SymTech Labs Intelligent Oxygen Sensor Simulator

Thank you for purchasing the SymTech Labs Intelligent Oxygen Sensor Simulator (iO_2SS)! Your iO_2SS is capable of perfectly replicating most downstream O_2 sensors' signals to eliminate check engine lights (CEL) due to missing or modified catalytic converters and other exhaust alterations. Please take note that this product is designed to replicate narrowband zirconia, not titania, O_2 sensors and is licensed for **off-road use only**.

INSTALLATION

Required Tools:

- Automotive datalogger/code scanner
- Wire crimping and cutting tool
- Digital multi-meter (DMM)
- Butt or closed end splice crimp connectors

Your iO_2SS features a six or seven wire connection and a six position DIP switch and potentiometer for adjusting the output waveform. Please take note of each wire's function: the *red* and *black* wires are used to power the unit, the *green* and *yellow* wires are used to generate the output signal, and the *white* wires are used to safely dissipate power from the heater circuit.

Begin by locating the stock downstream oxygen sensor. Disconnect it from its harness. Identify the type of O_2 sensor based on the number of wires stemming from it (4-wire, 3-wire, 2-wire, 1-wire); the connections to the iO_2SS depend on this information. Next, determine which installation type suits your application:

- **Complete Installation:** In applications where the O_2 sensor must be removed completely, a complete installation is necessary.
- **Signal-only Installation:** For many three- and four-wire O_2 sensors, it is often best to leave the O_2 sensor installed in the exhaust piping, and only use the iO_2SS to simulate the signal waveform but not the heater circuit. All one- and two-wire installations are signal-only installations.
- **Piggyback Installation:** Certain applications require valid, non-simulated downstream O_2 sensor data for upstream O_2 sensor calibrations. For these applications, the iO_2SS can intercept and augment the downstream O_2 sensor's signal by adding a user-configurable amount of positive or negative voltage offset.

Begin by identifying each of the wires on your O_2 sensor according to function (see the appendix for help).

Complete and Signal-only Installations

For complete installations, cut each wire between the O_2 sensor and its connector. For signal-only installations, cut the signal and ground (if applicable) wires. The heater circuit simulator resistor is omitted in signal-only installations. Use the table below to determine the appropriate connections between the O_2 sensor and iO_2SS.

IO_2SS	4-wire	3-wire	2-wire	1-wire
Green	Signal	Signal	Signal	Signal
Black	Ground	Chassis	Ground	Chassis
White	Heater	Heater	NC	NC
White	Heater	Heater	NC	NC
Red	+12V Ign	+12V Ign	+12V Ign	+12V Ign

O2 Snsr Connection =	
External Connection =	
No Connection =	NC

Dual output iO_2SS's (indicated by two *green* signal output wires) may be connected to two downstream oxygen sensors. Simply follow the same procedure outlined above for the second oxygen sensor. For complete installations, additional heater circuit simulator resistors may be purchase separately from SymTech Labs.

Piggyback Installations

For piggyback installations, only cut the signal wire between the O_2 sensor and its connector. Connect the end of this wire leading to the O_2 sensor to the iO_2SS's *yellow* signal input wire and the other end to the iO2SS's *green* signal output wire. The heater circuit simulator resistor is omitted in piggyback installations.

Dual output iO2SS's used in piggyback installations should not be used with more than one O_2 sensor.

All Installations

Trim and secure all unused wires to prevent electrical shorts.

The iO_2SS requires a connection to a switched +12V power source in each type of installation. Do not make this connection to a constant +12V source. If possible, you may use the O_2 sensor's heater circuit to power the iO_2SS. With the ignition switch in the "ON" position, use a DMM to determine which wire supplies +12V.

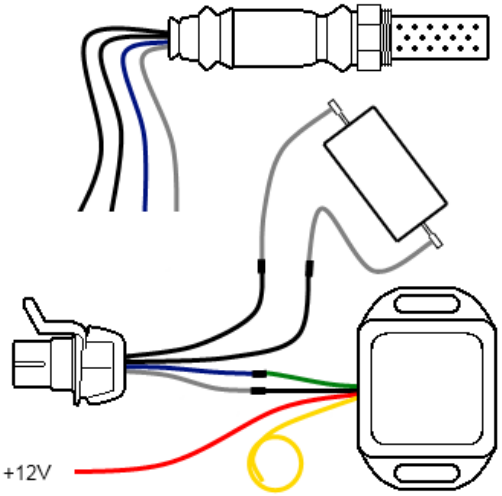

Figure 1: Typical complete installation

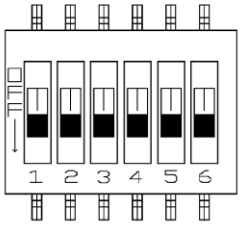

Figure 2: DIP switches

For O_2 sensors without dedicated signal ground wires, be sure to connect the *black* iO_2SS wire to chassis ground.

Crimp, or otherwise connect, each wire from the iO_2SS to its corresponding connection on either the O_2 sensor or the car's electrical system. Many O_2 sensors use stainless steel wire, which cannot be easily soldered.

