensors work) is required before continuing.

NOTE: Sensors are sold separately; refer to datasheets listed in REFERENCE DOCUMENTS for details.

Contents

1 DEFINITIONS

The following definitions apply to WARNINGS, CAUTIONS and NOTES used throughout this manual.

WARNING:

The warning symbol is used to indicate instructions that, if they are not followed, can result in minor, serious or even fatal injuries to personnel.

CAUTION:

The caution symbol is used to indicate instructions that, if they are not followed, can result in damage to the equipment (hardware and/or software), or a system failure occurring.

NOTE: Highlights an essential operating procedure, condition or statement.

2 CIRCUIT DESIGN

If you are not using one of SST Sensing's interface boards for sensor control and conditioning, this section describes the basic building blocks required to create an interface circuit.

2.1 Heater Control

The sensor requires either $4V_{DC}$ or $4.35V_{DC}$ (dependant on sensor cap; refer to sensor datasheet) to create the correct operating temperature for the sensing cell. This should be measured as close to the sensor as possible because due to the high current requirement of the low resistance heater there will be voltage drops across connections and wiring. The designed adjustable voltage supply should be capable of providing at least 2A and emit minimal noise.

2.2 Control Circuit Voltage Regulation

Step down and control of input supply voltage.

2.3 Start Up Delay

Zirconium dioxide only becomes operational above 650°C and as the temperature decreases below this threshold the cell impedance increases dramatically. It is therefore important that the sensing cell is NOT pumped when cold. Doing so may irreparably damage the sensor as the constant current source will try and drive whatever voltage is necessary, this has been found to create an effect similar to when there is zero ppO_2.

It is recommended that the sensor is warmed up for a minimum 60s before the sensor control circuitry becomes active. This delay is usually achieved in software but could also be implemented in hardware.

2.4 Constant Current Source

A typical 40µA DC constant current source is required to drive the pump side of the sensing cell. It is recommended that an op amp configured as a constant current source is used. A single resistor and reference voltage are chosen to set the current with the sensor cell being the variable load placed in the feedback loop.

2.5 Constant Current Source Reversal

Connection of the constant current source between PUMP and COMMON has to be able to be reversed whenever either of the reversal voltages are met.

2.6 Output Amplification and Filtering

As the sensed Nernst voltage is a mV signal it is necessary to amplify this to a more sensible voltage range before sampling; refer to page 3-1. Input impedance of the chosen amplifier should be as high as possible to avoid loading the cell.

2.7 Pump Reversal Voltage Reference and Comparison

The amplified SENSE signal should be compared to voltage references which are the specified pump reversal voltages scaled by the same gain factor as the output amplifier. Each time either the upper or lower reference is met the constant current source should be reversed.

This part of the circuit should always start up in the condition that applies the constant current source between PUMP and COMMON as this begins the evacuation necessary to start the pumping cycle, i.e. PUMP should be positive with respect to COMMON.

2.8 Signal Conditioning

A suitable microprocessor is required to monitor the amplified SENSE signal and continually calculate t_d. Averaging will reduce natural sensor noise with the amount of averaging set to suit the response time needs of the application. Adaptive filtering is the best solution where the amount of averaging is changed depending on the amount of variation in the calculated values.

2.9 Output Conditioning

The microprocessor output should be scaled or transformed into the required output i.e. voltage, current loop, serial, etc.

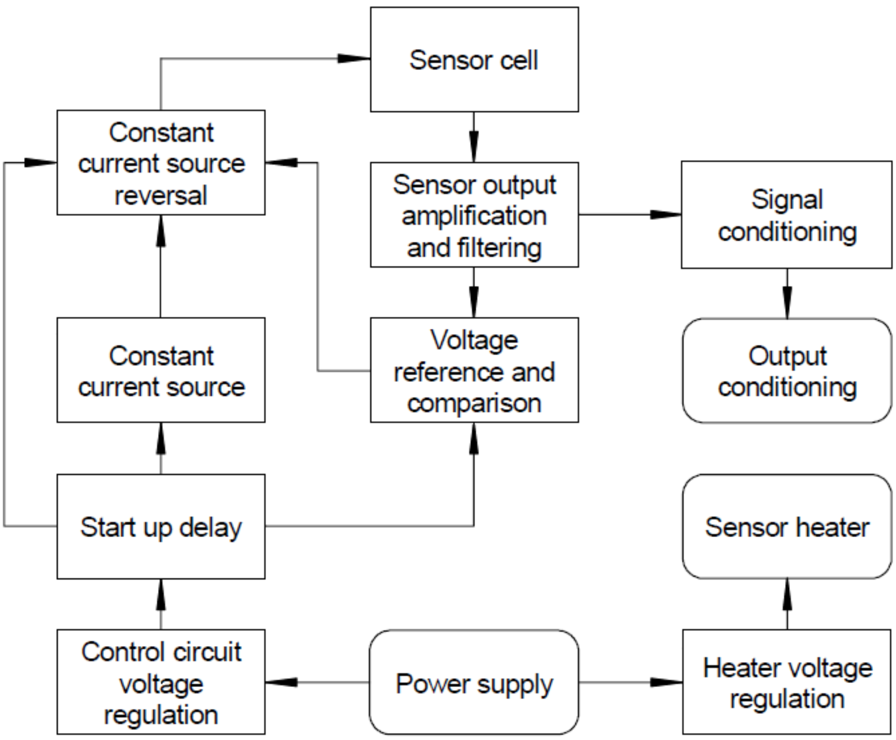


Figure 2-1 - Oxygen Sensor Interface Block Diagram

3 AMPLIFYING AND SAMPLING THE SENSOR'S SENSE SIGNAL

This section describes the hardware required to amplify the generated Nernst voltage from the sensor and also the ADC requirements to correctly sample the signal.

