Kele K-02

Oxygen Ventilation and Alarm Controller

User's Manual

Kele, Inc. • 3300 Brother Blvd. • Memphis, TN 38133
Revision: 1/29/2021

TABLE OF CONTENTS

OS-2 Oxygen Sensor

1 SPECIFICATIONS

Mechanical	
Chassis Construction	Industrial strength, 18 Ga. Gray powder-coated steel. Pad-lockable, hinged or screw-on cover style available.
Weight	2.0 Lbs
Operating Temperature	-20 to 50°C
Operating Humidity	15 – 90 %RH
Storage Temperature	-20 to 20°C (to minimize sensor degradation)
Case Dimensions (H x W x D)	6.4" x 5.9" x 2.4" (163.5 x 150.8 x 60.7 mm)
Sensor Vents	Natural ventilation through 18, 0.1" (2.54 mm) diameter vents
External Indicators	Tri-color LED indicates operational status of sensor.
Knockouts	4 trade ½" knockouts (1 per side)

TABLE 1: MECHANICAL SPECIFICATIONS

Electrical	
Operating Power Voltage	14 – 30 VAC (RMS) or DC Isolated power supply; separate transformer not required.
Power Consumption	< 5W
Control Relays	2 Separate SPDT line-voltage-capable relays for warning/ventilation and alarm outputs. 10 Amps max at 120/277 VAC (RMS) or 30 VDC.
Concentration Reporting Output	Isolated, powered 4 – 20 mA current loop output. 4 mA output => 0 % concentration. 20 mA => 25% Maximum loop resistance: 510Ω
Termination	Pluggable screw-terminals for use with 12 AWG or thinner wire

TABLE 2: ELECTRICAL SPECIFICATIONS

Oxygen Sensor (O2)	
Sensor Type	Galvanic cell
Measurement Range	0 – 25%
Analog Output Range	4mA to 20mA (corresponds to 0 to 25%)
Accuracy	±0.2% (Typical)
Calibration Interval	6 Months
Sensor Life	2 Year (Typical)[1]
Calibrated Field-Replaceable Sensor	KMOD-O2
Calibration Kit	UCK-3 kit

TABLE 3: OXYGEN SENSOR SPECIFICATIONS

[1] Exposure to harsh ambient environmental conditions may shorten sensor life.

2 MECHANICAL INSTALLATION

The Model K-O2 is available in two versions of an industrial-strength, 18 Gauge, gray, powder-coated steel enclosure. The removable, pad-lockable, hinged-cover version is shown in Figure 1 and the screw-down cover version is shown in Figure 2. All electronics are attached to the front cover. There are trade ½" conduit knock-outs on all sides for electrical connections. In potentially damp locations the knock-out on the bottom of the case should be used to minimize the possibility of water entry. **DO NOT USE THE VENT HOLES FOR WIRE ENTRY.**

1. This unit is designed to mount to a rigid, vibration-free surface near the middle of the area to be monitored about 5 feet above the floor.
2. It should be located where there is free airflow - avoid corners or recesses.
3. The air vents on the sides of the enclosure should not be closer than 1 foot from the nearest perpendicular wall and must not be obstructed or painted-over.
4. May be mounted in any orientation but hinge on the left side is most common.
5. Mounting holes are made for direct wall screws for the surface encountered. (Mounting screws not provided) or switch box spacing.

