O2IO-2200 Oxygen Controller User Manual

Version 1.1, November 2019

Australian Oxytrol Systems Pty Ltd

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Contents

1   Revision History

Initial release

- Initial Release, 2/09/2019
- Manual Release, 14/11/2019

Oxygen Controller Current & Voltage Source

2   Description

The O2IO-2200 is a networked or stand alone product. When connected to a network the user may configure, monitor and log oxygen sensor mV's, and temperature. The O2IO-2200 can also be configured to operate in stand alone mode to translate oxygen and thermocouple voltage readings to configurable current or voltage outputs. The product employs patented interface circuitry allowing longer use of the Oxygen Probe, and supports monitoring of sensor impedance for advance warning of when the sensor requires replacement. The O2IO-2200 is also a standalone temperature PID controller, supporting constant temperature control for a heated probe, or kiln.

Features

- Two input channels:
    - O_2 Sensor input (differential)
    - Thermocouple input (differential)
- Two configurable output channels:
    - O_2 Sensor mV to 4-20, or 0-24mA
    - O_2 Sensor mV to 0-5, or 0-10 VDC
    - Temperature ° C °F to 4-20, or 0-24mA
    - Temperature °C /°F to 0-5, or 0-10 VDC
- Linear or S-Curve transfer function for mA or V
- Configurable slope, thresholds, and curve.
- Supports all Zirconia sensor types
- Ethernet remote viewing and configuration
- Sensor impedance checking
- 2 kV Isolated control outputs
- DIN Rail mounting
- PWM/PID Temperature controller
- Software and Firmware update facility

Applications

- Remote environment monitoring
- Oxygen control systems
- Temperature control systems
- Flue gas monitoring
- Single zone kiln control
- Heated oxygen probe control
- Thermocouple or oxygen to current and or voltage transmitter

3 Specifications

Environmental				
Parameter	Minimum	Typical	Maximum	Unit
Operating Temperature	-20	30	60	°C
Storage Temperature	-20	30	80	°C

Electrical				
Parameter	Minimum	Typical	Maximum	Unit
Supply Input Voltage	12	24	36	V DC
Supply Input Current	–	100	–	mA
Input Power	–	1.2	–	Watts

Measurement Inputs (2 kV Isolation) – ESD sensitive inputs				
Parameter	Minimum	Typical	Maximum	Unit
Oxygen Input	-2.0	–	2.0	VDC
Oxygen Input LSB size	–	13	–	μV
Oxygen Input Impedance		See over page		
Impedance measurement range	10	–	10^8	Ω
Temperature Input	-2.0	–	2.0	VDC
Temperature Input Impedance	–	10		MΩ
Temperature Input LSB	–	0.320		μV
Samples Per Second (data and display)	1	2	4	SPS
ADC Samples per second	–	300	–	SPS
Cold Junction Input	-1	–	1	VDC
Cold Junction Impedance	–	10	–	MΩ

Interface				
Parameter	Minimum	Typical	Maximum	Unit
Ethernet	10	100	1000	Mbps

Mechanical				
Parameter	Minimum	Typical	Maximum	Unit
Height	–	70	–	mm
Width	–	89.6	–	mm
Depth	–	31.25	–	mm
Weight	–	100	–	g
Material (top)	–	PC (UL 94 V-0)	–	
Material (bottom)	–	PPO (UL 94 V-0)	–	
Color (top)	–	Grey RAL 7035	–	
Mounting	–	DIN Rail	–	

- RoHS Compliant (product)
- DIN EN60715 TH35 (case)
- DIN VDE 0470-1 (case)
- DIN 43880 unit 1 (case)
- REACH Compliant (product)
- VBG 4 (case)
- IEC 529 (case)

Input impedances for the oxygen sensor input are shown below, for the given test current.

Impedance		
Test Current (A)	Measured Voltage (V)	Resistance (Ω)
1.00E-12	1.45	1.45E+12
2.00E-12	1.456	7.28E+11
3.00E-12	1.46	4.87E+11
4.00E-12	1.468	3.67E+11
5.00E-12	1.472	2.94E+11
6.00E-12	1.475	2.46E+11
7.00E-12	1.476	2.11E+11
1.00E-11	1.48	1.48E+11
2.00E-11	1.51	7.55E+10
3.00E-11	1.55	5.17E+10
4.00E-11	1.58	3.95E+10
5.00E-11	1.6	3.20E+10
6.00E-11	1.64	2.73E+10
7.00E-11	1.665	2.38E+10
8.00E-11	1.72	2.15E+10
9.00E-11	1.875	2.08E+10
1.00E-10	1.9	1.90E+10

4   Electrical Connections and Characteristics

J6 - Power Input		
Pin	Type	Description
1	Power	12 - 36 VDC
2	Power	Ground

J1 - Control signal inputs and outputs				
	Pin	Type	Description	Symbol
GND2	1	Power	Analog ground	GND2
	2	Output	Voltage or Current output	IV1
	3	Output	Voltage or Current output	IV2
	4	Power	Analog ground	GND2
GND1	5	Output	Pulse width modulator output	PWM
	6	Output	Cold junction 5 VDC supply	5V
	7	Input	Cold junction reference input	CJ
	8	Power	Analog ground	GND1
	9	Input	Thermocouple positive leg input	TP
	10	Input	Thermocouple negative leg input	TN
	11	Input	Positive oxygen sensor input	OP
	12	Input	Negative oxygen sensor input	ON