3.1 ADC Minimum Resolution

To accurately sample the sensor SENSE signal (Nernst Voltage) using the recommended hardware solution in 3.3 Nernst Signal Amplification, the ADC resolution must be at least 12-bits. Two ADC channels are required as the signal is a differential signal (SENSE with respect to COMMON).

3.2 ADC Acquisition Time

The acquisition time required to convert the analogue signal should be keep to a minimum. If the ADC is serviced by an interrupt, it is important to keep its frequency equal to or greater than the maximum sample frequency; refer to 5.1 Sample Frequency on page 5-1.

3.3 Nernst Signal Amplification

The recommended circuit for amplifying the sensor Nernst voltage generated across the SENSE connection with respect to the COMMON connection is shown in Figure 3-1 on page 3-2. The circuit provides two buffered and filtered outputs to be sampled by the ADC channels.

The key characteristics of the amplifier design are;

1. Good common mode noise rejection.
2. Biased for low frequency operation; the SENSE signal is typically less than 15Hz.
3. Op amp gain bandwidth product (GBP) of 10kHz ideal for low frequency operation.
4. Low input offset voltage ±150µV maximum.
5. Single ended power supply operation coupled with high PSRR (88dB typical).
6. Ultra-low input bias current avoids loading of the SENSE signal.
7. Rail to rail input and output.
8. Low cost surface mount components used, X7R/X5R ceramic capacitors and 1% tolerance resistors.

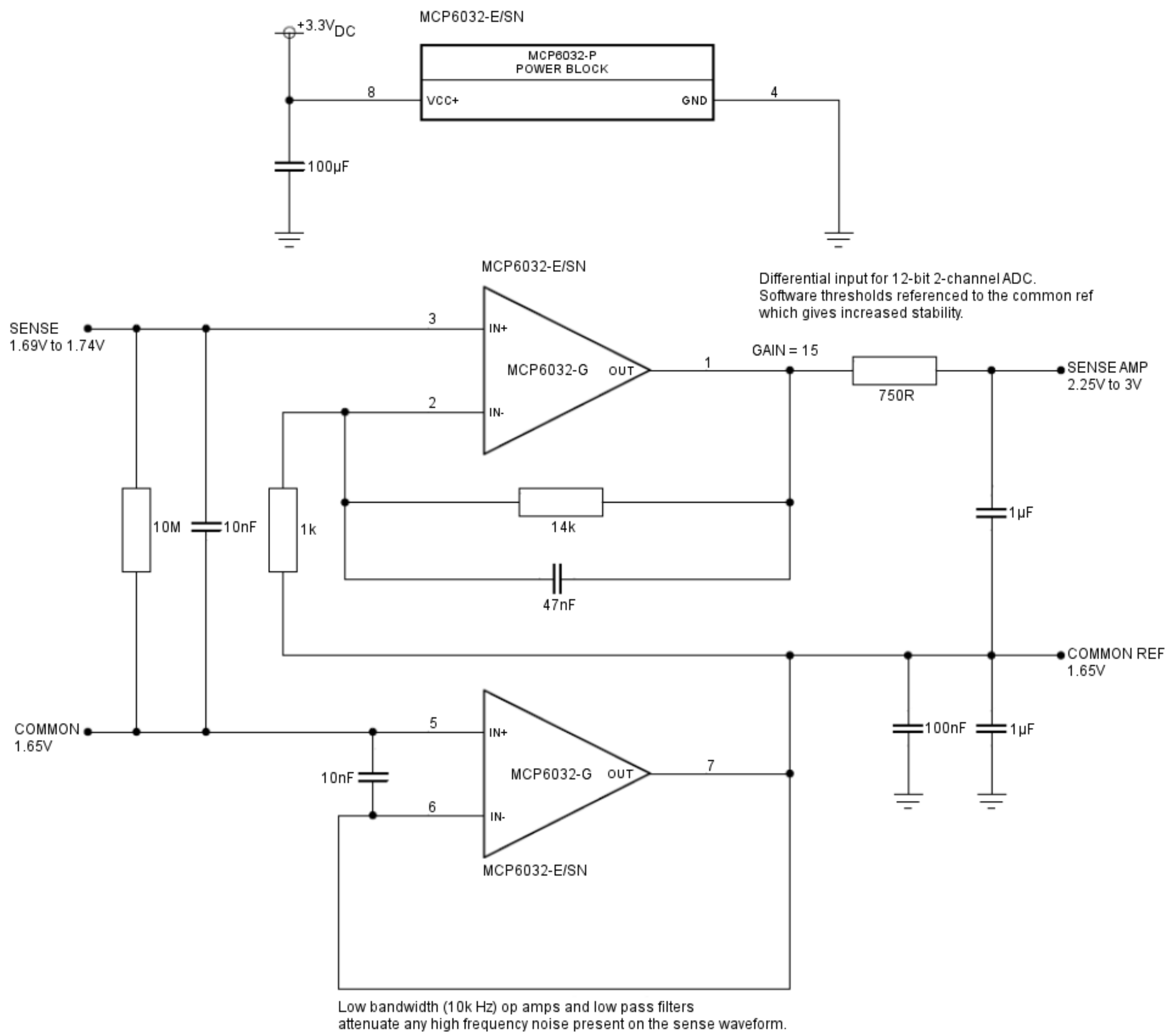


Figure 3-1 - Sensor SENSE Signal Amplification & Filtering with Buffered COMMON Reference

3.4 ADC Averaging

To help reduce noise in the sampled signal the ADC results should be placed into a software moving average filter; refer to 8 MOVING AVERAGE FILTER on page 8-1.

