

Oxygen Sensing – LuminOx ppm Modbus Register Set

This document details the Modbus register set developed to control and analyse data from the LuminOx ppm oxygen sensor.



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2 MODBUS SETUP

NOTE: Background reading is strongly recommended if there is no prior knowledge of Modbus. A good place to start is www.modbus.org, where the specification and resources can be obtained in the technical resources page.

The RS232 TTL Modbus interface is configured as follows:

- **Modbus mode:** RTU
- **Address:** One
- **Baudrate:** 9600
- **Parity:** None
- **Stopbits:** Two

3 MODBUS REGISTERS

NOTE: Default values are shown in **bold**.

NOTE: Values shown in grey are reserved, not applicable or indicate that they should not be changed.

3.1 Serial Registers

Table 3-1 – Serial - Input Registers

Name	Register Address	Description	Actions / Notes
Serial Status	0x762B (30251)	<p>0 = Error Error committing serial changes to memory</p> <p>1 = Not Ready Serial changes are currently not permitted</p> <p>2 = Ready Serial changes are permitted</p> <p>3 = Busy Serial changes in process</p> <p>4 = Complete Serial changes committed to memory, system will restart in 1s with the new communication settings</p>	<p>ACTION: Monitor in system</p> <p>NOTE: Used in Table 3-2 below.</p>

Table 3-2 – Serial - Holding Registers

Name	Register Address	Description / Valid Values	Actions / Notes
Serial Address^a	0x9D3B (40251)	1-247	ACTION: Set/Monitor in system
Reserved	0x9D3C (40252)	Reserved	
Reserved	0x9D3D (40253)	Reserved	
Serial Control	0x9D3E (40254)	<p>0 = Idle</p> <p>1 = Save and reset</p>	

^a LuminOx ppm evaluation kit; sensor serial address set to 1.

3.2 Temperature Registers

Table 3-3 – Temperature - Input Registers

Name	Register Address	Description	Actions / Notes
Temperature ID	0x7725 (30501)	0101	ACTION: For reference NOTE: Unique identifier
Temperature Warning	0x7726 (30502)	16-bit bitmask Each bit represents an individual warning state 0 = No fault Temperature within normal operating range 14 = Greater Temperature above valid operating limit 15 = Less Temperature below valid operating limit	ACTION: Monitor in system NOTES: Warnings are not retained on power loss.
Temperature Error	0x7727 (30503)	16-bit bitmask Each bit represents an individual error state	ACTION: Monitor in system NOTES: Errors are not retained on power loss.
Temperature Uncalibrated Value	0x7728 (30504)	Floating point IEEE 754 (MSB 16-bits) Unit = °C	ACTION: Monitor in system
	0x7729 (30505)	Floating point IEEE 754 (LSB 16-bits) Unit = °C	
Temperature Calibrated Value	0x772A (30506)	Floating point IEEE 754 (MSB 16-bits) Unit = °C Valid Range = -10 to 35	ACTION: Monitor in system
	0x772B (30507)	Floating point IEEE 754 (LSB 16-bits) Unit = °C Valid Range = -10 to 35	
Temperature Status	0x772C (30508)	0 = Loading System initialising, no temperature measurements 1 = OFF No temperature measurements 2 = Standby No temperature measurements 3 = Reserved 4 = ON Valid temperature measurements 5 = Reserved 6 = Calibration Invalid temperature measurements, calibration in process	ACTION: Monitor in system

Table 3-4 – Temperature - Holding Registers

Name	Register Address	Description / Valid Values	Actions / Notes
Temperature Control	0x9E35 (40501)	Reserved	ACTION: Monitor in system NOTE: The temperature measurement cannot be switched off.
Clear Temperature Warning	0x9E36 (40502)	0 = Idle 1 = Clear warning (Reserved)	ACTION: None NOTE: Any warning present in <i>Temperature Warning</i> (30502) will auto clear if the condition that caused the warning is removed.
Clear Temperature Error	0x9E37 (40503)	0 = Idle 1 = Clear Error	ACTION: None NOTE: If an error present in <i>Temperature Error</i> (30503) has forced <i>Temperature Status</i> to <i>OFF</i> (30508 = 1) the error may be cleared using this register. If the error persists, contact technical@sstsensing.com for guidance.

