

# Flyin' Miata

*We make Miatas fly!*



## Installation of the AEM Gauge type wide band oxygen sensor (WBO2)

5-10-11

Due to the numerous options for mounting a 2" gauge in the interior of a Miata, these instructions will only cover the wire connections on the gauge.

- 1) Begin the installation by disconnecting the negative terminal on the battery.
- 2) Mount the WBO2 sensor. The sensor element needs to be installed in a standard O2 fitting in the exhaust pipe before the catalytic converter.

On FM turbo cars there will be a fitting in the lower portion of the downpipe right before the catalytic converter. This is the best place to install the WBO2 because the more consistent exhaust gas temperatures will ensure the most accurate performance. If the downpipe does not have a fitting in the lower portion (older FM kits or other brands), AEM does include a steel threaded sleeve that can be welded onto the downpipe. The O2 sensor must be mounted in such a way that the sensing tip is lower than any other part of the sensor.

On supercharged cars the O2 sensor should be mounted in a location that receives exhaust gasses from all 4 cylinders. If the factory manifold or aftermarket header does not have the O2 sensor fitting in this location, the fitting supplied from AEM must be welded onto the header in a location that contains gasses from all 4 cylinders. The O2 sensor must be mounted in such a way that the sensing tip is lower than any other part of the sensor. AEM recommends mounting the sensor at least 18" from the exhaust ports.

- 3) Mount the AEM WBO2 gauge in your desired location. From the gauge there are two harnesses, one pre-terminated for the O2 sensor and the other for power and signal to the gauge.
- 4) The harness for the O2 sensor needs to pass through the fire wall to the engine bay. If the car does not have cruise control the factory opening for the cable can be used after making it a little larger. Otherwise, you can route it down through the shifter boot.

**Note:** The white wire is the 0 to 5 volt wide band signal we need to connect to the Link ECU. The blue wire will not be used. If your car has a stock ECU, DO NOT connect the white wire or blue wire to the ECU harness. Your stock narrowband will need to remain in the car.

## Steps for 1990 to 1993 cars

2Y	2W	2U	2S	2Q	2O	2M	2K	2I	2G	2E	2C	2A	1U	1S	1Q	1O	1M	1K	1I	1G	1E	1C	1A
*	L/O	Y	*	L/W	R	(R/B) *	LG/R	B/W	Y/L	W	B/LG	B	R/B	L/O	LG/B	G	*	LG/Y	*	BR/Y	Y/B	V	L/R
(LB) *	Y/R	Y/B	*	*	R/G	R/L	LB/W (*)	*	R/W (*)	*	B/LG	B	BR/W (B/L)	*	B/G	(L/Y) *	R	*	L/B	BR	W/Y	W/G	W/R
2Z	2X	2V	2T	2R	2P	2N	2L	2J	2H	2F	2D	2B	1V	1T	1R	1P	1N	1L	1J	1H	1F	1D	1B

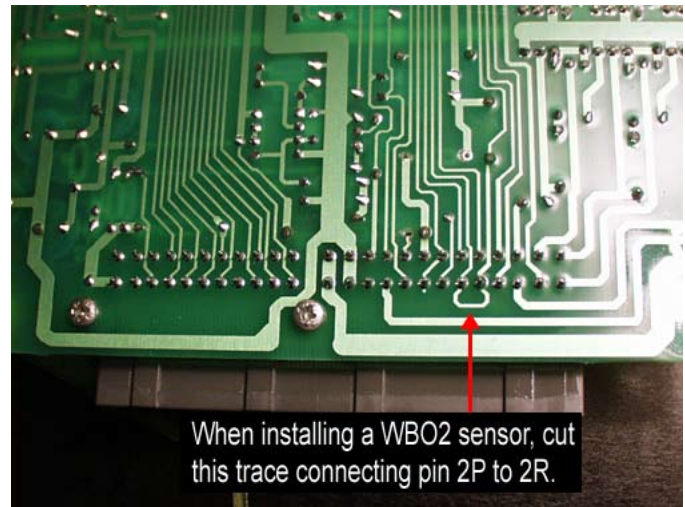
Here are diagrams of the ECU terminals viewed from the wire side

5) Run the red, black and white wires over to the passenger foot well. All the electrical connections will be made at the ECU harness. The white wire is only used with the Link standalone ECU.

6) Connect the red wire to switched 12 volts. This will be the white/red wire in terminal 1B.

7) Connect the black ground wire to either black/green wire in terminals 2C or 2D.

