

Description:

The Enricher is an automotive electronic module that can facilitate richer engine operation while the ECU is in closed loop. It is primarily used as part of an overall fuel strategy on forced induction applications. It can be used in applications with up to four oxygen (O₂) sensors. These sensors can be virtually any type of narrowband or wideband sensor.

The Enricher has an internal map sensor that can be used to activate the enrichment mode as function of manifold pressure. The enrichment mode can also be activated by a flexible combination of two external inputs. The threshold for activation on each input is independently adjustable. Activation can be based on one input or an AND combination of both. There is an invert function for each input which makes it possible to activate when inputs are either less-than or greater-than the threshold.

The Enricher is especially useful for forced induction conversions where a supercharger or turbocharger is fitted to an engine. Because modern ECUs operate in closed loop over most of the engine operating range, it is difficult to achieve enrichment in a way that is consistent and dependable. Fuel strategies such as larger injectors or additional injectors can provide extra fuel, but that is often countered by the ECU with fuel trim. The Enricher makes the ECU target a richer mixture so that additional fuel is not trimmed away.

Features:

- Implements enrichment on transition into boost
- Provides enrichment when ECU is in closed-loop
- Operates with narrowband or wideband O₂ sensors
- Uses fuel trim to provide additional fuel
- Avoids faults caused by excess fuel trim
- Modifies up to four O₂ sensors
- Flexible trigger options
- Internal pressure sensor
- Two outputs for indicators or external module activation
- Compatible with OBDII systems
- Jumper plug to return wiring to stock

Operation:

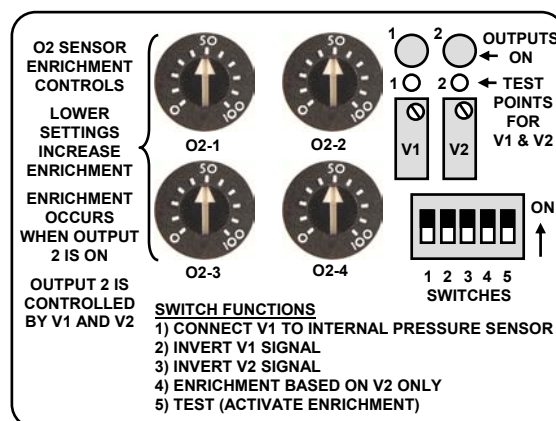
The Enricher is activated by a combination of two inputs: V1 and V2. The V1 input can come from an external voltage or the internal pressure sensor. Both V1 and V2 can be inverted so that the activation for either input can be made to occur as the input increases or decreases.

In the normal mode for activation, both V1 and V2 must exceed their thresholds. These thresholds are adjusted by the 20-turn potentiometers labeled V1 and V2. The threshold can be precisely adjusted by monitoring the corresponding test point for each input with a DVM. These thresholds can be set anywhere between zero and 5 volts.

The various modes of operation are controlled by a series of five dip switches. When switch 1 is on, V1 is provided by the internal 2.5 bar pressure sensor. When the V1 potentiometer is set to 2 V, the V1 threshold activates at approximately 1 psi of boost. Switches 2 and 3 invert the V1 and V2 signals, respectively. When switch 4 is on, the activation of the enrichment module is based on V2 only. Switch 5 activates the enrichment function directly for test purposes.

The Enricher has two switched outputs labeled VO1 and VO2. These are active-low outputs that pull to ground. They can provide up to one amp of current. They can be used to turn on indicators or activate relays to switch on external circuits. The VO1 output is turned on when the threshold for V1 is reached. The VO2 output is activated whenever the enrichment mode is activated.