3.3 Pressure Registers

Table 3-5 – Pressure - Input Registers

Name	Register Address	Description	Actions / Notes
Pressure ID	0x781F (30751)	0102	ACTION: For reference NOTE: Unique identifier
Pressure Warning	0x7820 (30752)	16-bit bitmask Each bit represents an individual warning state 0 = No fault Pressure within normal operating range 14 = Greater Pressure above valid operating limit 15 = Less Pressure below valid operating limit	ACTION: Monitor in system NOTES: Warnings are not retained on power loss.
Pressure Error	0x7821 (30753)	16-bit bitmask Each bit represents an individual error state	ACTION: Monitor in system NOTES: Errors are not retained on power loss.
Pressure Uncalibrated Value	0x7822 (30754)	Floating point IEEE 754 (MSB 16-bits) Unit = mbar	ACTION: Monitor in system
	0x7823 (30755)	Floating point IEEE 754 (LSB 16-bits) Unit = mbar	
Pressure Calibrated Value	0x7824 (30756)	Floating point IEEE 754 (MSB 16-bits) Unit = mbar Valid Range = 500 to 1200	ACTION: Monitor in system
	0x7825 (30757)	Floating point IEEE 754 (LSB 16-bits) Unit = mbar Valid Range = 500 to 1200	
Pressure Status	0x7826 (30758)	0 = Loading System initialising, no pressure measurements 1 = OFF No pressure measurements 2 = Standby No pressure measurements 3 = Reserved 4 = ON Valid pressure measurements 5 = Reserved 6 = Calibration Invalid pressure measurements, calibration in process	ACTION: Monitor in system

Table 3-6 – Pressure - Holding Registers

Name	Register Address	Description / Valid Values	Actions / Notes
Pressure Control	0x9F2F (40751)	Reserved	ACTION: Monitor in system NOTE: The pressure measurement cannot be switched off.
Clear Pressure Warning	0x9F30 (40752)	0 = Idle 1 = Clear warning (Reserved)	ACTION: None NOTE: Any warning present in <i>Pressure Warning</i> (30752) will auto clear if the condition that caused the warning is removed.
Clear Pressure Error	0x9F31 (40753)	0 = Idle 1 = Clear Error	ACTION: None NOTE: If an error present in <i>Pressure Error</i> (30753) has forced <i>Pressure Status</i> to <i>OFF</i> (30758 = 1) the error may be cleared using this register. If the error persists, contact technical@sstsensing.com for guidance.

3.4 ppO₂ Registers

Table 3-7 – ppO₂ - Input Registers

Name	Register Address	Description	Actions / Notes
ppO₂ ID	0x7919 (31001)	0103	ACTION: For reference NOTE: Unique identifier
ppO₂ Warning	0x791A (31002)	16-bit bitmask Each bit represents an individual warning state 0 = No fault ppO ₂ within normal operating range 14 = Greater ppO ₂ above valid operating limit 15 = Less ppO ₂ below valid operating limit	ACTION: Monitor in system NOTES: Warnings are not retained on power loss.
ppO₂ Error	0x791B (31003)	16-bit bitmask Each bit represents an individual error state	ACTION: Monitor in system NOTES: Errors are not retained on power loss.
ppO₂ Uncalibrated Value	0x791C (31004)	Floating point IEEE 754 (MSB 16-bits) Unit = mbar	ACTION: Monitor in system NOTES: This value can be greater than or less than the sensor range and is used to determine measurement stability during the calibration process. Refer to instructions on page 3-14.
	0x791D (31005)	Floating point IEEE 754 (LSB 16-bits) Unit = mbar	
ppO₂ Calibrated Value	0x791E (31006)	Floating point IEEE 754 (MSB 16-bits) Unit = mbar Valid Range = 0 to 1.2	ACTION: Monitor in system NOTE: Refer to instructions on page 3-14.
	0x791F (31007)	Floating point IEEE 754 (LSB 16-bits) Unit = mbar Valid Range = 0 to 1.2	
ppO₂ Status	0x7920 (31008)	0 = Loading System initialising, no ppO ₂ measurements 1 = OFF No ppO ₂ measurements 2 = Standby No ppO ₂ measurements 3 = Reserved 4 = ON Valid ppO ₂ measurements 5 = Reserved 6 = Calibration Invalid O ₂ measurements, calibration in process	ACTION: Monitor in system NOTE: Refer to instructions on page 3-14.