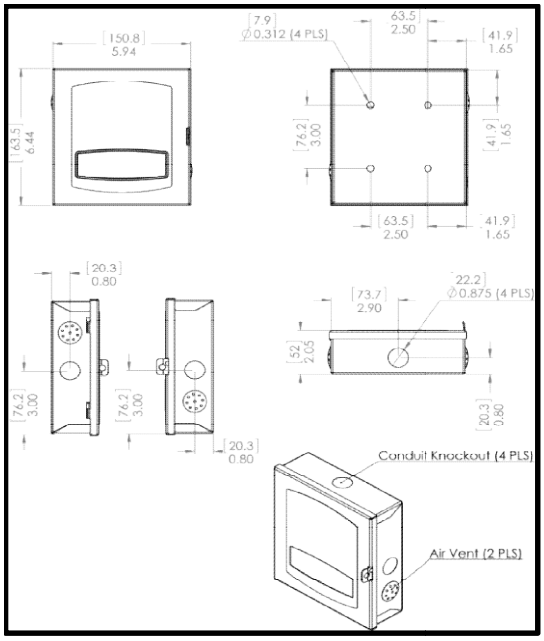


FIGURE 1: HINGED FRONT PANEL ENCLOSURE DIMENSIONS

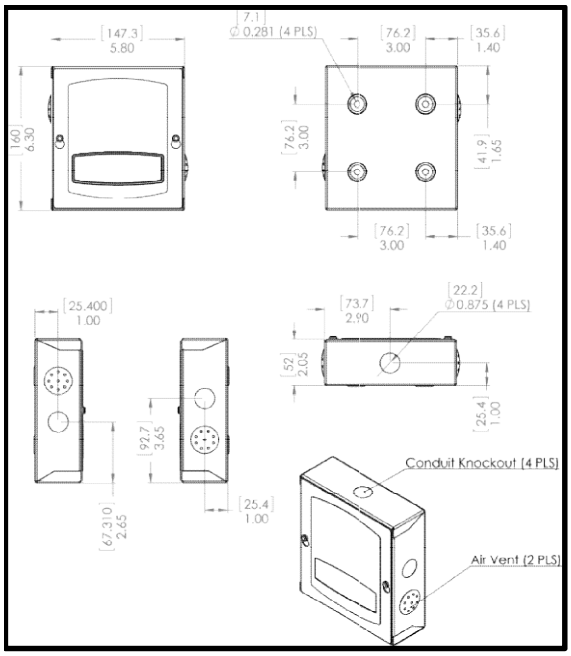


Figure 2: Screw-Down Front Panel Enclosure Dimensions

2.1 ENCLOSURE DIMENSIONS

		Distance from center	
Case Style	**Mtg hole diameter**	**Horizontal**	**Vertical**
Hinged	5/16" (7.94 mm)	1.25" (31.75 mm)	1.50" (38.10 mm)
Screw-down	9/32" (7.14 mm)	1.50" (38.10 mm)	1.50" (38.10 mm)

Table 4: Mounting Hole Diameters & Locations

3 ELECTRICAL INSTALLATION

The controller is not equipped with a power switch; it is operational whenever sufficient power is applied to the power input terminals.

All electrical connections to the controller are made through screw terminals that can be unplugged for easy landing of wires. The controller's enclosure contains conduit knockouts on all sides for flexibility during installation; refer to Figure 1 and **Figure 2** for details and dimensions of the enclosures.

3.1 ANALOG OUTPUT CONNECTIONS

The sensor's readings are reported at the controller's powered 4-20mA analog output connections. Current flows out of the '+' terminal and returns to the '-' terminal.

The oxygen sensor output is provided at the terminal highlighted in Figure 3. Analog output connection has polarity as labeled on the controller silkscreen: care must be taken to ensure proper connection. To wire the analog output connections:

1. Power down the controller, this can be done by unplugging the controller power terminal (see Figure 6).
2. Unplug the analog output screw terminal labeled O1.
3. Attach the signal wires, paying close attention to the polarity.
4. Plug the analog output screw terminal back into the controller.