3.5 ADC Step Voltage

Knowing the step voltage is important when calculating the voltage level thresholds of the amplified SENSE signal; refer to Figure 4-1 on page 4-1.

To calculate the step voltage, use Equation 1.

$$ADC_{SV} = \frac{V_S}{2^N} \qquad (1)$$

ADC_{SV}	ADC step voltage
V_S	ADC voltage supply
N	ADC bit resolution

For example, if the ADC is connected to a 3.3V supply and the resolution is 12-bits, then:

$$ADC_{SV} = \frac{3.3}{2^{12}} = \mathbf{0.00080566\ Volts\ per\ bit}$$

4 SENSOR PUMP CONTROL

This section describes the relationship between the direction of the constant source supplied between the sensor PUMP and COMMON connections and the generated Nernst voltage.

4.1 Pump Current Minimum Requirements

CAUTION: Minimum options required in software for controlling the direction of the pump current are;

- 40µA PUMP to COMMON
- 40µA COMMON to PUMP
- No pump current (sensor disabled)

It is important to have the capability to remove the pump current as this prevents the sensor operating before the appropriate start routine is applied. The relationship between the applied pump current and the generated Nernst voltage (measured between COMMON and SENSE) is shown in Figure 4-1.

The recommended hardware to provide a true 40µA constant current source in shown in Figure 4-2 on page 4-2. This is very important for correct sensor operation.

CAUTION: The voltage across the cell MUST NOT exceed 1.65V as excess voltage will damage the sensor!

This simple constant current source uses a very low cost amplifier, X7R/X5R ceramic capacitors and 1% tolerance resistors. A digital output from the microprocessor connects to the terminal CCS reverse in the schematic.

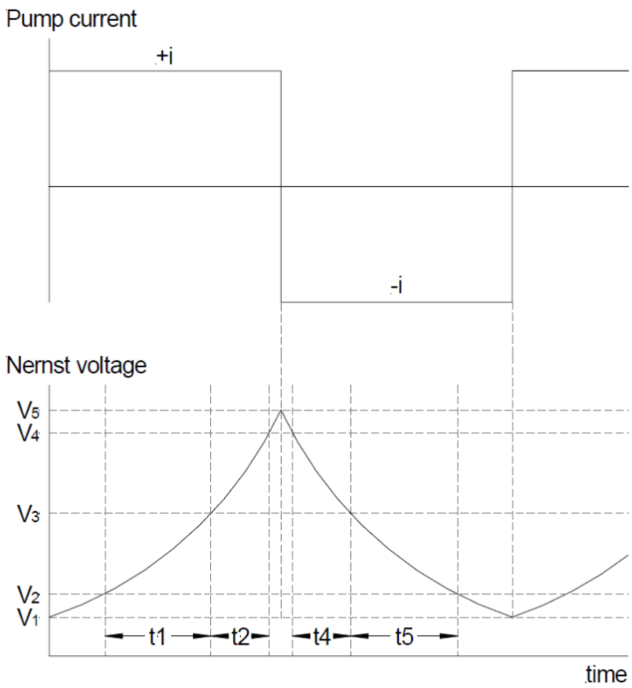
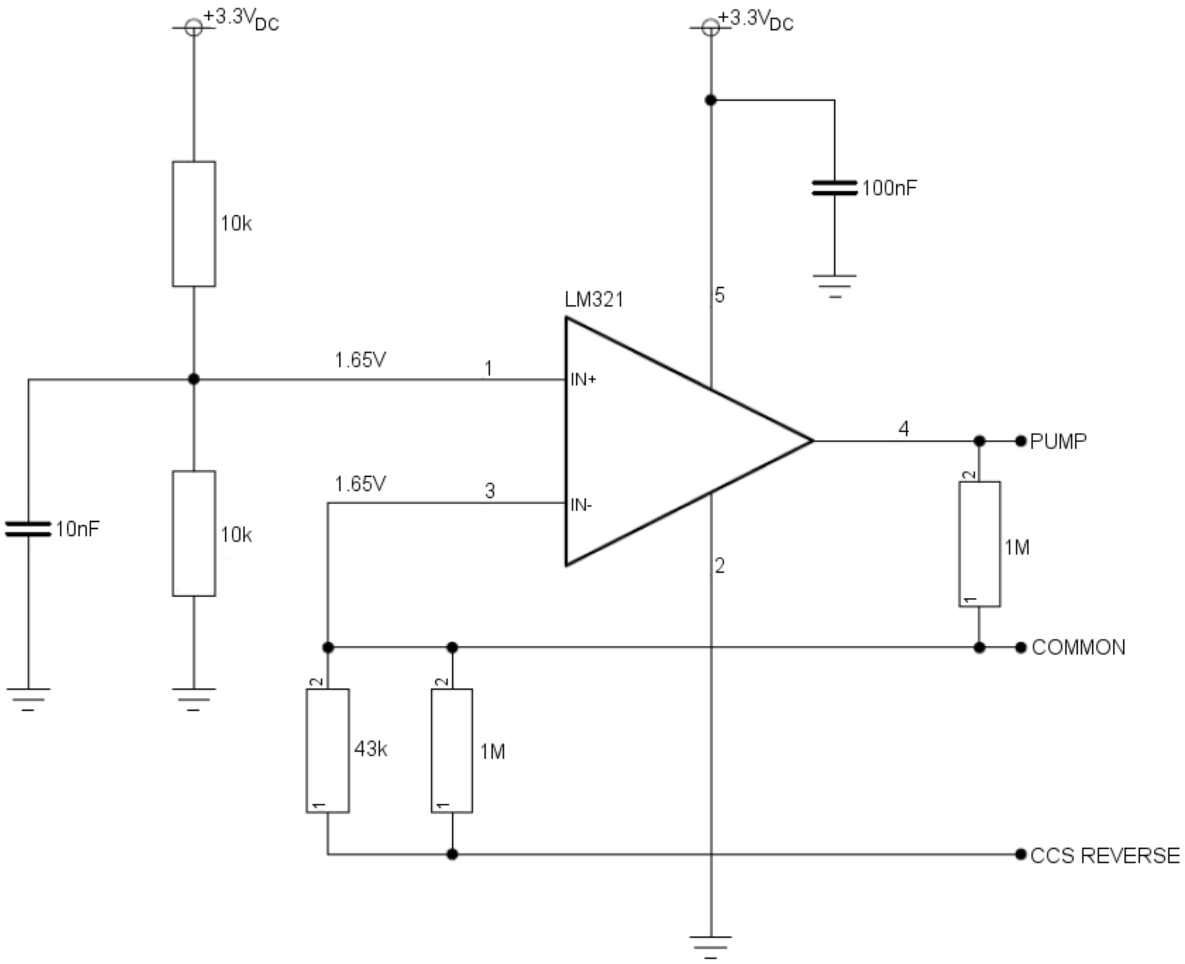