Name	Register Address	Description	Actions / Notes
ppO₂ Offset Status (Calibration)	0x7921 (31009)	0 = Error Error during the calibration process 1 = Not Ready Calibration is currently disabled 2 = Ready Calibration enabled 3 = Busy Calibration in progress 4 = Complete Calibration complete	ACTION: Monitor in system NOTE: Refer to instructions on page 3-14.
ppO₂ Gain Status (Calibration)	0x7922 (31010)	0 = Error Error during the calibration process 1 = Not Ready Calibration is currently disabled 2 = Ready Calibration enabled 3 = Busy Calibration in progress 4 = Complete Calibration complete	ACTION: Monitor in system NOTE: Refer to instructions on page 3-14.
ppO₂ DAC (Diagnostic)	0x7923 (31011)	32-bit integer (MSB 16-bits) Unit = (0.8mv) steps Valid range = 0 to 65535	ACTION: Monitor in system
	0x7924 (31012)	32-bit integer (LSB 16-bits) Unit = (0.8mv) steps Valid range = 0 to 65535	
ppO₂ DAC Status (Diagnostic)	0x7925 (31013)	0 = Error Error during the diagnostic index change process 1 = Not Ready Diagnostic values are currently disabled 2 = Ready Diagnostic values enabled	ACTION: Monitor in system
ppO₂ ADC Background (Diagnostic)	0x7926 (31014)	32-bit integer (MSB 16-bits) Unit = (0.8mv) steps Valid range = 0 to 65535	ACTION: Monitor in system
	0x7927 (31015)	32-bit integer (LSB 16-bits) Unit = (0.8mv) steps Valid range = 0 to 65535	

Name	Register Address	Description	Actions / Notes
ppO₂ ADC Background Status (Diagnostic)	0x7928 (31016)	0 = Error Error during the diagnostic index change process 1 = Not Ready Diagnostic values are currently disabled 2 = Ready Diagnostic values enabled	ACTION: Monitor in system
ppO₂ ADC Peak (Diagnostic)	0x7929 (31017)	32-bit integer (MSB 16-bits) Unit = (0.8mv) steps Valid range = 0 to 65535	ACTION: Monitor in system
	0x792A (31018)	32-bit integer (LSB 16-bits) Unit = (0.8mv) steps Valid range = 0 to 65535	
O₂ ADC Peak Status (Diagnostic)	0x792B (31019)	0 = Error Error during the diagnostic index change process 1 = Not Ready Diagnostic values are currently disabled 2 = Ready Diagnostic values enabled	ACTION: Monitor in system