Thermocouples			
Type	Minimum	Maximum	Unit
B	250/482	1820/3308	°C/F
E	-200/-328	1000/1832	°C/F
J	-210/-346	1200/2192	°C/F
K	-200/-328	1372/2501.6	°C/F
N	-200/-328	1300/2372	°C/F
R	-50/-58	1768.1/3214.58	°C/F
S	-50/-58	1768.1/3214.58	°C/F
T	-200/-328	400/752	°C/F

J1 - Pin descriptions and use				
	Pin	Type	Description	Symbol
	1, 4	Power	Pins 1, and 4 are isolated grounds for IV1, and IV2. These grounds are specifically for the Current and Voltage ouputs, and are completely isolated from all other grounds.	GND2
GND2	2,3	Output	The Voltage or Current output 1 or 3 is a software configurable output, allowing the user to set current, voltage, and ranges. The outputs are set in concert with the user preferences for either the oxygen mV level, or the temperature. The user may configure the transfer function for: 1. Oxygen mV (or Nernst) to mA or V, positive or negative slope, and range; 2. Temperature to mA or V, positive or negative slope, and range.	IV1, IV2
GND1	5	Output	Pulse width modulator output – 5 V max output self driving, and isolated, referenced to GND1. Emitter follower output with 10KΩ pull down.	PWM
	6	Output	Cold junction 5 VDC supply	5V
	7	Input	Cold junction reference input. This input allows for the user to fit a range of different temperature sensors, that form the basis of the cold junction calculations. The recommended (and supplied) temperature sensor is manufactured by Texas Instruments, and is a precision centigrade temperature sensor. Offering an external temperature sensors allows the installer to select a local or remote (to the cabinet) temperature sensing option. The part supplied with the product as standard, is the LP TO-92 package. The terminals on the O2IO-2200 are designed to align with the LM35LP package. See Figure 1 for more information.	CJ
	8	Power	Analog ground	GND1
	9	Input	Thermocouple positive leg input (differential input – referenced to GND1)	TP
	10	Input	Thermocouple negative leg input (differential input – referenced to GND1)	TN
	11	Input	Positive oxygen sensor input (differential input – referenced to GND1)	OP
	12	Input	Negative oxygen sensor input (differential input – referenced to GND1)	ON

O2IO-2200		LM35 Pin	
Pin	Description	Pin	Description
6	5VDC	1	+Vs
7	CJ	2	Vout
8	GND1	3	GND

Figure 1: Connecting the LM35 part to the O2IO-2200 (TO-92 Package only)

5   Configuration

The following O2IO-2200 configuration options via the Utility are available to the user:

Configuration	
Input	Response
Oxygen mV	4 – 20 mA
	0 - 24 mA
	20 – 4 mA
	24 - 0 mA
	0 – 5 VDC
	5 – 0 VDC
	0 – 10 VDC
	10 – 0 VDC
Temperature °C	4 – 20 mA
	0 - 24 mA
	20 – 4 mA
	24 - 0 mA
	0 – 5 VDC
	5 – 0 VDC
	0 – 10 VDC
	10 – 0 VDC

By inverting the phase on any one of the two outputs in a control system, the user may apply the controller as a component in a negative feedback loop.

6 Connectivity

The O_2 concentration can be monitored and controlled via the desktop application over a network connection, when the O2IO-2200 is connected via ethernet to an appropriate router, and is on the same subnet. Monitoring and control via portable devices like phones or tablets is available as standard with a WiFi router, on the same subnet.

7 Typical installation

Below is an example of a PID controller for a heated probe. This configuration controls the temperature and can provide a current or voltage to a secondary control apparatus.