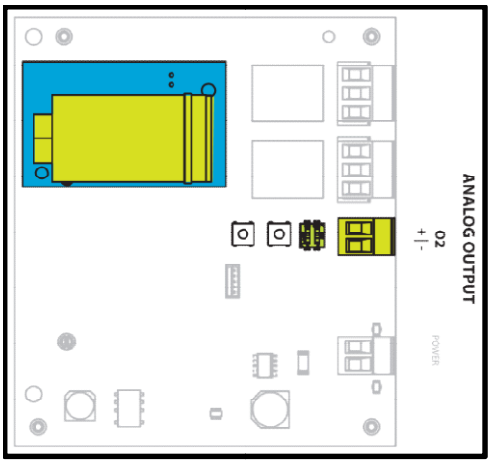


FIGURE 3: Analog Output

3.2 RELAY CONNECTIONS

The controller has two, 10 Amp, 120/277 VAC rated, SPDT dry-contact relay output connections (shown In **Figure 4**) that can directly control loads up to 10 Amps. The relay connections have three-terminal screw connectors that allow devices to be wired to the controller in either normally-open (*NO*) or normally-closed (*NC*) configuration. These outputs are activated when ambient air oxygen concentrations fall below the controller threshold settings (refer to *Section 4.2* for more information).

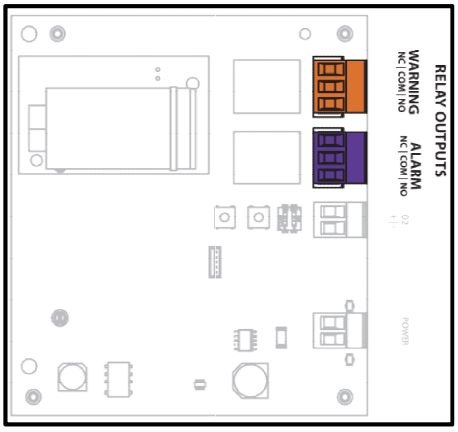


Figure 4: Relay Outputs

In the *NO Configuration*, the voltage attached to the *NO* terminal will be present at the *COM* terminal **only when the relay output is activated.**

In the *NC Configuration*, the voltage attached to the *NC* terminal will be present at the *COM* terminal **only while the relay output is deactivated:** the voltage attached to the NC terminal is removed when the relay output is activated.

Example wiring diagrams for relay connection are provided in Figure 5. To wire the *Warning/ventilation* and *Alarm* relay outputs:

1. Determine if the device being attached to the relay output should be wired in NO or NC configuration.
2. Unplug the relay output screw terminal.
3. Connect a supply voltage for the device being attached to the controller's relay output to either the *NO* or *NC* location of the screw terminal (see Figure 4).
4. Wire the power input of the device being attached to the controller's relay output to the *COM* location of screw terminal.
5. Plug the relay output screw terminal back into the correct location on controller board.

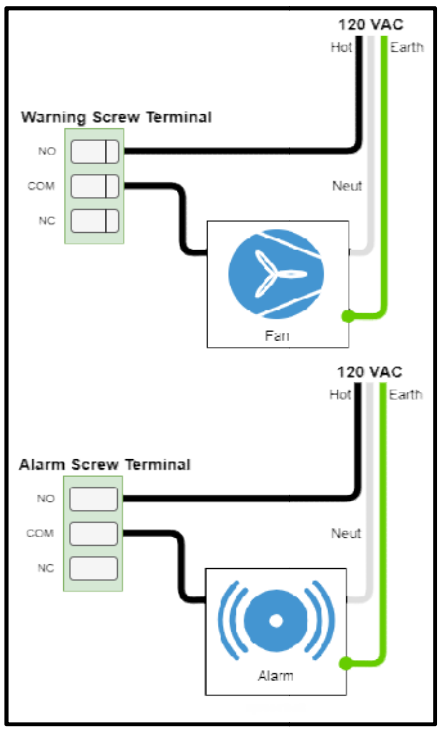


FIGURE 5: Example Wiring Diagram for Normally Open Operation

3.3 Power Connection

The K-O2 has a fully isolated, unpolarized power input; either AC or DC operating power can be connected in either polarity. Multiple K-O2 units can operate on the same transformer (up to its load limit) even when they are not connected with the same positive/negative or hot/common polarity.