Though the unit is sealed, ideal mounting locations are away from heat and moisture, within the passenger's compartment of the vehicle. **For complete installations, securely mount the white ceramic power resistor to the vehicle chassis to dissipate excess heat.**

TUNING

Before adjusting anything, be sure to have a datalogger/code scanner available to record the values the powertrain control module (PCM) measures from the iO_2SS, discover any subsequent error codes and clear those codes if necessary. After making adjustments, reset the PCM with either your datalogger/code scanner or by removing the negative terminal from the car battery for a period of ten (10) minutes of more.

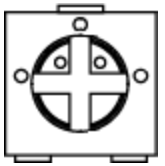

Figure 3: Potentiometer

See figure 2 for a representation of the DIP switches and figure 3 for a representation of the potentiometer. Notice that each switch is numbered, and that all are OFF from the factory.

Complete and Signal-only Installations (manual mode)

Your iO_2SS is pre-configured to mimic the output of most narrowband zirconia O_2 sensors. If a check engine light (CEL) or diagnostic trouble code (DTC) appears after installation, the signal

waveform may be adjusted accordingly. DIP switches and a potentiometer mounted on the iO_2SS can be configured to obtain the desired signal behavior.

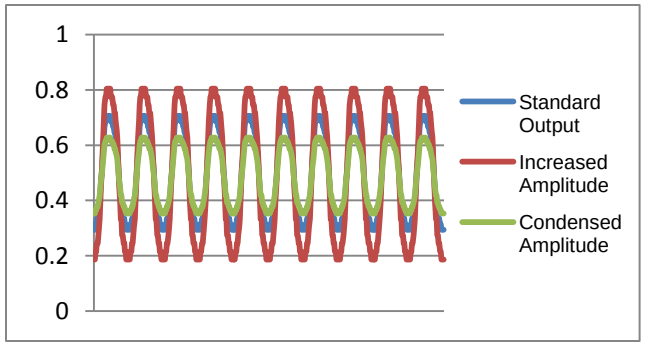

Figure 4: Amplitude modified waveforms

The switches are arranged in groups with #1 & #2 controlling amplitude and #3 & #4 controlling AFR. The potentiometer controls the signal frequency. Use a small jeweler's screwdriver or similar tool to change the switches' positions or turn the potentiometer.

See figure 4 for a graph of the standard waveform along with waveforms with modified amplitudes. The default switch position yields the standard amplitude. For a compressed amplitude, set switch #1 to ON. For an increased amplitude, set switch #2 to ON. For a further increased amplitude, set switches #1 & #2 to ON.

See figure 5 for a graph of the standard waveform along with waveforms with different voltage offsets. The offset corresponds to the air/fuel ratio (AFR). The default switch position yields the standard voltage offset. For a leaner condition, set switch #3 to ON. For a richer condition, set switch #4 to ON. Do not set both switches to ON simultaneously.

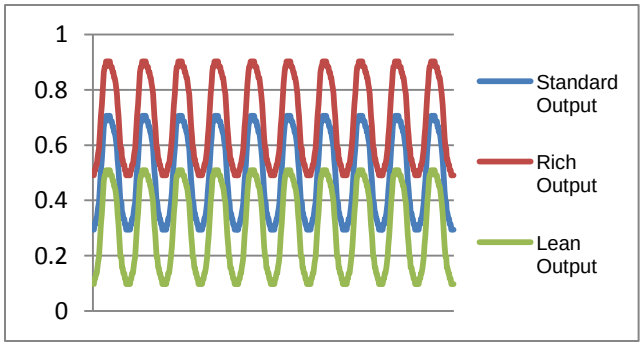

Figure 5: Offset modified waveforms

In some cases, the datalogger/code scanner might reveal that the iO_2SS is producing a signal with a frequency either too quick or too slow. Turn the potentiometer clockwise for a slower signal and counter-clockwise for a quicker signal. The frequency can be adjusted from approximately 20Hz to 0.5Hz.

Piggyback Installations (automatic mode)

To enter automatic mode, set switches #3 & #4 to ON. By default, the iO_2SS is set to duplicate the O_2 sensor's signal. The iO_2SS can augment this signal by adding positive or negative voltage offset. The offset, which can be adjusted by turning the potentiometer, corresponds to the air/fuel ratio (AFR). See figure 5 for a graph of the standard waveform and examples of waveforms with different voltage offsets.

Making adjustments is best done by monitoring the input and output signals with an oscilloscope. If an oscilloscope is unavailable, the PCM measured values can be monitored with your datalogger/code scanner. Add or subtract offset in small increments of 0.05V or 0.10V until any check engine lights (CEL) or diagnostic trouble codes (DTC) are eliminated. Turn the potentiometer clockwise to add positive offset and turn it counter-clockwise to add negative offset. In most cases, when the catalytic converter has been altered or removed, negative offset should be added to the signal.

APPENDIX: STOCK O_2 SENSOR WIRE SCHEMES

Four-Wire Oxygen Sensors

Function				
Signal	Blue	White	Green	Black
Ground	White	Green	Yellow	Gray
Heater	Black	Black	Black	White
Heater	Black	Black	Black	White

Three-Wire Oxygen Sensors

Function				
Signal	Blue	White	Green	Black
Heater	Black	Black	Black	White
Heater	Black	Black	Black	White

Two-Wire Oxygen Sensors

Function				
Signal	Blue	White	Green	Black
Ground	White	Green	Yellow	Gray

One-Wire Oxygen Sensors

Function				
Signal	Blue	White	Green	Black