Below is an example of an O_2 controller providing a current source to control oxygen concentration.
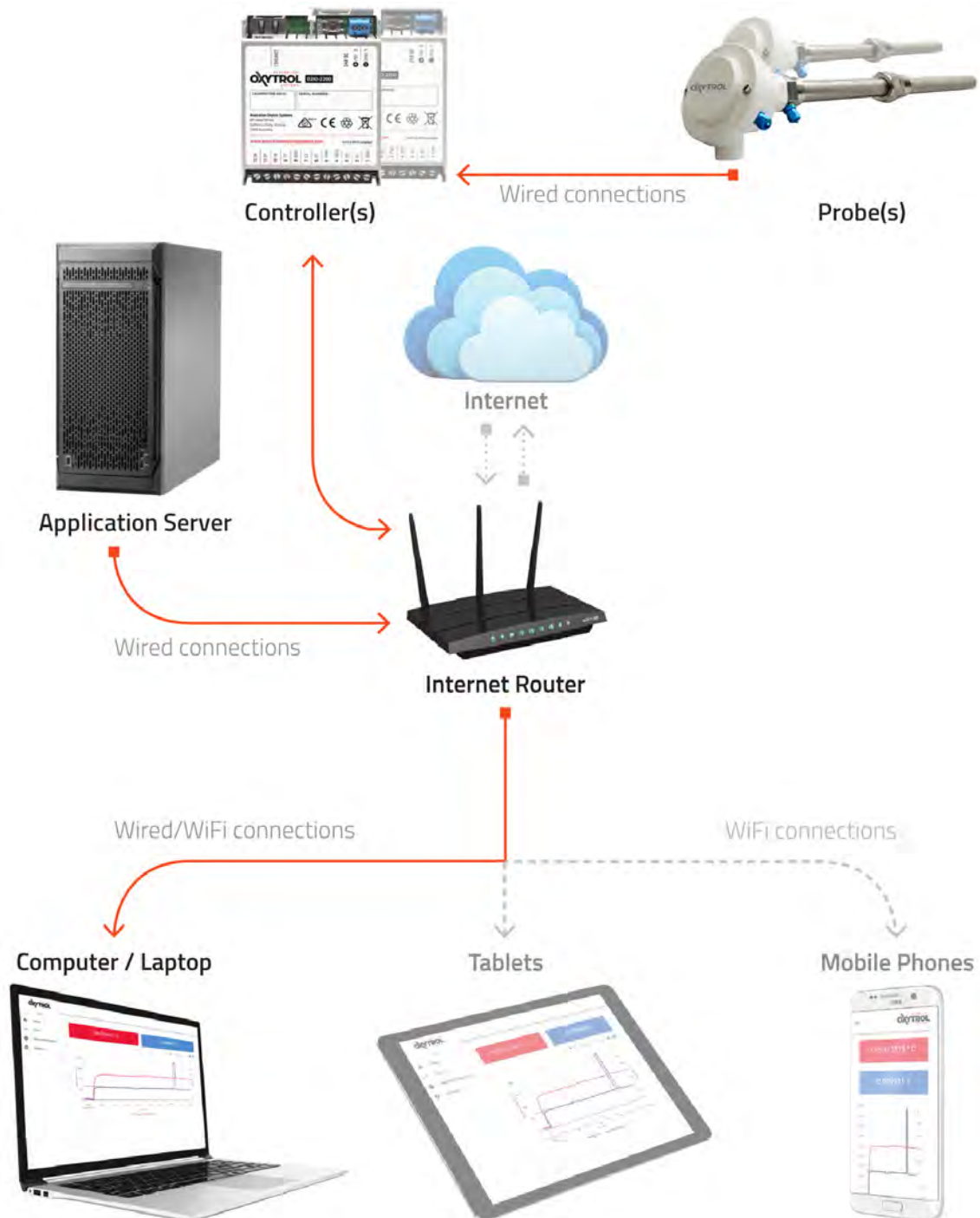
8   Mechanical
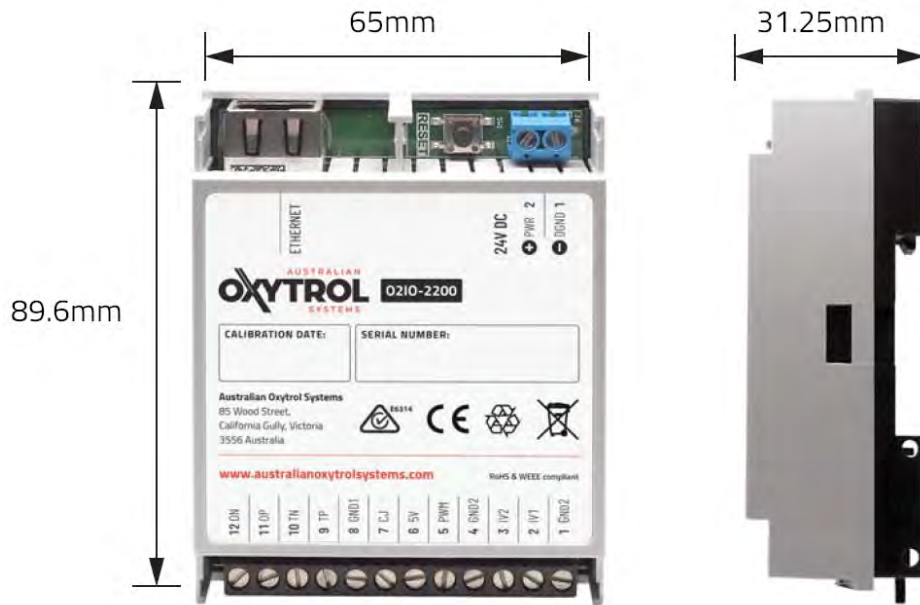
O2IO-2200 Connection Utility

9   Software Installation

To access the O2IO-2200, the Connection Utility must be installed. It can be downloaded as a zip file for installation from https://www.australianoxytrolsystems.com. Access to the O2IO-2200 is via a web browser. To configure the O2IO-2200, or monitor the oxygen sensor or thermocouple, a network connection must exist between the controller and a personal computer or server running the Server/Utility software, on the same subnet. The Server/Utility software can be installed on a server or personal computer that acts as the data server. There are two components to the Utility, one being a data service (Server) that runs in the background, and the other, a web browser interface. The Server/Uility can run on a personal computer, server or laptop connected to the same subnet as the O2IO-2200 devices.

In the event the user decides to install the Server/Utility software onto a server, for optimal use, a DNS can be setup that links a name to the machine IP address the server is running on. In our installation we have used http://o2io-2200 as the URL for the connected devices on the same subnet.

A server supporting VPN access, will allow external users to browser the O2IO-2200 connected devices. Similarly, any computer connected to that server inside the firewall can access connected devices, either by the server IP address and port number, or URL.

The Utility allows the device to be configured with persistent settings for one off configuration. These settings will be remembered by the device when powered down. Once configured, the device can be used in a stand alone mode, without a network connection.

9.1   Steps for Getting Started

The steps detailed below provide for the minimum requirements to power up the controller, and configure. The steps do not provide any electrical and or engineering guidelines for use with third party equipment. Configuration, and wiring must only be performed by a qualified engineer or technician.