Power connection to the controller is made at the two-terminal screw connector located at the bottom-right side of the board (highlighted in Figure 6). Power to the controller can be either AC or DC voltage; DC voltage can be connected in either polarity (see *Section 1.0* for more details). To wire power:

1. Open the controller's enclosure and unplug the screw terminal labeled *POWER* on the controller board.
2. Attach power wires to the screw terminal ensuring the connection is snug.
3. Plug the screw terminal back into the *POWER* receptacle on the controller board: this will cause the controller to power up and begin operation.

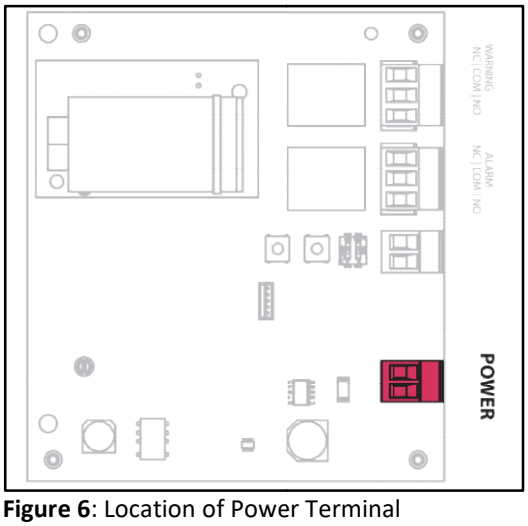


Figure 6: Location of Power Terminal

It is recommended that all wired connections are made prior to providing power to the controller.

4 OPERATIONAL DESCRIPTION

The K-O2 is a ventilation and alarm controller that senses the oxygen concentration in the ambient space around it and operates a Warning/Ventilation contact closure that can be used to operate ventilation fans when reduced levels of oxygen are detected. If the oxygen concentration approaches unsafe levels, a second set of alarm contacts is operated to trigger an alarm.

The gas sensor is a calibrated module that can be replaced with minimal effort when it reaches end-of-life (EOL), while leaving the main control mounted and wired (refer to *Section 7.1*).

The front cover has an LED status indicator that illuminates in different colors to indicate normal (green), Warning/Ventilation (yellow), and Alarm (red) conditions. Blinking red indicates that the sensor is NOT operational. While the LED is blinking red, the analog output is delivering 4 mA to indicate the error.

The concentration of oxygen in the ambient air is reported at the controller's analog current-loop output as percent by volume. The analog output ranges from 5 to 20mA (refer to Table 2 and Table 3).

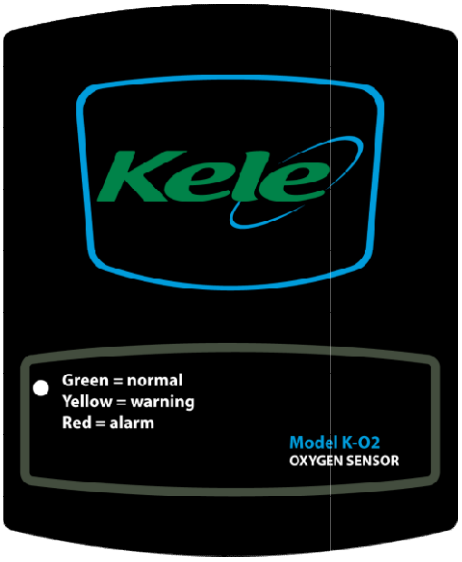


FIGURE 7: FRONT COVER STATUS LED

Status LED Color	Operational Status Description
GREEN	Concentration is above the warning/ventilation threshold. **No relay outputs are active.**
YELLOW	Concentration is below the warning/ventilation threshold and above the alarm threshold. **Warning/ventilation relay is active.**
RED	Concentration is below the alarm threshold. **Both warning/ventilation and alarm relays are active**.
BLINKING YELLOW	End of Life warning. Sensor has reached the end of its rated service life and should be replaced. **Relays and analog outputs continue to function normally.**
BLINKING RED	Sensor Failure. **Warning/ventilation relay is active and analog output is 4 mA.** (refer to Section 7)

Table 5: Front panel status LED Indications during normal operation..