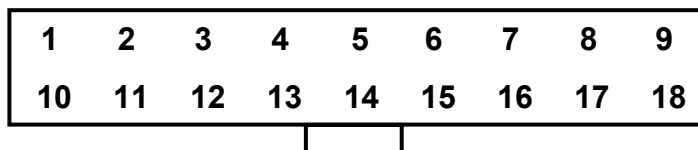
Once the enrichment function is activated, the readings for the O2 sensors are altered according to the four single-turn potentiometers. On the 100 setting there will be a minimum change to the reading and minimal enrichment. As the setting is turned down, the enrichment effect increases. The settings should be as high as possible while achieving the desired enrichment. Settings that are too low may result in a fault.



Internal Control Layout

Wire Assignments:

All wire connections to the Enricher are made through the 18-pin connector on the side of the unit. This diagram shows the pin numbers as they appear with the top of the unit facing up. In this orientation, the connector latch is on the bottom.



Connector pin assignments as viewed with the latch facing down

| PIN | TYPE | LABEL | CONNECT TO | WIRE COLOR |
|-----|--------|-------|----------------------------|---------------|
| 1 | Input | B- | Ground | Black |
| 2 | Output | MAPO | External system (optional) | Violet |
| 3 | Input | V1 | External 0-5V | Green |
| 4 | Output | VO1 | Indicator, relay. Etc. | Orange/Green |
| 5 | Input | O4I | O2-4 sensor output | White |
| 6 | Input | O3I | O2-3 sensor output | Pink |
| 7 | Input | O12R | O2-1 reference voltage | Tan/Black |
| 8 | Input | O2I | O2-2 sensor output | Tan |
| 9 | Input | O1I | O2-1 sensor output | Yellow |
| 10 | Input | B+ | Switched battery positive | Red |
| 11 | Output | +5V | V1, V2 or external system | Blue |
| 12 | Input | V2 | External 0-5V | Green/Yellow |
| 13 | Output | VO2 | Indicator, relay. Etc. | Orange/Yellow |
| 14 | Output | O4O | ECU O2-4 sensor input | White/Green |
| 15 | Output | O3O | ECU O2-3 sensor input | Pink/Blue |
| 16 | Output | O34R | O2-3 reference voltage | White/Black |
| 17 | Output | O2O | ECU O2-2 sensor input | Tan/Yellow |
| 18 | Output | O1O | ECU O2-1 sensor input | Yellow/Green |

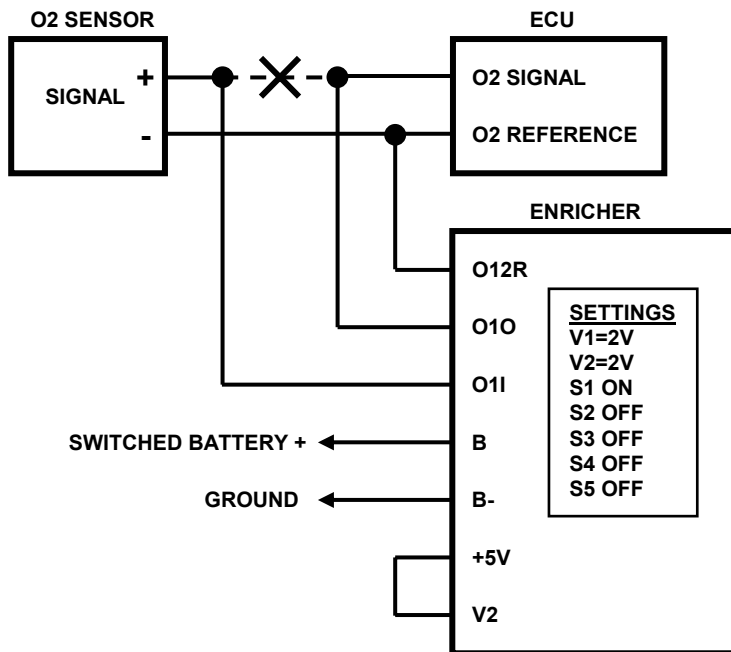
Connections:

The following diagrams show the typical connections required to use the Enricher. The Enricher can be used on applications that have between one and four sensors. On many applications it is only necessary to modify the pre-cat sensor(s). Some applications require modification of the post-cat O2 sensor(s) as well. Start with the front sensor(s) only and see if acceptable enrichment is achieved. If that works, the rear sensor(s) can be left alone. If not, connect to the rear sensor(s) as well.