1. Download and install Utillity

2. Ensure computer is connected to a network switch

3. Ensure the O2IO-2200 is connected to the same network switch (same subnet)

4. Ensure power is connected to the O2IO-2200 - 24 VDC

5. Ensure LM35 is fitted - (comes complete with factory fitted component)

6. Using the Utility, connect and configure the selected (MAC Address) device

9.2   Installation of connection Utility

To install the O2IO Utility, visit the Australian Oxytrol Systems web site, and download the O2IO-2200 controller Utilitiy program. Install the O2IO-2200 Utility and background server application.
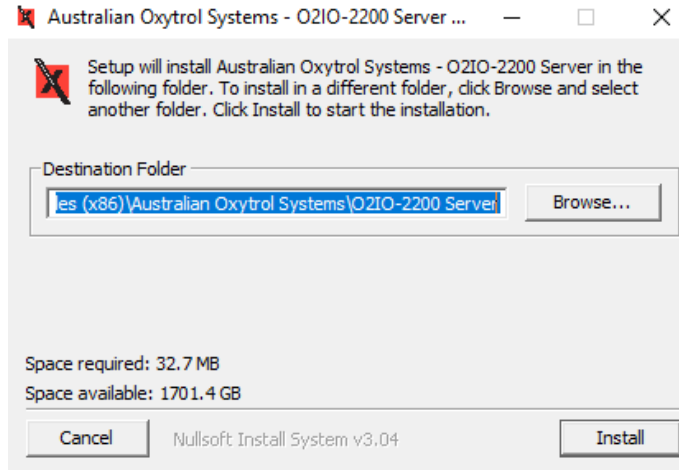

10   Configuration and use

10.1   Startup

Once the Utility application installer has been downloaded, and installed, double click on the desktop Icon or the O2IO-2200 server process in the start menu to start the software. On initialising, the background server application a server message window will open, shown below.
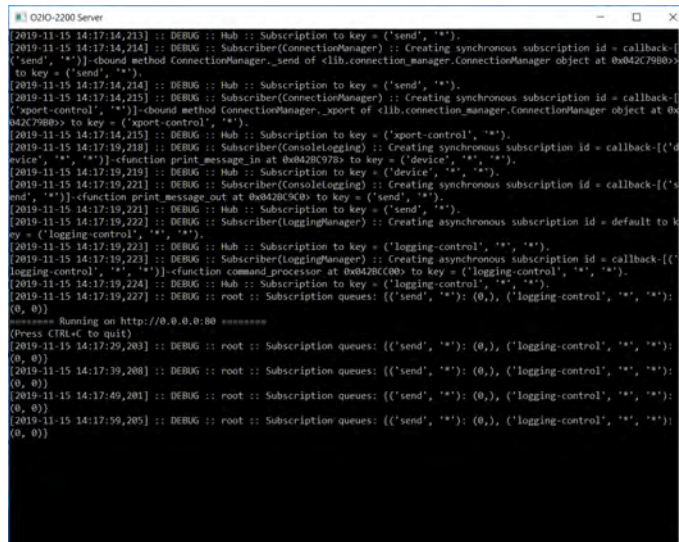
Once the background server has started, a windows browser will open, shown below. Bookmark the IP address and port number for ease of return to later, if a DNS with a selected name for the URL has not been set up.
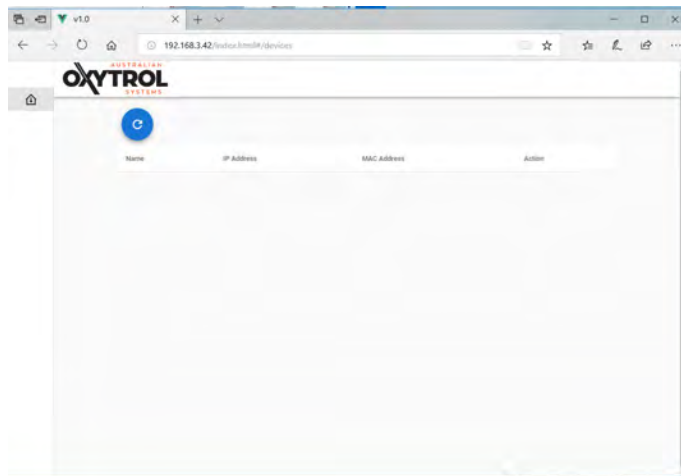
If the following is seen on the browser, refresh the window.
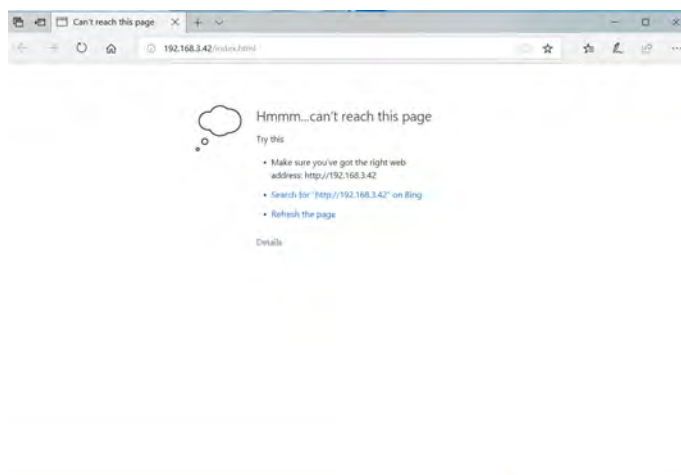

The browser will then show the correct view, allowing you commence configuring and monitoring the connected controllers.
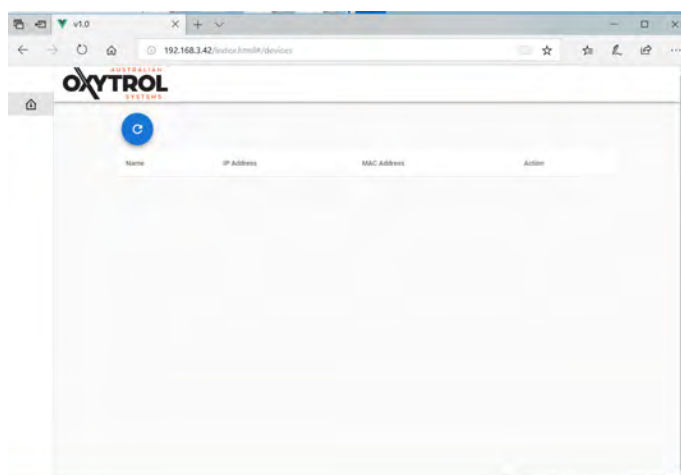
Upon starting, the Utility will open a web browser window and searches for devices on the network.