4.1 SPECIAL MODES

The K-O2 operates in several modes as shown in Table 7. Normal operation is as described above. During standby mode the sensor is stabilizing and analog output is held at 20 mA.

During span calibration the sensor's sensitivity is compared to its sensitivity at initial factory calibration. If its sensitivity has fallen below manufacturer's specification the K-O2 goes into Sensor Expired mode with the analog output held at 4 mA and only the Warning/Ventilation relay activated.

Mode	Front Cover LED	Analog Output	Relays Actuated	Comment
Normal	Steady Green, Yellow or Red	4 – 20 mA	Depends on concentration	During normal operation
Standby	Various	20 mA	NONE	During start-up interval or any time during calibration
EOL warning	Slow Blinking Yellow	4 – 20 mA	Depends on concentration	Sensor nearing the end of its rated service life. Relays and analog output function normally.
Sensor Expired	Slow Blinking Red	4 mA	Warning/Ventilation	After calibration of expired sensor. Sensor is no longer operational.

TABLE 7: K-O2 OPERATING MODES

	O_2
Federal OSHA Personal Exposure Limit (PEL) .	≥ 19.5 %

4.2 Warning /Ventilation and Alarm Conditions

Two, 10 Amp, 120/277 VAC rated, dry-contact, SPDT relays activate during warning/ventilation and alarm conditions: refer to *Section 3.2* for wiring information.

When the concentration of oxygen falls below its configured warning/ventilation threshold, the ***WARNING/VENTILATION*** relay output is activated. When the concentration falls below the alarm threshold, the controller's ***ALARM*** relay is also activated. When the oxygen concentration rises above the alarm threshold, the **ALARM** relay is deactivated; when it rises above the ventilation threshold the **WARNING/VENTILATION** relay is also deactivated.

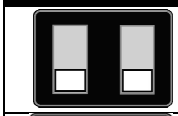
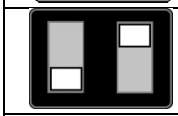
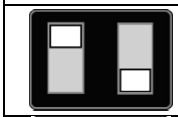
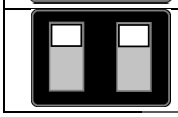
Dip switch Setting	OXYGEN %	
	Warn	Alarm
	20.5	20.0
	20.3	20.0
	20.0	19.5
	19.8	19.5

Table 6: Concentration Threshold Settings.

4.3 Setting Ventilation and Alarm Thresholds

The four, factory-preset pairs of ventilation and alarm levels are shown in Table 6. Each setting determines both the controller's warning/ventilation and alarm thresholds.

The active threshold values are selected by setting the two DIP switches on the main board (highlighted in Figure 8) as shown in the first column of Table 6 for the desired setting.

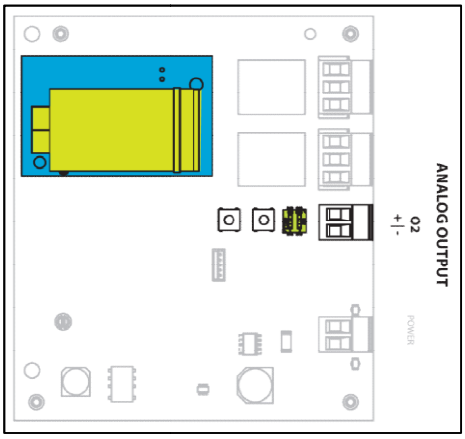


Figure 8: DIP Switch Locations.

4.4 Concentration Reporting

In normal mode, oxygen concentration readings from the sensor are reported by the controller's powered 4 – 20mA current loop output. The output connector location is shown in Figure 3. Output scaling is as shown in Table 3.