The essential connection to each sensor is made by cutting the O2 sensor signal wire and running the signal through the Enricher. The signal input is on the OXI terminal, where X refers to sensor 1 through 4. The output is on the corresponding OXO terminal.

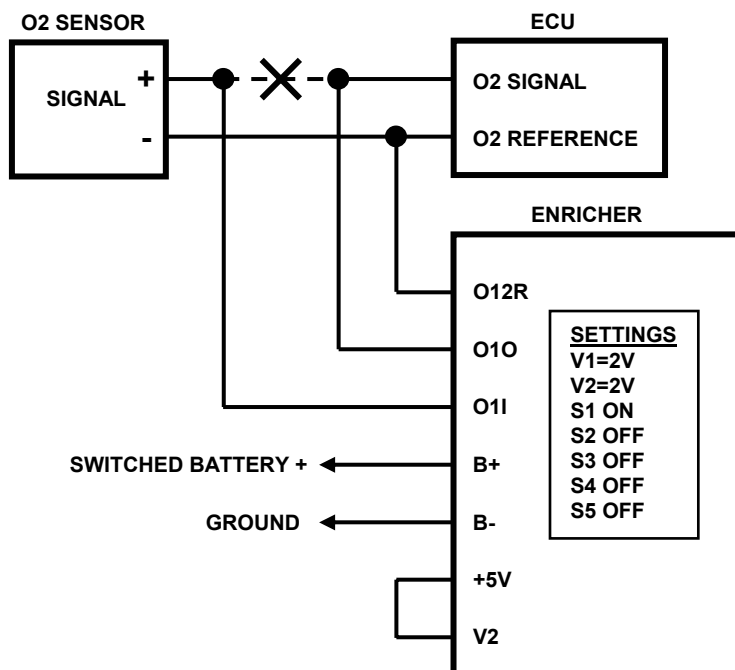
Minimum Connections:

This diagram shows the typical connections for a one-wire or three-wire sensor. This connection is typical for applications up through the 1995 model year.



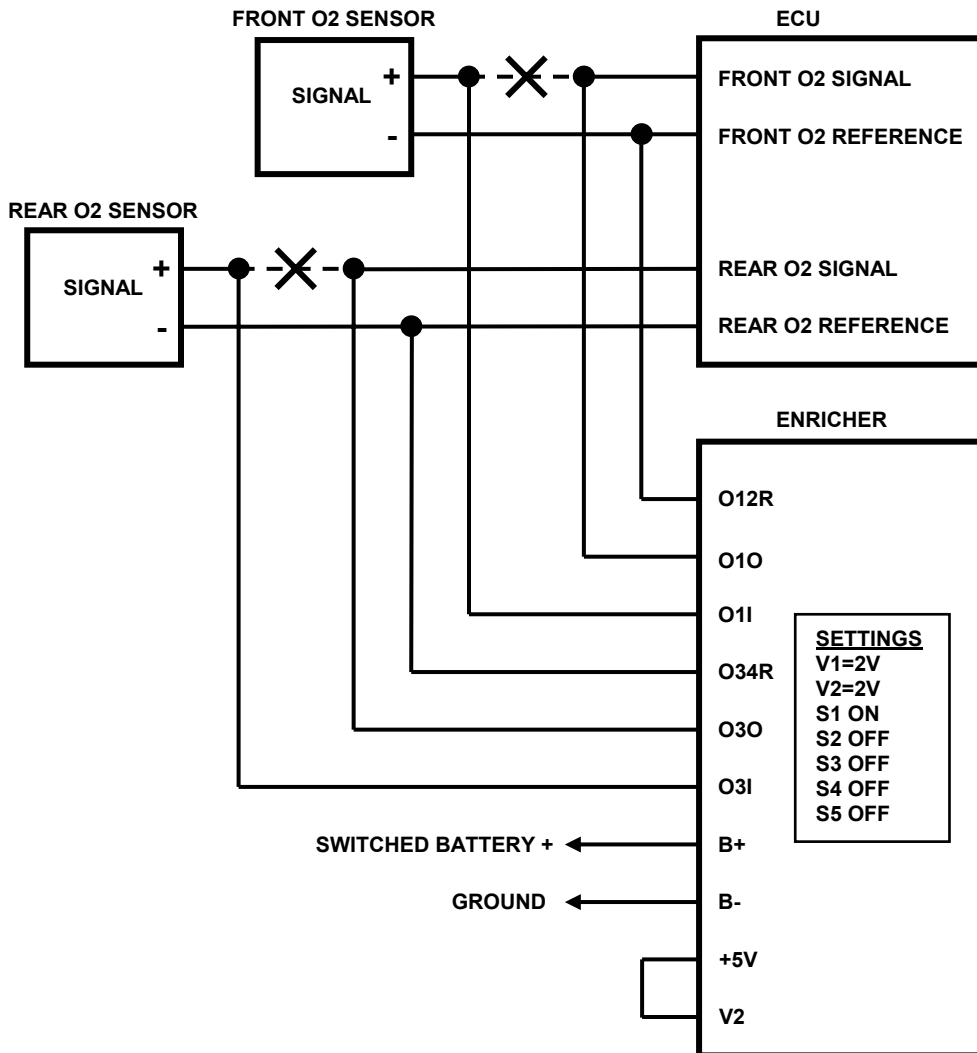
Connections with a 4-wire O2 Sensor:

Four-wire O2 sensors have a separate reference wire. It may be called a reference, sensor ground or return wire. On many applications the reference wire is at a voltage above ground. It can range as high as 2.5V. The O12R wire is connected as a T-tap connection to the O2 reference wire.



Connections to Front and Rear 4-wire O2 Sensors:

This diagram illustrates the connections for a single pre-cat and a single post-cat sensor. The Enricher can also be used in applications with two pre-cat and two post-cat sensors. In that case the second pre-cat sensor is intercepted by the O2I and O2O wire pair. The second post-cat sensor is intercepted by the O4I and O4O wire pair.



Connections to Wideband O2 Sensors:

Most 5-wire and 6-wire wideband sensors produce an output voltage and can use the same connections as shown above for narrowband sensors. Current mode sensors such as the Toyota 4-wire air/fuel sensors can be adjusted by using a T-tap connection to the signal wire. On current mode sensors, the Enricher output wire (O1O for example) is T-tapped to the signal wire and the input wire (O1I) is not used.

Adjustment:

To access the adjustments, remove the four corner screws and the cover. Once you determine how the Enricher is to be activated, wire the unit accordingly and select the correct switch settings. Adjustment is completed by setting the V1 and V2 potentiometers and the O2 sensor controls. In many cases the internal pressure sensor will be used to activate the unit. The internal 2.5 bar pressure sensor has the following transfer function. P in this expression is in the units of kPa.

$$V_o (V) = 5(.004P-.04)$$

The following table shows a few examples of pressures that may be used for activation and the corresponding voltage.

| PRESSURE | (kPa) | V1 VOLTAGE (V) |
|----------|-------|----------------|
| -4 inHg | 87.5 | 1.55 |
| 0 psi | 101.0 | 1.82 |
| 1 psi | 107.9 | 1.96 |
| 2 psi | 114.8 | 2.10 |
| 4 psi | 128.6 | 2.37 |
| 10 psi | 169.9 | 3.20 |

The following table outlines several configurations that can be used and how they are set up. Activation refers to the way that enrichment is controlled. The connect-to columns indicate what the V1 and V2 inputs are tied to. The adjust-to columns indicate the settings for the V1 and V2 potentiometers. These voltages can be measured with a DVM connected to the corresponding test points next to the potentiometers. An entry of N/C in the table means no connection.