Table 3-8 – ppO₂ Sensor - Holding Registers

Name	Register Address	Description / Valid Values	Actions / Notes
ppO₂ Control	0xA029 (41001)	Reserved	ACTION: Monitor in system
Clear ppO₂ Warning	0xA02A (41002)	0 = Idle 1 = Clear warning (Reserved)	ACTION: None NOTE: Any warning present in <i>ppO₂ Warning</i> (31002) will auto clear if the condition that caused the warning is removed.
Clear ppO₂ Error	0xA02B (41003)	0 = Idle 1 = Clear error	ACTION: Set in system NOTE: If an error present in <i>ppO₂ Error</i> (31003) has forced <i>ppO₂ Status</i> to <i>OFF</i> (31008 = 1) the error may be cleared using this register. If the error persists, contact technical@sstsensing.com for guidance.
ppO₂ Offset (Calibration)	0xA02C (41004)	Floating point IEEE 754 (MSB 16-bits) Unit = mbar Valid Range = 0 to 0.1	ACTION: Set/Monitor in system NOTES: Any changes are saved in EEPROM and retained on power loss. Default = 0.01 . Refer to instructions on page 3-14 .
	0xA02D (41005)	Floating point IEEE 754 (LSB 16-bits) Unit = mbar Valid Range = 0 to 0.1	
ppO₂ Offset Control (Calibration)	0xA02E (41006)	0 = Idle 1 = Apply Calibration 2 = Reset Status	ACTION: Set in system NOTE: Refer to instructions on page 3-14 .
ppO₂ Gain (Calibration)	0xA02F (41007)	Floating point IEEE 754 (MSB 16-bits) Unit = mbar Valid Range = 0.1 to 1.2	ACTION: Set/Monitor in system NOTES: Any changes are saved in EEPROM and retained on power loss. Default = 1.0 . Refer to instructions on page 3-14 .
	0xA030 (41008)	Floating point IEEE 754 (LSB 16-bits) Unit = mbar Valid Range = 0.1 to 1.2	
ppO₂ Gain Control (Calibration)	0xA031 (41009)	0 = Idle 1 = Apply Calibration 2 = Reset Status	ACTION: Set in system NOTE: Refer to instructions on page 3-14 .

3.5 O₂ Registers

Table 3-9 – O₂ Sensor - Input Registers

Name	Register Address	Description	Actions / Notes
O₂ ID	0x7A13 (31251)	0104	ACTION: For reference NOTE: Unique identifier
O₂ Warning	0x7A14 (31252)	16-bit bitmask Each bit represents an individual warning state 0 = No fault O ₂ within normal operating range 14 = Greater O ₂ above valid operating limit 15 = Less O ₂ below valid operating limit	ACTION: Monitor in system NOTES: Warnings are not retained on power loss.
O₂ Error	0x7A15 (31253)	16-bit bitmask Each bit represents an individual error state	ACTION: Monitor in system NOTES: Errors are not retained on power loss.
O₂ Uncalibrated Value	0x7A16 (31254)	Floating point IEEE 754 (MSB 16-bits) Unit = ppm	ACTION: Monitor in system NOTES: This value can be greater than or less than the ppm sensor range and is used to determine measurement stability during the calibration process. Used in Section 3.6 on page 3-14.
	0x7A17 (31255)	Floating point IEEE 754 (LSB 16-bits) Unit = ppm	
O₂ Calibrated Value	0x7A18 (31256)	Floating point IEEE 754 (MSB 16-bits) Unit = ppm Valid Range = 0 to 1200	ACTION: Monitor in system NOTE: Used in Section 3.6 on page 3-14.
	0x7A19 (31257)	Floating point IEEE 754 (LSB 16-bits) Unit = ppm Valid Range = 0 to 1200	
O₂ Status	0x7A1A (31258)	0 = Loading System initialising, no O ₂ measurements 1 = OFF No O ₂ measurements 2 = Standby No O ₂ measurements 3 = Reserved 4 = ON Valid O ₂ measurements 5 = Reserved 6 = Calibration Invalid O ₂ measurements, calibration in process	ACTION: Monitor in system NOTE: Used in Section 3.6 on page 3-14.

Name	Register Address	Description	Actions / Notes
O₂ Offset Status (Calibration)	0x7A1B (31259)	0 = Error Error during the offset calibration process 1 = Not Ready Offset calibration is currently disabled 2 = Ready Offset calibration enabled 3 = Busy Offset calibration in progress 4 = Complete Offset calibration complete	ACTION: Monitor in system NOTES: Used in Section 3.6.1 on page 3-14.
O₂ Gain Status (Calibration)	0x7A1C (31260)	0 = Error Error during the gain calibration process 1 = Not Ready Gain calibration is currently disabled 2 = Ready Gain calibration enabled 3 = Busy Gain calibration in progress 4 = Complete Gain calibration complete	ACTION: Monitor in system NOTES: Used in Section 3.6.2 on page 3-14.
O₂ DAC (Diagnostic)	0x7A1D (31261)	32-bit integer (MSB 16-bits) Unit = (0.8mv) steps Valid range = 0 to 65535	ACTION: Monitor in system
	0x7A1E (31262)	32-bit integer (LSB 16-bits) Unit = (0.8mv) steps Valid range = 0 to 65535	
O₂ DAC Status (Diagnostic)	0x7A1F (31263)	0 = Error Error during the diagnostic index change process 1 = Not Ready Diagnostic values are currently disabled 2 = Ready Diagnostic values enabled	ACTION: Monitor in system
O₂ ADC Background (Diagnostic)	0x7A20 (31264)	32-bit integer (MSB 16-bits) Unit = (0.8mv) steps Valid range = 0 to 65535	ACTION: Monitor in system
	0x7A21 (31265)	32-bit integer (LSB 16-bits) Unit = (0.8mv) steps Valid range = 0 to 65535	