Figure 4-1 - Relationship Between Pump Current and Generated Nernst Voltage



CCS REVERSE Description

LOW (0V) = 40µA PUMP to COMMON (sense voltage increases)
High (3.3V) = 40µA COMMON to PUMP (sense voltage decreases)
Tristate (floating) = pump disabled

Figure 4-2 - Microprocessor Controlled Constant Current Source

4.2 Controlling the Waveform

In order to run the sensor successfully, the pump current direction needs to alternated at fixed points V_1 and V_5 as illustrated in Figure 4-1 on page 4-1.

To calculate V_1 to V_5 thresholds in software refer to 5.3 Voltage Level Calculations on page 5-1.

The process for controlling the direction of the pump current is shown in Figure 4-3.

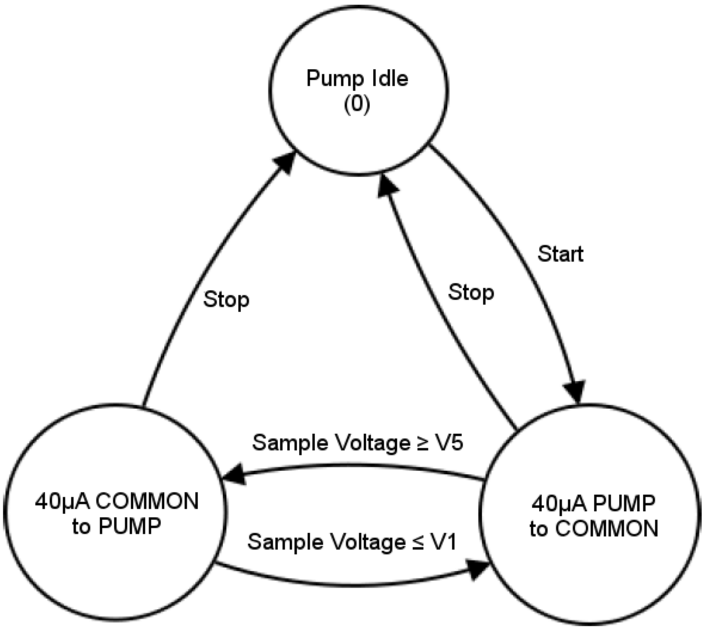


Figure 4-3 - Controlling the Pump Current Direction

When the sensor is initially activated the 40µA PUMP to COMMON must be applied to the sensor (CCS LOW). The system should remain in this state until the sampled SENSE voltage reaches the threshold V_5.

The pump current direction can now be reversed and 40µA COMMON to PUMP is applied to the sensor (CCS HIGH). The system should remain in this state until the sampled SENSE voltage reaches the threshold V_1.

The system will continue to switch between states until the pump current is disabled (Pump Idle, CCS High Impedance or tri-stated) or power is removed from the microprocessor/system.

4.3 Timeout Health Check

CAUTION: A pump current timeout should be introduced as a fault detector. This can help indicate a faulty sensor or a problem with the interface.

This can be achieved introducing a timeout of approximately 30 seconds. The timeout should be reset at each pump current reversal.

When a timeout occurs the stop routine should be implemented; see 6.2 Stop Routine on page 6-1.

5 SIGNAL PROCESSING

5.1 Sample Frequency

For the best possible accuracy, a minimum sample frequency of 10kHz should be implemented in the system.

Higher frequencies up to 30kHz can be used to marginally increase accuracy but the benefits are minimal and not normally required for the majority of applications.

5.2 Timer Requirement

To sample the amplified SENSE signal correctly a timer is required to be set up to measure t_1, t_2, t_4 and t_5. Refer to Figure 4-1 on page 4-1.