5 Sensor Calibration

The sensor requires calibration at the specified calibration interval listed in Table 3 to ensure its accuracy is maintained over its life. Calibration is a two-step process that provides the sensor module with oxygen-free (or zero) gas, and then a specific concentration (or span) gas. Two calibration buttons (*ZERO* and *SPAN*) are provided on the main board as shown in Figure 9.

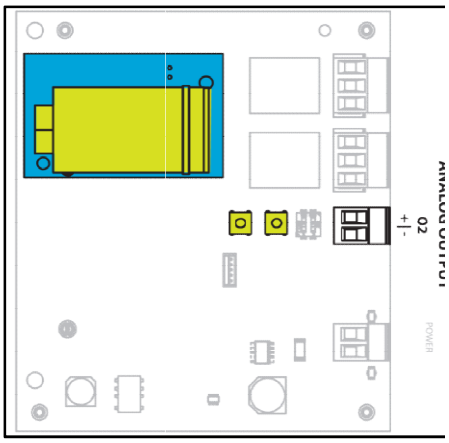


FIGURE 9: Location of SPAN & ZERO Controls

Blinking Yellow	During gas sampling period that starts immediately when calibration is initiated.
Blinking Green	Temporary calibration applied. Waiting for user to confirm or reject the temporary calibration.
Blinking Red	Failed calibration attempt. Waiting for user to acknowledge with either a re-try or and exit.
Green/Yellow	During ambient equilibration period after successful calibration. **New calibration is applied.**
Red/Yellow	During ambient equilibration period after failed calibration. **Old calibration is unchanged.**

TABLE 8: Meaning of status LED blink patterns **during calibration.**

5.1 Calibration Gases

Pure nitrogen zero gas and a precise mixture of oxygen and nitrogen (see Table 9) are required to calibrate the oxygen sensor.

An orificed calibration adapter is recommended to ensure that the sensor is completely immersed in the calibration gas without applying higher than ambient pressure to it.

A complete calibration kit that includes all the required accessories in a convenient carrying case is available from your distributor.

Type	Mixture (by volume)	Recommended Accuracy	Comments
Zero gas	Pure nitrogen		if supplied from liquid source beware of cooling the sensor.
Span gas	20.9% oxygen balance nitrogen	± 0.1 % oxygen	Calibration gas inaccuracy adds directly to sensor's specified accuracy error.

TABLE 9: Required Calibration Gases

5.2 ZERO CALIBRATION PROCEDURE

The Zero calibration procedure below MUST be done before the Span calibration.

The progress and status of the calibration process is indicated by the color and flash-state of the front cover status LED (see Table 8).

Apply the nitrogen (zero) calibration gas to the sensor using a calibration adapter, following the instructions for the calibration kit being used. Ensure that gas is flowing to the sensor, then press and hold the 'ZERO' button (see Figure 9) for 3 seconds until the front cover LED starts blinking YELLOW, indicating that gas sampling is in progress.

1. Ensure that the calibration adapter remains correctly seated and calibration gas continues to flow for the 2 minute sampling period.
2. At the end of the sampling period, the sensor's status LED blinks GREEN if the calibration was successful or RED if not.

3A. If successful (blinking GREEN):

The gas sampling completed successfully. Turn off the calibration gas flow, remove the calibration adapter then **press and hold** the 'ZERO' calibration button until the LED blinks GREEN/YELLOW indicating that the calibration gas has been removed, the calibration has been applied and the unit is in standby for two minutes while the sensor re-equilibrates to the ambient atmosphere before normal operation resumes. The calibration is complete when the status LED returns to steady GREEN.

OR

3B. If NOT successful (blinking RED):

The most likely cause of zero calibration sampling failure is insufficient gas flow or leaks around the calibration adapter failing to completely immerse the sensor in nitrogen. Verify that calibration gas is still flowing at the required rate (typically about 0.2 liters per minute) and the calibration adapter is properly positioned.