Please ensure the computer or server running the Utility is on the same subnet as the controllers. Found devices are listed. Press the connect button to connect to a device. The interface automatically navigates to the Live Data display.
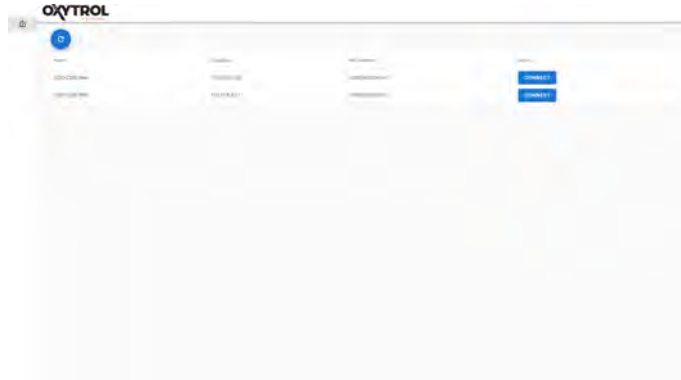

Below is an example of live data from one of the connected devices. To view a second device, visit the same URL in a new browser window, select the device and view live data.

10.2 General

All configuration settings for the O2IO-2200 are accessed through the settings menu. The settings menu will expand upon selection. For easy identification of devices, the user may name them. To name a device, select the device, and navigate to the general settings menu, click on General. Once a name has been entered for the device, press the save button.
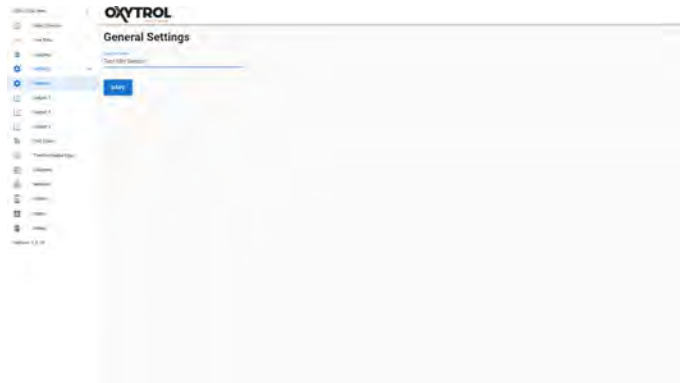
This device now has an easily identifiable name.

10.3 Outputs 1 and 2

Outputs 1 and 2 can be configred to have a single input, either temperature or oxygen mV. Or, both outputs are mapped individually to the oxygen mV and temperature inputs. Outputs 1 and 2 are used to translate their respecitve inputs to either current or voltage outputs. Transfer functions from inputs to outputs are configurable for current or voltage.

The transfer function can be set as a linear output with respect to the input, a logistics s-curve, or provide a threshold output, for high or low.

To configure either Output 1 or Output 2, click on the Output menu entry (Output 1 and Output 2 have identical configuration interfaces). The transfer function table and graph update immediately with parameter changes, but changes are applied to the device when the save button is clicked. The output interface configures the output proportional to an input signal with a configurable transfer function.

For ease of understanding the transfer function behaviour, a table of values and graph is provided to the user.

In the example below, Output 1 is configured to provide a transfer or translation function of the oxygen mV signal from 0 - 2000 mV translating to 0 - 2000 mV. The example also introduces use of the s-curve for smoother or softer upper and lower transition limits.

1. Click the 'Enable Output' checkbox.

2. Click on Input type and select O2(mV).

3. Enter 0 in the 'Low' field.

4. Enter 2000 in the 'High' field.

5. Click on 'Output type' and select 0 – 5000mV.

6. Enter 0 in the 'Low' field.

7. Enter 2000 in the 'High' field.

8. Set the 'Enable Output Curve Coefficients' checkbox to unchecked.

9. Click the save button.

The output will be enabled and will output a Voltage linearly proportional to the mV signal of the oxygen sensor.
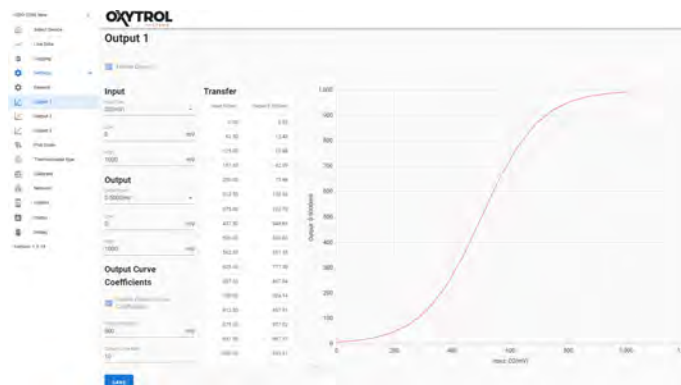
To configure a curved transfer function:

1. With the output configured per the above instructions, enable the output curve coefficients by setting the 'Enable Output Curve Coefficients' checkbox to checked.