Name	Register Address	Description	Actions / Notes
O₂ ADC Background (Diagnostic)	0x7A22 (31266)	0 = Error Error during the diagnostic index change process 1 = Not Ready Diagnostic values are currently disabled 2 = Ready Diagnostic values enabled	ACTION: Monitor in system
O₂ ADC Peak (Diagnostic)	0x7A23 (31267)	32-bit integer (MSB 16-bits) Unit = (0.8mv) steps Valid range = 0 to 65535	ACTION: Monitor in system
	0x7A24 (31268)	32-bit integer (LSB 16-bits) Unit = (0.8mv) steps Valid range = 0 to 65535	
O₂ ADC Peak (Diagnostic)	0x7A25 (31269)	0 = Error Error during the diagnostic index change process 1 = Not Ready Diagnostic values are currently disabled 2 = Ready Diagnostic values enabled	ACTION: Monitor in system

Table 3-10 – O₂ Sensor - Holding Registers

Name	Register Address	Description / Valid Values	Actions / Notes
O₂ Control	0xA123 (41251)	Reserved	ACTION: Monitor in system NOTE: The O ₂ measurement cannot be switched off.
Clear O₂ Warning	0xA124 (41252)	0 = Idle 1 = Clear warning (Reserved)	ACTION: None NOTE: Any warning present in <i>O₂ Warning</i> (31252) will auto clear if the condition that caused the warning is removed.
Clear O₂ Error	0xA125 (41253)	0 = Idle 1 = Clear Error	ACTION: Set in system NOTE: If an error present in <i>O₂ Error</i> (31253) has forced <i>O₂ Status</i> to <i>OFF</i> (31258 = 1) the error may be cleared using this register and an attempt made to reset the status by setting the <i>O₂ Control</i> to <i>Reset Status</i> (41256 = 2 or 41259 = 2). If the error persists, contact technical@sstsensing.com for guidance.
O₂ Offset (Calibration)	0xA126 (41254)	Floating point IEEE 754 (MSB 16-bits) Unit = ppm Valid Range = 0 to 100	ACTION: Set/Monitor in system NOTES: Any changes are saved in EEPROM and retained on power loss. Default = 10 . Used in Section 3.6.1 on page 3-14 .
	0xA127 (41255)	Floating point IEEE 754 (LSB 16-bits) Unit = ppm Valid Range = 0 to 100	
O₂ Offset Control (Calibration)	0xA128 (41256)	0 = Idle 1 = Apply Calibration 2 = Reset Status	ACTION: Set in system NOTE: Used in Section 3.6.1 on page 3-14 .
O₂ Gain (Calibration)	0xA129 (41257)	Floating point IEEE 754 (MSB 16-bits) Unit = ppm Valid Range = 10 to 1200	ACTION: Set/Monitor in system NOTES: Any changes are saved in EEPROM and retained on power loss. Default = 1000 . Used in Section 3.6.2 on page 3-14 .
	0xA12A (41258)	Floating point IEEE 754 (LSB 16-bits) Unit = ppm Valid Range = 10 to 1200	
O₂ Gain Control (Calibration)	0xA12B (41259)	0 = Idle 1 = Apply Calibration 2 = Reset Status	ACTION: Set in system NOTE: Used in Section 3.6.2 on page 3-14 .

3.6 Calibrating the Sensor

3.6.1 Offset Calibration

1. Confirm *O₂ Offset Status (Calibration) = Ready* (31259 = 2).

2. Apply a “zero” (Offset) gas of a known ppm value over the sensor.

NOTE: The “zero” gas MUST have an Oxygen concentration less than 100ppm; it is recommended that the “zero” gas is less than 25ppm.