If an interrupt timer is used it is important to make sure a high priority is assigned to the interrupt to prevent inaccurate measurements.

The time resolution needed has to be equal to or greater than the chosen sample frequency, although it should be noted that having greater time resolution will yield no extra benefits.

Example: If using a 10kHz sample frequency, then a time resolution of 0.1ms will be sufficient.

5.3 Voltage Level Calculations

To calculate the SENSE voltage levels (V_1 to V_5) correctly, a good understanding of the SENSE amplification and the ADC step volts are required; refer to 3.5 ADC Step Voltage on page 3-2.

Taking into account all amplification gains (x15 for the recommended circuit) and the common reference voltage (if applicable) the following equation should be used to calculate each threshold in ADC steps:

$$Threshold = \frac{V_{SENSE} - V_{COMMON}}{ADC_{SV}} \qquad (2)$$

Threshold	Digital threshold voltage level (ADC steps)
V_{SENSE}	Each amplified SENSE voltage, V_1 to V_5 (SENSE AMP; Figure 3-1 on page 3-2)
V_{COMMON}	COMMON reference voltage (COMMON REF; Figure 3-1 on page 3-2)
ADC_{SV}	ADC volts per step (as calculated in 3.5 ADC Step Voltage on page 3-2)

The calculated thresholds in ADC steps can be saved in a lookup table for system reference.

The recommended Nernst voltages at the sensor level versus the corresponding ADC thresholds for 12-bit ADCs (using the recommended circuit from Figure 3-1 on page 3-2) can be found in Table 5-1 on page 5-2.

The system should sample both ADC channels applying the moving average described in 3.4 ADC Averaging on page 3-2 and 8 MOVING AVERAGE FILTER on page 8-1. Every measurement should be V_{SENSE} minus V_{COMMON} and this result should be compared to the ADC thresholds in Table 5-1 on page 5-2.

Table 5-1 Recommended Nernst Voltage Vs ADC Threshold

Thresholds	Nernst Voltage at the Sensor	12-bit ADC Threshold (Amplified SENSE – COMMON)
V_1	40mV	745
V_2	45mV	838
V_3	64mV	1191
V_4	85mV	1583
V_5	90mV	1676

5.4 Signal Sampling

To illustrate the sampling of the SENSE signal the waveform can be split into six unique phases, refer to Figure 5-1.

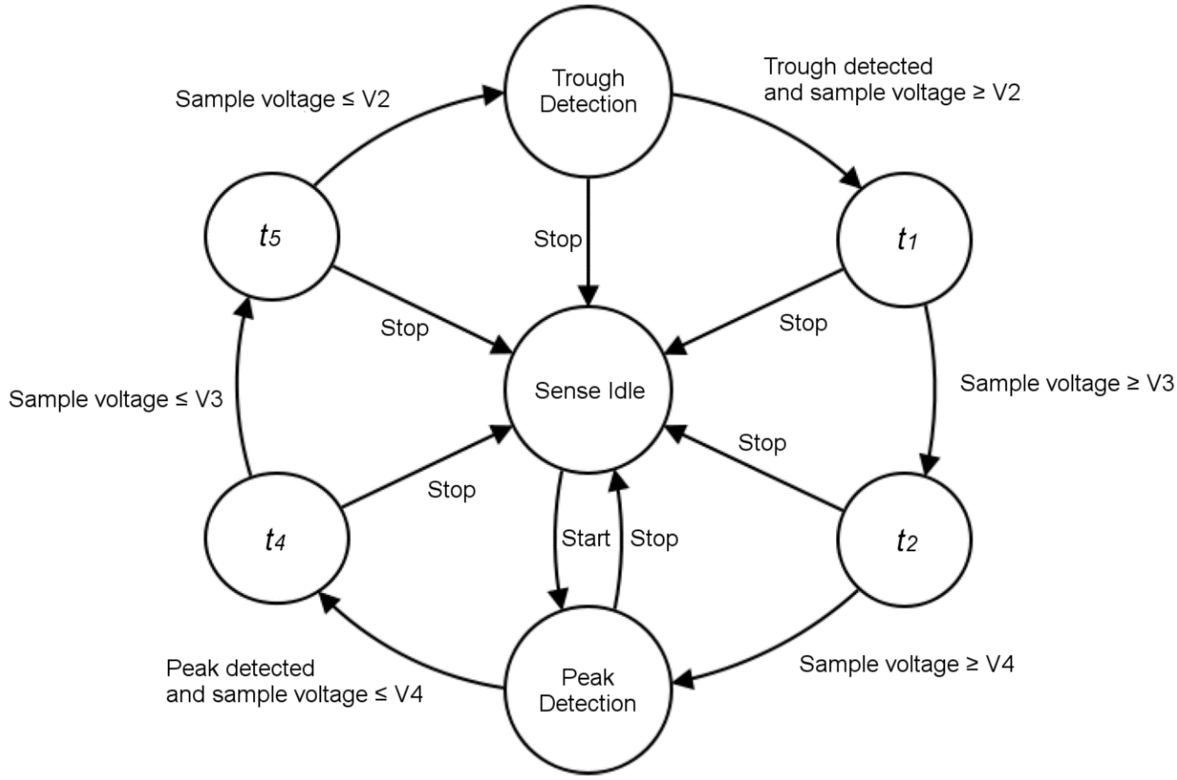


Figure 5-1 - Waveform Phases

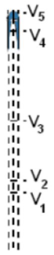
The following phases describe the process and operations required. Individually each phase has its own process to perform in order to obtain the timing values (t_1, t_2, t_4 and t_5) required to calculate t_d and subsequently O_2%.