The calibration sampling can be re-started while the LED is blinking RED by again **pressing and holding** the 'ZERO' button until the LED blinks YELLOW, then return to step 1 above.

To exit the zero calibration routine preserving the original calibration: turn off the calibration gas flow and remove the calibration adapter, then **press and quickly release** the 'ZERO' button. The status LED will blink RED/YELLOW indicating that the calibration gas has been removed, the original calibration has been restored and the unit is in standby for two minutes while the sensor re-equilibrates to the ambient atmosphere before normal operation resumes. The original calibration is completely restored when the status LED returns to steady GREEN.

5.3 SPAN CALIBRATION PROCEDURE

The Zero calibration procedure in section 5.2 MUST be done before the Span calibration.

The progress and status of the calibration process is indicated by the color and flash-state of the front cover status LED (see Table 8).

1. Apply the SPAN calibration gas to the sensor using a calibration adapter, following the instructions for the calibration kit being used. Ensure that gas is flowing to the sensor, then press and hold the 'SPAN' button (see Figure 9) for 3 seconds until the status LED starts blinking YELLOW, indicating that gas sampling is in progress.
2. Ensure that the calibration adapter covers the sensor completely for the 2 minute sampling period. At the end of the sampling period, the sensor's status LED blinks GREEN if the sampling was successful or RED if not.

3A. If successful (blinking GREEN):

The sampling completed successfully. Turn off the calibration gas flow, remove the calibration adapter then **press and hold** the 'SPAN' calibration button until the LED blinks GREEN/YELLOW indicating that the calibration gas has been removed, the new calibration has been applied and the unit is in standby for two minutes while the sensor re-equilibrates to the ambient atmosphere before normal operation resumes. The calibration is complete when the status LED returns to steady GREEN.

OR

3B. If NOT successful (blinking RED):

The most likely causes of span gas sampling failure are:

- Insufficient gas flow or leaks around the calibration adapter not completely immersing the sensor in the calibration gas. Verify that calibration gas cylinder has not run-out and the calibration adapter is properly positioned.
- The oxygen concentration in the calibration gas is NOT between 20.8 and 21.0 percent (by volume).

The calibration sampling can be re-started while the LED is blinking RED by again **pressing and holding** the 'SPAN' button until the LED blinks YELLOW, then go to step 1 above.

To exit the span calibration preserving the original calibration unchanged, **press and quickly release** the 'SPAN' calibration button. The status LED will blink RED/YELLOW indicating that the calibration gas has been removed, the original calibration will be preserved and the unit is in standby for two minutes while the sensor re-equilibrates to the ambient atmosphere before normal operation resumes. The calibration is complete when the status LED returns to steady GREEN.

At the conclusion of a successful Span calibration the sensitivity of the sensor is compared to its sensitivity during initial factory calibration. If its sensitivity has fallen below manufacturer's end-of-life specification, the K-O2 goes into Sensor Expired mode with the front cover LED slowly blinking RED, the analog output at a constant 4 mA and the warning/ventilation relay activated. The sensor is no longer operational and must be replaced (See Table 7)

6 SENSOR MODULE REPLACEMENT

When the sensor module is expired, the front cover LED will blink RED slowly and the module's analog output will produce a steady 4 mA to indicate the sensor is not operational. When this occurs, the sensor module must be replaced before the K-O2 will again operate normally.

Calibrated sensor modules are available from Kele.