2. Set the high field of the output to 2000 mV.

3. The Output Mid-point will be pre-populated with the mid-point between the output high and low settings.

4. Set the Output Curve Rate to 10.

10.4   Output 3

Output 3 configures a PWM output with a PID controller, with a temperature control variable.

1. Set the Enable Output checkbox to checked.

2. Set the Temperature set point to the desired temperature.

3. Set the Kp, Ki, and Kd gain values for the PID controller. These values are highly application and context specific.

4. Set the PWM minimum and maximum values.

5. Click Save to apply the changes to the device.

10.5   Plot Scale

 The Plot window selectors allow the user to set their preferences for viewing the data.

Once the maximum time is reached the time window will scroll. Data rate sets the period of data points. The Temperature and Oxygen scale settings, set the units to be used for the vertical axes, supporting fixed or auto scaling ranges.
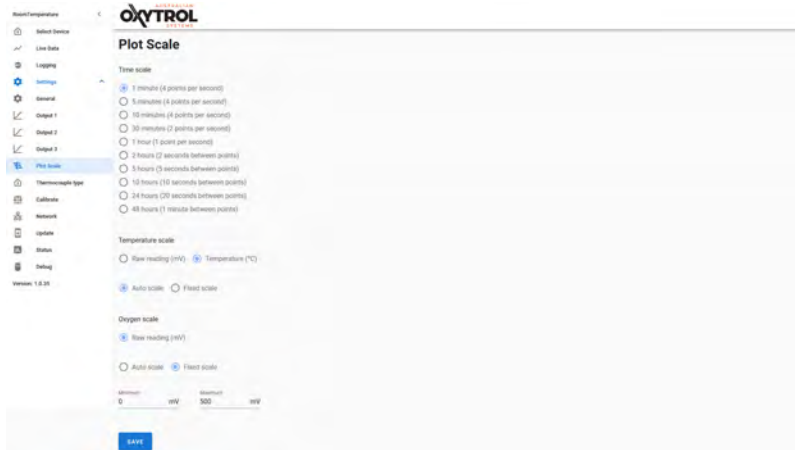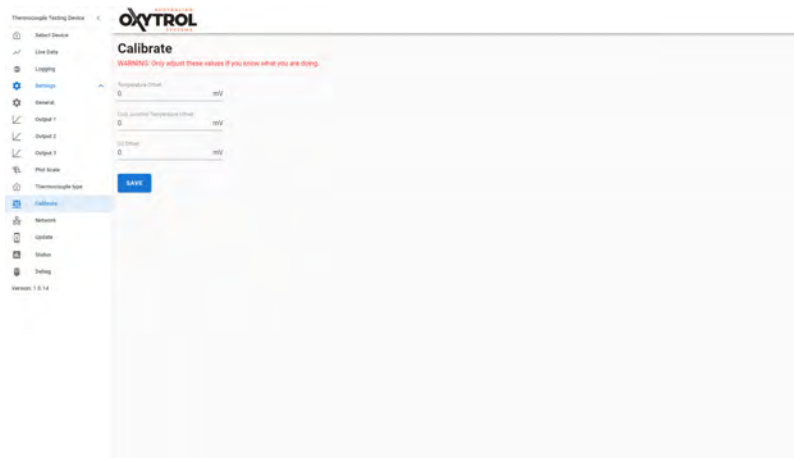

10.6   Thermocouple Type

Select the appropriate thermocouple type according to the type of thermocouple that is connected to the device, and click the save button.
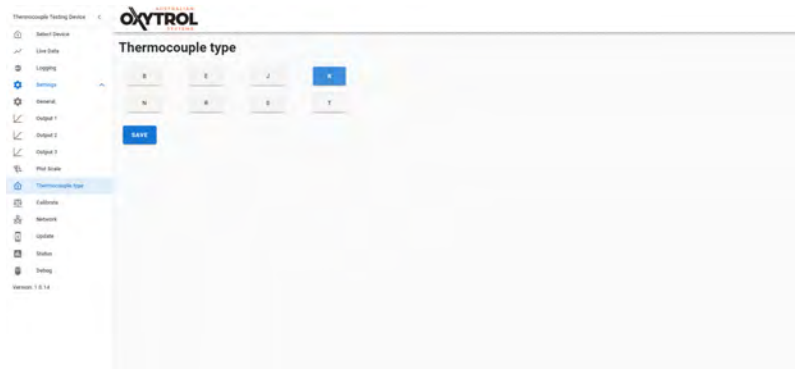
10.7   Calibrate

The input fields in the calibration interface configure an offset voltage that is applied to the thermo-couple, cold junction compensation, and oxygen sensor measurements.

10.8   Network

The O2IO-2200 is configured by default to use DHCP for automatic network address configuration. If a DHCP server is unavailable, or if static IP address allocation is required for some reason, the network address of the device can be configured manually. Note that for initial configuration the device will need a DHCP IP address lease in order to connect to the device the first time and configure it from the web interface.