Idle State

Current Direction: No Pump Current

In Idle state the system should not be trying to sample the SENSE signal. Once the sensor pump current is activated the system should begin at Phase One: Peak Detection. The pump current should always initialise in the state 40µA PUMP to COMMON.

Phase One: Peak Detection

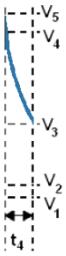


Current Direction: 40µA PUMP to COMMON → 40µA COMMON to PUMP

In this phase the system should be looking to detect the first peak when the sampled SENSE voltage is ≥ V_5. When this occurs the pump current should be reversed as described above.

Once the sampled SENSE voltage is ≤ V_4, Step Two: t_4 is activated.

Phase Two: t_4

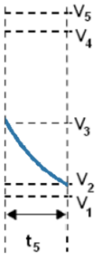


Current Direction: 40µA COMMON to PUMP

When entering this phase, the timer should be initialised/reset. This is done when the sampled SENSE voltage is ≤ V_4.

Once the sampled SENSE voltage is ≤ V_3, the results from the timer can be stored as t_4. Phase Three: t_5 is now activated.

Phase Three: t_5

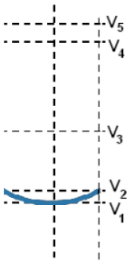


Current Direction: 40µA COMMON to PUMP

When entering this phase, the timer should be reset. This is done when the sampled SENSE voltage is ≤ V_3.

Once the sampled SENSE voltage is ≤ V_2, the results from the timer can be stored as t_5. Phase Four: Trough Detection is now activated.

Phase Four: Trough Detection

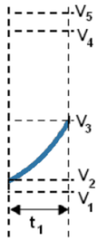


Current Direction: 40µA COMMON to PUMP → 40µA PUMP to COMMON

In this phase the system should be looking to detect the waveform trough when the sampled SENSE voltage is ≤ V_1. When this occurs the pump current should be reversed as described above.

Once the sampled SENSE voltage is ≥ V_2, Phase Five: t_1 is activated.

Phase Five: t_1



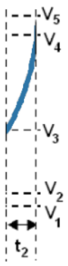
Current Direction: 40µA PUMP to COMMON

When entering this section, the timer should be reset. This is done when the sampled SENSE voltage is ≥ V_2.

Once the sampled SENSE voltage is ≥ V_3, the results from the timer can be stored as t_1.

Phase Six: t_2 is now activated.

Phase Six: t_2



Current Direction: 40µA PUMP to COMMON

When entering this phase, the timer should be reset. This is done when the sampled SENSE voltage is ≥ V_3.

Once the sampled SENSE voltage is ≥ V_4, the results from the timer can be stored as t_2.

Phase One: Peak Detection is now activated and the continuous loop begins again.

6 START AND STOP ROUTINES

6.1 Start Routine

The start routine is required every time the sensor is switched off or power cycled. This helps prevent irreversible damage to the oxygen sensor which can occur if the sensor is pumped when the zirconium dioxide sensing cell is cold.

On system initialisation it is important to make sure the pump current and signal processing are deactivated.

The start routine is illustrated in Figure 6-1.

The first process should be to make sure the heater is enabled to heat up the sensor. Once the heater is applied, the system should then begin a warm up delay period with a minimum of 60 seconds.

On delay completion, the pump current and signal processing can be activated to allow the sensor to begin its pump cycle. To shut down the sensor operation correctly, follow 6.2 Stop Routine below.

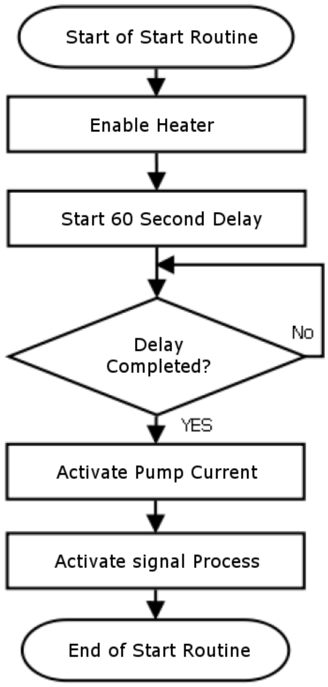


Figure 6-1 - Start Routine

6.2 Stop Routine

Some applications may require the sensor to be stopped during operation for safety, maintenance or for energy efficiency reasons.

The correct stop routine is illustrated in Figure 6-2.

The first process should be to deactivate the pump current and signal processing. Minimal delay should be present between each process shutdown. The heater may then be turned OFF.

The system cool-down delay is an optional process depending on the application requirements. If used, a minimum of three minutes should be applied. It may be necessary for a longer delay to be implemented to allow the application to fully cool down before the sensor heater is turned OFF. The delay should be determined by the application and its purpose is to prevent condensation forming on the sensor in humid environments during the shutdown process.

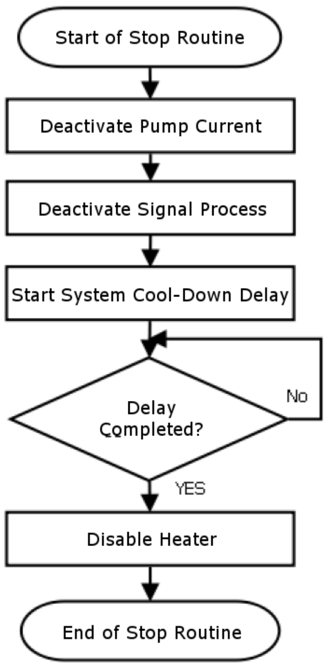


Figure 6-2 - Stop Routine

7 CALCULATIONS

7.1 Calculating t_d

The calculations needed to determine t_d and for diagnostics are not time dependent and can be managed during the processors free time.