Calibrated Oxygen Sensor	Cal Kit
KMOD-O2	**UCK-3 kit**

6.1 FIELD REPLACEMENT OF SENSOR MODULES

Sensor modules can be replaced when they reach the end of their service life. To replace a sensor module with a new factory-calibrated one, follow the steps below:

1. Open the controller's front cover.
2. Unplug the controllers power connector (refer to Figure 6).
3. Unplug the sensor module by pulling the sensor module firmly away from the main board (Figure 10).
4. Plug the new sensor module into the vacant 'Sensor 1' location, then press the module firmly until the nylon standoff (shown in Figure 10) has 'snapped' the bottom-left side of the module board
5. Plug in the controllers power connector.
6. Observe that the front cover indicator is no longer flashing red, and then close the controller's enclosure.

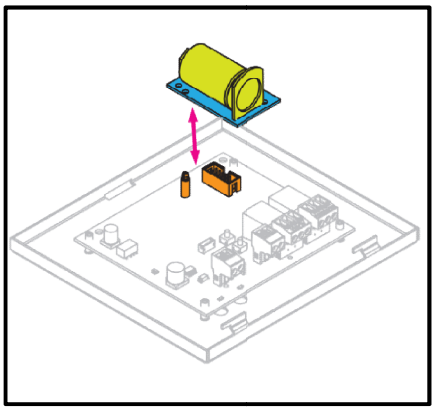


Figure 10: Sensor Module Replacement

7 WARRANTY

7.1 DURATION

Component / Class	Duration of Warranty
Enclosure & main board	5 years
Sensor modules	1 year

7.2 LIMITED WARRANTY AND REMEDIES.

KELE warrants to Buyer that for the duration stated in the "Duration of Warranty" section above from the date of shipment of Products to the Buyer that Products will substantially conform to the product specifications agreed to by KELE. This warranty is not transferable.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED. KELE EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

KELE IS NOT RESPONSIBLE IN ANY WAY FOR DAMAGE TO A PRODUCT, PROPERTY DAMAGE OR PHYSICAL INJURY RESULTING IN WHOLE OR IN PART FROM (1) IMPROPER OR CARELESS USE, (2) UNAUTHORIZED MODIFICATIONS, OR (3) OTHER CAUSES BEYOND KELE'S CONTROL.

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- Defects due to misuse, abuse, or improper or inadequate care, service or repair of Products;
- Defects due to modification of Products, or due to their alteration or repair by anyone other than KELE;
- Problems that arise from lack of compatibility between KELE's Products and other components used with those Products or the design of the product into which Products are incorporated. **Buyer is solely responsible for determining whether Products are appropriate for Buyer's purpose, and for ensuring that any product into which Products are incorporated, other components used with KELE's Products, and the purposes for which Kele's Products are used are appropriate and compatible with those Products.**

Unless KELE agrees otherwise, to obtain service under this warranty, Buyer must pack any nonconforming Product carefully, and ship it, postpaid or freight prepaid, to Kele, Inc. at

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before the expiration of the warranty period. Buyer must include a brief description of the nonconformity. Any actions for breach of this warranty must be brought within one year of the expiration of this warranty.

If Kele determines that a returned Product does not conform to this warranty it will, at Kele's sole discretion, either repair or replace that Product, and will ship the Product back to Buyer free of charge. At KELE's option, KELE may choose to refund to Buyer the purchase price for a nonconforming Product instead of repairing or replacing it.

8 DISCLAIMERS

8.1 INSPECTION AND MAINTENANCE

In order to maintain the specified accuracy this device, both its sensors must be calibrated at least every 6 months. During calibration the sensitivity of the sensor is compared to its sensitivity during initial factory calibration. If the sensitivity has fallen below the manufacturer's specification, the sensor has reached the end of its operating life and must be replaced. Contact Kele for a calibrated replacement module.

In harsh environments a sensor may fail prematurely. During normal operation the sensor is regularly tested to detect common failures. If a failure is detected, the front cover status LED will blink slowly RED, the warning relay

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will be activated and the concentration-reporting analog output will stay at 4 mA until the sensor is replaced.

8.2 LIFE SAFETY

This unit is not designed, certified, sold or authorized for use in applications where the failure of this device could be reasonably expected to result in personal injury or death.