CAUTION: any user that can connect to the devices through the connection utility has access to change the configuration of the device with potentially adverse effects. The devices are accessible by design with the expectation that network layer security will control authorised access. It is the responsibility of the administrator of the network to which the device is connected to control authorised access to the devices.
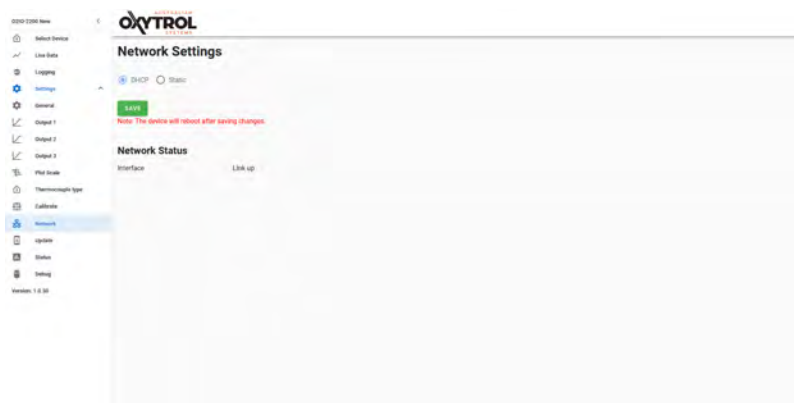
10.9   Update

10.10   Status

The Status function reports the following:

- Oxygen sensor voltage
- Oxygen sensor Impedance
- Temperature sensor burn out voltage
- Cold junction burnout voltage
- Analog voltage
- External reference voltage
- ADC temperature sensor offset
- Cold junction temperature offset
- Oxygen sensor offset

Click the Run Impedance Measurement button to trigger a new measurement. The results are updated asynchronously when the measurements complete.
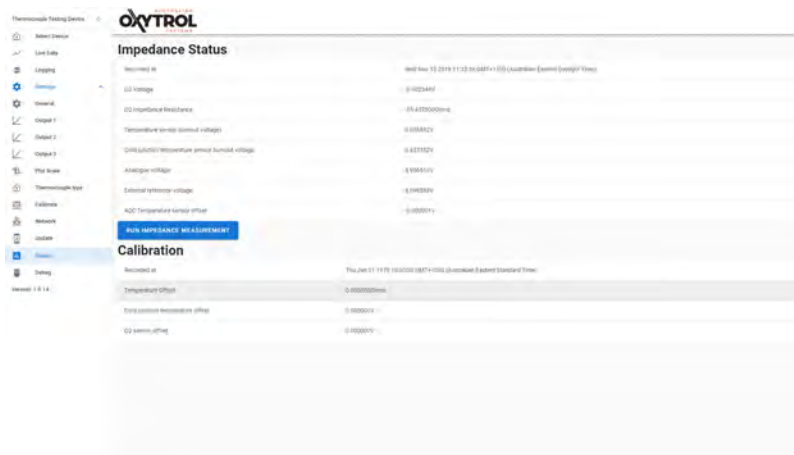
10.11   Debug - Factory use only
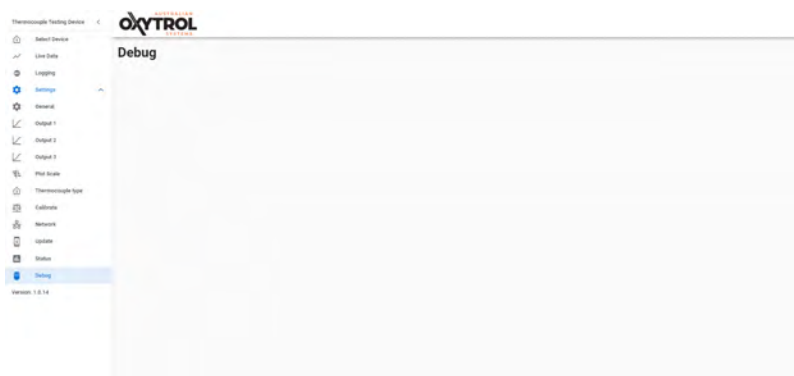
10.12   Version Number

The version number of the connection utility and web interface is displayed below the settings menu.

11   Ordering information

To order an AOS O2IO-2200, please contact Australian Oxytrol Systems via the details listed below. We also offer a variety of oxygen probes, all compatible with the O2IO-2200 controller and O2TA-2200 oxygen analyzer.

12   Contact information

Australian Oxytrol Systems Pty Ltd
85 Wood Street
California Gully VIC 3556
Australia

P   + 61 3 5446 1530
F   + 61 3 5446 1215
W   www.australianoxytrolsystems.com
E   info@australianoxytrolsystems.com

13   Australian Oxytrol Systems Pty Ltd one (1) year limited warranty

13.1   Introduction

This is a limited warranty from Australian Oxytrol Systems Pty Ltd (as warrantor) that gives you specific legal rights.

You may also have other rights under specific consumer protection laws and regulations – if any (referred to in this warranty as "law") of the country, state or province in which the Product was purchased ("your jurisdiction"). This warranty is governed by and subject to law and is not intended to and does not exclude, limit or suspend any rights you have under law. Some or all of the limitations or exclusions described below may not apply to you.

For the purposes of this warranty –

AOS means Australian Oxytrol Systems Pty Ltd (Australian Business Number 59 007 371 824).

Product means any AOS – branded hardware product manufactured by or for AOS and identified by the AOS trademark, trade name, or logo affixed to it.

You means the original end-user and retail purchaser of a AOS Product.

AOS reserves the right to make changes at any time to:

1. Product hardware and software components and specifications; and
2. Terms and conditions governing Product use, service and repair; and
3. AOS services.

Such changes are entirely at AOS's discretion and may involve modification, upgrade, enhancement, replacement, deletion or abandonment.

13.2   Specific Warranty obligations

AOS warrants that its Product is free from defects in materials and workmanship under normal use for a period of one (1) year from the date of your purchase (the "Warranty Period"). Subject to law and the conditions set out below, if a Product is defective, AOS will decide whether to:

1. Repair the Product at no charge, using new parts or parts that are equivalent to the new in performance or reliability; or
2. Exchange the Product with either a new product or one that is equivalent to new in performance, reliability and functionality; or
3. Refund the purchase price of the product,

provided that your claim is made in accordance with this warranty and is received by AOS within the warranty period.