The following equation is used to calculate t_d:

$$t_d = (t_1 - t_2) + (t_5 - t_4) \quad (3)$$

t_d	Cycle time (T_c = 0 mode)
t_1, t_2, t_4 & t_5	Individual phase timing values

The time values (t_1, t_2, t_4 and t_5) are obtained during the signal processing routine (refer to 5.4 Signal Sampling on page 5-2). Therefore, t_d only needs to recalculated after every new *t* value.

It is recommended t_d is put into a moving average filter to reduce noise and stabilise the t_d output. We recommend a buffer size of between 4 to 400. This value is very application dependent with a small buffer size best for fast sensor response and a large buffer size optimal for output stability.

Therefore, the maximum buffer size is ideal for systems with slowly drifting O_2 levels and the minimum buffer size is ideal for applications with rapidly changing O_2 levels.

For a balance between response and stability a buffer size of 100 is ideal.

For applications where both response and stability are critical an adaptive filtering method may be used. This can be achieved by monitoring the variance in each new recorded t_d value and when the variance exceeds a predetermined level the buffer is flushed and the buffer size reduced to its minimum value. When the t_d values begin to stabilise again the buffer size can be gradually increased until it reaches its maximum value.

7.2 Calculating Asymmetry

The following equation is used to calculate the sampled SENSE voltage asymmetry:

$$Asymmetry = \frac{(t_1 + t_2)}{(t_5 + t_4)} \quad (4)$$

Asymmetry	SENSE voltage asymmetry
t_1, t_2, t_4 & t_5	Individual phase timing values

Asymmetry need only be recalculated on each new *t* value at the same time as t_d.

To help avoid divide by zero fault conditions during the start-up cycle it is good practice to only calculate asymmetry if t_4 or t_5 are not equal to zero.

The asymmetry value should also be placed into a moving average filter to reduce noise and add stability. A buffer size of 10 to 100 is recommended. See 8 MOVING AVERAGE FILTER on page 8-1.

7.3 Calibration Processes – Converting t_d*(Ave)* to ppO_2 and O_2%

The following procedures are relevant to t_d*(Ave)* measurements made in $T_C = 0$ mode as this is the recommended mode of operation.

In order to convert t_d*(Ave)* to a ppO_2 measurement, sensitivity must first be calculated in a known ppO_2 atmosphere. The volumetric content can easily be calculated from Dalton's law if the total pressure of the gas mixture is known; refer to *AN-0043, Zirconia O_2 Sensor Operating and Construction Guide* for information.

If a relative content (percent by volume) is to be determined without measuring the total pressure, Sensitivity must be calculated in the actual measurement environment with a known oxygen concentration. Future measurements will then be referenced to the total pressure at the time of this calculation. Typically, this would involve calibration in normal air to 20.7% (not 20.95%) to take into account average humidity levels. In order to maintain accuracy, calibration should occur regularly to remove variance caused by fluctuations in barometric/application pressure. As barometric pressure changes relatively slowly, daily calibrations are recommended. Regular calibration also removes any sensor drift which is typical in the first few hundred hours of operation; refer to *AN-0043, Zirconia O_2 Sensor Operating and Construction Guide* for information.

If regular calibration in fresh air is not possible it may be necessary to use a pressure sensor in conjunction with the sensor to automatically compensate the output for fluctuations in the barometric or application pressure. This is a relatively simple process as variations in the barometric pressure change the sensor output by the same proportion. So, if the barometric pressure changes by 1% the sensor output will also change by 1%.

Ideally the initial system calibration should be performed after the sensor has burned in for 200hrs. This will ensure any sensor drift, which may affect future accuracy, has occurred beforehand.

7.3.1 ppO_2 Measurement Only

1. Place sensor in calibration gas with a known ppO_2. If this is fresh air, then the weather data should be used to accurately calculate ppO_2 (refer to *AN-0043, Zirconia O_2 Sensor Operating and Construction Guide* for information).
2. Oxygen sensor heats up until the correct operating temperature is reached, ~60s from cold.
3. Pumping cycles commence.
4. Leave sensor at the operating temperature for 5 – 10 mins to fully stabilise.
5. Calculate output t_d*(Ave)*. Usually over at least ten cycles to average out any noise; the greater the averaging the better.
6. Calculate Sensitivity[a] using Equation 5 below.

$$Sensitivity = \frac{t_d(Ave)}{ppO_2} \qquad (5)$$

7. Rearranging Equation 5 allows ppO_2 to be calculated for all future t_d*(Ave)* measurements (see Equation 6 below):

$$ppO_2 = \frac{t_d(Ave)}{Sensitivity} \qquad (6)$$

[a] Sensitivity for a nominal sensor, when calculating t_d, is typically 1.05ms/mbar. Though due to many factors that may influence the sensitivity (chamber volume, ZrO_2 thickness, etc.), there is a production tolerance of ±15%. This makes calibration a necessity to ensure good sensor to sensor repeatability.

