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 intended for **off-road use only**.

INSTALLATION

Required Tools:

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

The iO_2SS features a six or seven wire connection and three potentiometers 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 connected to 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 is missing or 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.
- **Piggy-back 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 adjusting its frequency.

Begin by identifying each of the wires on the 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.

Piggy-back Installations

For piggy-back 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 piggy-back installations.

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

All Installations

Trim and secure all unused wires to prevent electrical shorts.

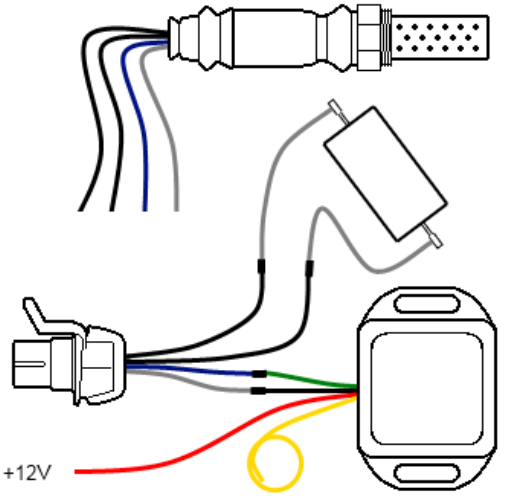

Figure 1: Typical complete installation

The iO_2SS requires a connection to a switched +12V power source. Do not make this connection to a constant +12V source (i.e. a direct connection to the battery). In some cases, 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.

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 protected, 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 a datalogger/code scanner or by removing the negative terminal from the car battery for a period of ten (10) minutes of more.

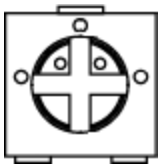

Figure 2: Potentiometer

See figure 2 for a representation of the potentiometers in the iO_2SS. *Note that each potentiometer can be rotated approximately 135 degrees in either direction from the default position. The potentiometers will physically rotate 360 degrees, but the working range is 270 degrees total.*

Complete and Signal-only Installations (Stand-Alone Mode)

The 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. The three potentiometers mounted on the iO_2SS can be configured to obtain the desired signal behavior.

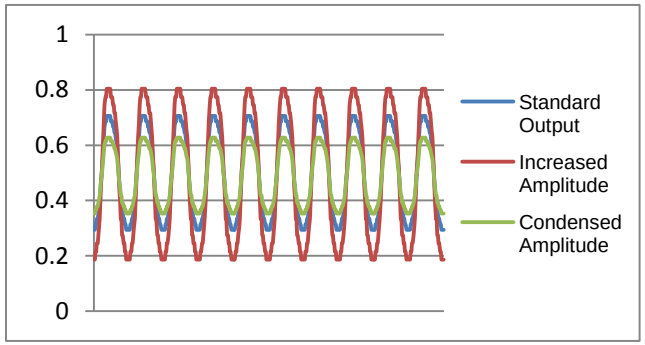

Figure 4: Amplitude modified waveforms

The potentiometers are labeled "FRQ," "AMP," and "OFF". FRQ controls the signal frequency, AMP controls the amplitude, and OFF controls the offset, which corresponds to AFR. Use a small jeweler's screwdriver or similar tool to turn the potentiometers.

See figure 4 for a graph of the standard waveform along with waveforms with modified amplitudes. The default potentiometer position yields the standard amplitude (approximately 0.7$V_{peak\text{-}to\text{-}peak}$). Rotate AMP counter-clockwise to compress the amplitude, or clockwise to expand it. The amplitude can be adjusted from 0.2 to 1.4 $V_{peak\text{-}to\text{-}peak}$.

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 potentiometer position yields the standard voltage offset (approximately 0.45V). For a leaner condition, rotate OFF counter-clockwise. For a richer condition, rotate OFF clockwise. Approximately 0.4V can be added or subtracted from the signal's zero-crossing point.

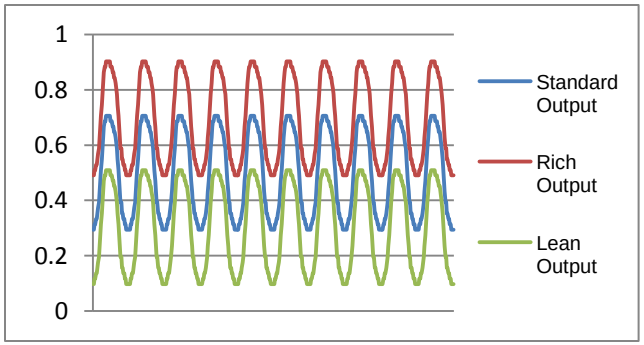

Figure 5: Offset modified waveforms

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. Rotate FRQ counter-clockwise for a slower signal and clockwise for a faster signal. The frequency can be adjusted from 0.3Hz to 20Hz.

Piggy-Back Installations (Piggy-Back Mode)

The iO_2SS will automatically enter piggy-back mode when a working oxygen sensor is connected to the *yellow* signal input wire. By default, the iO_2SS is set to duplicate the O_2 sensor's signal. The iO_2SS can augment this signal by increasing or decreasing its frequency. Rotate the potentiometer labeled "FRQ" counter-clockwise for a slower signal and clockwise for a faster signal. The frequency can be adjusted from approximately 20Hz to 0.3Hz.The other potentiometers have no effect in piggy-back mode.

Making adjustments is best done by monitoring the input and output signals with an oscilloscope. If an oscilloscope is not available, the PCM measured values can be monitored with a datalogger/code scanner. Increase or decrease the frequency in small increments until check engine lights (CEL) or diagnostic trouble codes (DTC) are eliminated. In most cases, when the catalytic converter has been altered or removed, the signal frequency should be decreased by rotating FRQ counter-clockwise.

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

WARNING

Oxygen sensor simulators are to be used on OFF-ROAD ONLY vehicles. Oxygen sensor simulators potentially nullify environmental protection equipment and techniques mandated by the federal government. Usage of an oxygen sensor simulator to conceal a removed catalytic converter is illegal. SymTech Laboratories, LLC assumes no responsibility for losses or damages due to installation of this product.

LIMITED WARRANTY

SymTech Laboratories, LLC warrants to the original customer purchasing products directly from SymTech Laboratories, LLC that all such products sold will be free from defects in materials and workmanship affecting form, fit and function. SymTech Laboratories, LLC, at its option, will repair, replace, or provide a credit or refund of either the original purchase price or fair market value, whichever is lower, of any product that is determined by SymTech Laboratories, LLC to be defective during the warranty period.

Any claim must be made within one (1) year from the original date of shipment by SymTech Laboratories, LLC; SymTech Laboratories, LLC shall have no liability thereafter. Customer must notify SymTech Laboratories, LLC within one (1) year from the original date of shipment. The foregoing warranty granted on SymTech Laboratories, LLC products is to the initial customer end-user and is non-transferable.

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