A replacement product or part assumes the remaining warranty of the original Product or ninety (90) days from the date of replacement or repair, whichever provides you with the longer coverage.

When a Product or part of a Product is exchanged, any replacement items become your property and the replaced item becomes AOS's property. Parts provided by AOS in fulfillment of its warranty obligation must only be used in the Product for which warranty service is claimed.

If AOS agrees to refund the purchase price of a Product, the refund can only be paid after you have returned that Product to AOS. All returned Products become AOS's property.

AOS does not make any representation that it will be able to repair or exchange any Product without loss of or corruption to programs and data.

13.3   Warranty exclusions and limitations

This limited warranty applied only to AOS Products and does not apply to any non–AOS hardware product or any software, even if packaged and sold with a AOS product. Manufacturers, suppliers, or publishers, other than AOS, may provide their own warranties to you, but AOS, in so far as permitted by law, provides itself "as is".

AOS Limited Warranty

Software (including system software) and hardware distributed by AOS with or without the AOS brand name is not covered under this warranty. Refer to the licensing agreement accompanying such software for details of your rights and obligations concerning its use.

AOS is not responsible for damage arising from failure to properly follow instructions relating to the Product's use.

This warranty does not apply to:

1. consumable parts, such as batteries, unless damage has occurred due to a defect in materials or workmanship; or
2. cosmetic damage, including but not limited to scratches, dents, and worn material on ports; or
3. damage caused by use with non-AOS products; or
4. damage caused by accident, abuse, misuse, or external causes (such as earthquake, fire or flood); or
5. damage caused by operating the product outside the permitted or intended uses described by AOS; or
6. damage caused by service (including upgrades and expansions) performed by anyone who is not a representative of AOS or a AOS authorised service provider; or
7. modifications by someone else other than AOS to alter Product functionality or capability without AOS's written approval; or
8. any AOS Product where its serial number has been removed or defaced.

13.4   Important!

Opening a hardware Product may cause damage; such damage is not covered by this warranty. Only AOS or an authorised service provider should open and perform Product service.

To the extent permitted by law:
(1) this warranty and your rights under it are exclusive and are in lieu of any other oral, written, statutory, express or implied warranties, remedies and conditions; and
(2) AOS disclaims all other warranties, including but not limited to warranties of merchantability and fitness for a particular purpose and warranties against hidden or latent defects.

If AOS cannot lawfully disclaim statutory or implied warranties then, to the extent permitted by law, all such warranties will be limited in the duration of the express warranty and to the repair or replacement service or refund as determined by AOS in its absolute discretion.

No AOS reseller, agent, or employee is authorised to make any amendment, extension, or addition to this warranty.

If any term or condition of this warranty is held to be illegal or unenforceable, the legality of the enforceability of the remaining terms and conditions will not be affected or impaired.

Except as provided in this warranty and to the maximum extent permitted by law, AOS is not responsible for direct, special, incidental or consequential damages resulting from any breach of the warranty or condition, or under any clause, category of head of claim, including but not limited to loss of use; loss of revenue; loss of actual or anticipated profits (including loss of profits on contracts); goodwill; loss of reputation; loss of damage to or corruption of data; any or indirect or consequential loss or damage howsoever caused including the replacement of equipment and property, and costs of recovering, programming or reproducing any program or data stored in or used with the AOS Product and any failure to maintain the confidentiality of data stored on the AOS product.

AOS does not authorise use of and reliance on any AOS Product in safety critical situations, where the failure of AOS Product or its compromised performance or interrupted operation could cause or contribute to personal injury or death ("potentially life threatening situations" or "PLTS"). For the avoidance of doubt out of the arising use or misuse and operation of any of its Products in such circumstances.

AOS may be prepared to assist you to undertake a risk management assessment and prepare a protocol for your use of AOS Products in the context of the PLTS, but always on the basis that all such use (including misuse) remains entirely at your risk.

It is your responsibility to identify and comply with the law governing your use of the Product applicable in each jurisdiction in which the Product is to be used.

13.5   Obtaining Warranty Service

Before seeking warranty service, please first refer to AOS's online help resources identified in the Product documentation.

If the product is still not functioning properly, you should contact the AOS representatives or, if applicable, a AOS retail store, distributor or authorised service provider.

AOS will determine whether the Product requires service, and if so, AOS will advise you how, where and by whom the service will be performed.

It is important that you assist AOS to diagnose issues with your Product and that you follow AOS's warranty processes.

Service options, parts availability and response times vary according to the place in which service is requested. Please note that service options are subject to review and change by AOS at any time and AOS may restrict service to be performed in the place at which the Product was originally sold.

Upon receipt of the replacement Product or part, the original Product or part becomes the property of AOS and you agree to properly follow instructions, including if required, arranging the return of the original Product or part to AOS in a timely manner.

When providing service requiring the return of the original Product or part, AOS may require a credit card authorisation as security for the retail price of the replacement Product or part and applicable shipping costs. If you follow AOS's instructions, AOS will cancel the credit card authorisation, and you will not be charged for the Product or part and shipping costs. If you fail to return the replaced Product or part as instructed, AOS will charge your credit card for the authorised amount.

If you seek service in a country that is not the country of original purchase, you must comply with the relevant export requirements and be responsible for the payment of all duties, taxes, levies, fees and other charges including shipping and handling costs.

Where international service is available, AOS may repair or exchange defective Products and parts with comparable Products or parts that comply with local law.

AOS may require you provide proof of purchase details and or comply with registration or other requirements before providing warranty service,

AOS will collect, maintain and use your information in accordance with AOS's privacy policy.