7.3.2 O_2% Measurement Only – No Pressure Compensation

1. Place sensor in calibration gas, typically normal air (20.7% O_2), though can be any gas of known concentration.
2. Oxygen sensor heats up until the correct operating temperature is reached, ~60s from cold.
3. Pumping cycles commence.
4. Leave sensor at the operating temperature for 5 – 10 mins to fully stabilise.
5. Calculate output $t_d(Ave)$. Usually over at least ten cycles to average out any noise; the greater the averaging the better.
6. Calculate Sensitivity% using Equation 7 below:

$$Sensitivity\% = \frac{t_d(Ave)}{O_2\%} \qquad (7)$$

7. Rearranging Equation 7 allows O_2% to be calculated for all future $t_d(Ave)$ measurements (see Equation 8 below).

   NOTE: Any fluctuations in the barometric or application pressure will result in measurement errors proportional to the difference between the pressure at the time of measurement and the pressure when Sensitivity% was calculated.

$$O_2\% = \frac{t_d(Ave)}{Sensitivity\ \%} \qquad (8)$$

7.3.3 ppO2 and O_2% Measurement – With Pressure Compensation

1. Place sensor in calibration gas, typically normal air (20.7% O_2), though can be any gas of known concentration.
2. Calculate ppO_2 from the known oxygen concentration and the total pressure environment using Equation 9 below:

$$ppO_2 = Total\ Pressure \times \frac{O_2\%\ cal\ gas}{100} \qquad (9)$$

3. Oxygen sensor heats up until the correct operating temperature is reached, ~60s from cold.
4. Pumping cycles commence.
5. Leave sensor at the operating temperature for 5 – 10 mins to fully stabilise.
6. Calculate output $t_d(Ave)$. Usually over at least ten cycles to average out any noise; the greater the averaging the better.
7. Calculate Sensitivity using Equation 5 on page 7-2.
8. Calculate all future $t_d(Ave)$ measurements using Equation 6 on page 7-2.
9. Rearranging Equation 9 allows O_2% to be calculated from new ppO_2 measurements and the total pressure (see Equation 10 below).

$$O_2\ \% = \frac{ppO_2}{Total\ Pressure} \times 100 \qquad (10)$$

8 MOVING AVERAGE FILTER

8.1 Filter Principle

A basic moving average filter is defined as the sum of all the last *N* number of data points divided by the number of results; refer to Equation 11:

$$Average = \frac{X_1 + X_2 + \cdots + X_{N-1} + X_N}{N} \qquad (11)$$

N	Buffer size
X	Data

This simple filter is extremely useful in reducing noise in a signal or system. It can also be quickly implemented into a system to improve the stability of sampled signals.

8.2 Processor Overhead

In some applications this approach can be problematic depending on the platform and compiler. The process of division can take a large amount of processing power and therefore time.

As the measurement of oxygen in this system is very time dependent all efforts should be made to avoid any unnecessary overheads.

One option to reduce the overhead is by replacing the intensive division calculations present in the averaging filters, with a less intensive process.

A division of two can be easily implemented by shifting the value right by one.

Example:

Binary 00001000 – which equals decimal value 8

becomes:

Binary 00000100 – which equals decimal value 4

Using this principle, we can carefully select *N* such that it equates to 2 to the power of *y*; refer to Equation 12:

$$N = 2^y \qquad (12)$$

N	Chosen buffer size
y	Number of places to shift to the right

It is recommended *N* should be between 16 and 32 when the ADC is sampled at 10KHz.

REFERENCE DOCUMENTS

Other documents in the Zirconium Dioxide product range are listed below; this list is not exhaustive, always refer to the SST website for the latest information.

Part Number	Title
AN-0043	O_2 Sensors – ZrO_2 Sensor Operating Principle and Construction Guide
AN-0050	O_2 Sensors – ZrO_2 Sensor Operation and Compatibility Guide
AN-0076	O_2 Sensors – ZrO_2 Sensor and Interface Selection Guide
DS-0044	Zirconia O_2 Sensors Flange Mounted Series – Datasheet
DS-0051	Zirconia O_2 Sensors Miniature Series – Datasheet
DS-0052	Zirconia O_2 Sensors Probe Series - Short Housing – Datasheet
DS-0053	Zirconia O_2 Sensors Probe Series - Screw Fit Housing – Datasheet
DS-0055	Zirconia O_2 Sensors Oxygen Measurement System – Datasheet
DS-0058	OXY-LC Oxygen Sensor Interface Board – Datasheet
DS-0072	OXY-COMM Oxygen Sensor – Datasheet
DS-0073	OXY-Flex Oxygen Analyser – Datasheet
DS-0074	O2I-Flex Oxygen Sensor Interface Board – Datasheet
DS-0122	Zirconia O_2 Sensors Probe Series - BM Screw Fit Housing – Datasheet
DS-0131	Zirconia O_2 Sensors Probe Series - Long Housing – Datasheet

CAUTION

Do not exceed maximum ratings and ensure sensor(s) are operated in accordance with their requirements.
Carefully follow all wiring instructions. Incorrect wiring can cause permanent damage to the device.
Zirconium dioxide sensors are damaged by the presence of silicone. Vapours (organic silicone compounds) from RTV rubbers and sealants are known to poison oxygen sensors and MUST be avoided. Do NOT use chemical cleaning agents.

Failure to comply with these instructions may result in product damage.

INFORMATION

As customer applications are outside of SST Sensing Ltd.'s control, the information provided is given without legal responsibility. Customers should test under their own conditions to ensure that the equipment is suitable for their intended application.

For technical assistance or advice, please email: technical@sstsensing.com

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