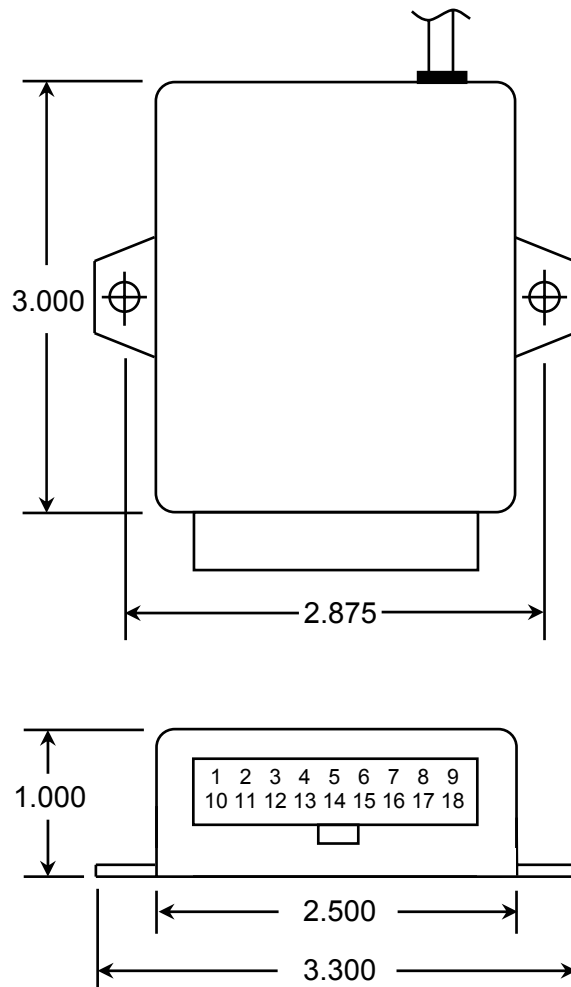
| ACTIVATION | CONNECT-TO | | ADJUST-TO (V) | | SWITCH SETTING | | | |
|-------------------------------|------------|-----------|---------------|-----|----------------|-----|-----|-----|
| | V1 | V2 | V1 | V2 | S1 | S2 | S3 | S4 |
| Pressure above 1psi | N/C | +5V | 2 | 2 | on | off | off | off |
| 1 psi and external 5V trigger | N/C | Ext. sig. | 2 | 2 | on | off | off | off |
| 1 psi and external 0V trigger | N/C | Ext. sig. | 2 | 2 | on | off | on | off |
| Pressure 1 to 10 psi only | V2 | V1 | 2 | 3.2 | on | off | on | off |
| External 5V trigger only | N/C | Ext. sig. | 2 | 2 | off | off | off | on |
| V1<1V and V2>2.5V | Ext sig. | Ext. sig. | 1 | 2.5 | off | on | off | off |

Turn on S5 to select the enrichment mode directly. When the enrichment mode is active the VO2 LED is illuminated. The relevant O2 sensor adjustments can be set for the desired enrichment. Start at 100 and turn down the settings until the desired enrichment is reached. Do not use a setting that is any lower than necessary. The enrichment can be observed as fuel trim on an OBDII scan tool and confirmed as air/fuel ratio measured in the exhaust.

Electrical Characteristics:

| PARAMETER | CONDITIONS | MIN | TYP | MAX | UNITS |
|----------------------------|---------------------------|-----|------|-----|-------|
| Supply Voltage | B+ to B- | 10 | 13.5 | 15 | V |
| Input Voltage V1 and V2 | Signal Input to B- | 0 | | 5 | V |
| Pressure Range | (Absolute pressure) | 0 | | 37 | psiA |
| Output Current VO1 and VO2 | Do not short to B+ | | | 1 | A |
| Output Current +5V | | 0 | | 100 | mA |
| Supply Current | B+ to B- | | 10 | | mA |

Mechanical Characteristics:



(dimensions in inches)



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