NOTE: Recommended flow rate is one litre per minute.

3. Monitor *O₂ Uncalibrated Value* (31254 and 31255) and wait at least 30 minutes until the value stabilises.

NOTE: Wait time based on purging from air.

4. Input the “zero” gas value (ppm) into *O₂ Offset (Calibration)* (41254 and 41255).

5. Set *O₂ Offset Control (Calibration)* to *Apply Calibration* (41256 = 1).

6. During the calibration routine *O₂ Offset Status (Calibration)* will change to *Busy* (31259 = 3) and *O₂ Status* will change to *Calibration* (31258 = 6). *O₂* measurements are not valid during this phase.

7. When the calibration routine is complete *O₂ Offset Status (Calibration)* will change to *Complete* (31259 = 4) and *O₂ Status* will return to *ON* (31258 = 4).

8. Set *O₂ Offset Control (Calibration)* to *Reset Status* (41256 = 2) to return *O₂ Offset Status (Calibration)* to *Ready* (31259 = 2).

9. Confirm the *O₂ Calibrated Value* (31256 and 31257) is within ± 2 ppm of the calibration gas applied. If not, repeat [Steps 3 to 8](#) and allow the *O₂ Uncalibrated Value* (31254 and 31255) to stabilise for a longer period. If multiple calibration attempts do not result in an accurate calibration, contact technical@sstsensing.com for guidance.

3.6.2 Gain Calibration

The Offset is the main calibration point, however, if a “span” (Gain) calibration is required:

1. Confirm *O₂ Gain Status (Calibration) = Ready* (31260 = 2).

2. Apply a “span” (Gain) gas of a known ppm value over the sensor.

NOTE: The “span” gas MUST have an Oxygen concentration greater than 100ppm; it is recommended that the “span” gas is the maximum of the working range or, if available, 1000ppm should be used.

NOTE: Recommended flow rate is one litre per minute.

3. Monitor *O₂ Uncalibrated Value* (31254 and 31255) and wait at least 10 minutes until the value stabilises.

NOTE: Wait time based on purging from air.

4. Input the “span” gas value (ppm) into *O₂ Gain (Calibration)* (41257 and 41258).

5. Set *O₂ Gain Control (Calibration)* to *Apply Calibration* (41259 = 1).

6. During the calibration routine *O₂ Gain Status (Calibration)* will change to *Busy* (31260 = 3) and *O₂ Status* will change to *Calibration* (31258 = 6). *O₂* measurements are not valid during this phase.

7. When the calibration routine is complete *O₂ Gain Status (Calibration)* will change to *Complete* (31260 = 4) and *O₂ Status* will return to *ON* (31258 = 4).

8. Set *O₂ Gain Control (Calibration)* to *Reset Status* (41259 = 2) to return *O₂ Gain Status (Calibration)* to *Ready* (31260 = 2).
9. Confirm the *O₂ Calibrated Value* (31256 and 31257) is within ± 2 ppm of the calibration gas applied. If not, repeat [Steps 3 to 8](#) and allow the *O₂ Uncalibrated Value* (31254 and 31255) to stabilise for a longer period. If multiple calibration attempts do not result in an accurate calibration, contact technical@sstsensing.com for guidance.

REFERENCE DOCUMENTS

Reference documents are listed below. The SST documentation list is not exhaustive, always refer to the [SST website](#) for the latest information.

Part Number	Title
DS-0154	Oxygen Sensing – LuminOx ppm Series Datasheet
UG-015	Oxygen Sensing – LuminOx ppm Series User’s Guide



INFORMATION

As customer applications are outside of SST Sensing Limited’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 contact technical@sstsensing.com.

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SST SENSING LIMITED, 5 HAGMILL CRESCENT, SHAWHEAD INDUSTRIAL ESTATE, COATBRIDGE, UK, ML5 4NS
www.sstsensing.com | e: sales@sstsensing.com | t: +44 (0)1236 459 020 | f: +44 (0)1236 459 026