**STOP HERE IF YOU DON'T HAVE A LINK ECU. THE FOLLOWING STEPS ARE ONLY FOR THE LINK STAND-ALONE ECU. IF YOU HAVEN'T REPLACED THE ECU, DON'T FOLLOW THE REST OF THE INSTRUCTIONS. IF YOU'VE PURCHASED A VOODOO KIT, YOU'RE USING THE STOCK ECU AND SHOULD NOT FOLLOW THE REST OF THE STEPS.**



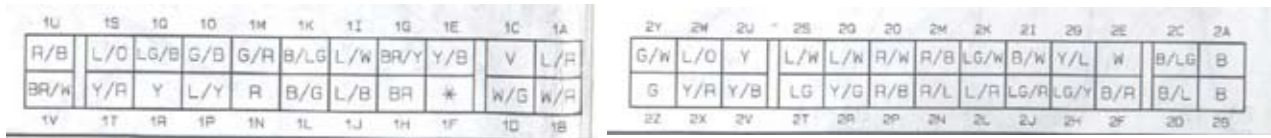
The next step will require the removal of one of the ECU terminals. YOU ONLY NEED TO DO THIS FOR THE STANDALONE LINK ECU. THESE DIRECTIONS DO NOT APPLY TO ANY OTHER ECU. To do this, use a sharp, straight tool like a pin. You need to unsnap the latch on the wire side of the terminal first. Looking into the plastic connector opposite the wires, there is a plastic tab that locks each metal terminal into the plastic. Lift up this tab with the pin and pull the terminal out of the plastic.

8) The WBO2 signal comes into the ECU on terminal 2P. Move the red/green wire from 2P over to 2R.

9) On the back side of the ECU's printed circuit board, cut the jumper that connects 2P to 2R. See the photo above. This is not a wire, but a copper trace on the pc board that connects these two pins. Cut the trace with a pocketknife tip or X-Acto knife.

10) Run a new wire from the white wire on the AEM WBO2 sensor (0 to 5 volt output) to position 2P in the ECU harness. If you need an ECU terminal for this, please contact us as we have them.

## Steps for 1994 to 1995 cars



Here are diagrams of the ECU terminals viewed from the wire side

- 5) Run the red, black and white wires over to the passenger side of the car behind the passenger seat. All the electrical connections will be made at the ECU harness. The white wire is only used with the Link standalone ECU.
- 6) Connect the red wire to switched 12 volts. This will be the white/red wire in terminal 1B.
- 7) Connect the black ground wire to the black/green wire in terminal 2C.

**STOP HERE IF YOU DON'T HAVE A LINK ECU. THE FOLLOWING STEPS ARE ONLY FOR THE LINK STANDALONE ECU. IF YOU HAVEN'T REPLACED THE ECU, DON'T FOLLOW THE REST OF THE INSTRUCTIONS. IF YOU'VE PURCHASED A VOODOO KIT, YOU'RE USING THE STOCK ECU AND SHOULD NOT FOLLOW THE REST OF THE STEPS.**

The next step might require the removal of one of the ECU terminals (read step 8). YOU ONLY NEED TO DO THIS FOR THE STANDALONE LINK ECU. THESE DIRECTIONS DO NOT APPLY TO ANY OTHER ECU. To do this, use a sharp, straight tool like a pin. You need to unsnap the latch on the wire side of the terminal first. Looking into the plastic connector opposite the wires, there is a plastic tab that locks each straight tool like a pin. Looking into the plastic connector opposite the wires, there is a plastic tab that locks each metal terminal into the plastic. Lift up this tab with the pin and pull the terminal out of the plastic. On these cars we use one of the signal lines for the EGR valve for the WBO2 input. This means the WBO2 sensor and the EGR function cannot be used at the same time. Later in these instructions we will cover how to disable the EGR system.

- 8) At the ECU locate terminal number 2J. Cut the light green/red wire a few inches from the ECU plug, and connect the white wire from the WBO2 here. If you'd rather not have a connector inline on the wire, remove the ECU terminal and connect the new wire. If you need an ECU terminal for this, please contact us as we have them.
- 9) Tape off the original light green/red wire and tuck in under the carpet.

## Steps for 1996 to 1997 cars

4Y	4W	4U	4S	4Q	4O	4M	4K	4J	4G	4E	4C	4A	3O	3M	3K	3I	3G	3E	3C	3A
L/W	G/W	Y	*	L/O	Y	*	*	L/R	Y/L	Y/B	B	B/LG	B/L	R/W	R/B	LG/W	L/W	*	R/G	*
*	G	Y/B	Y/R	BR	Y/W	BR/Y	B/W	Y/G	Y/W	W	B	W/R	L/Y	B/Y	R	LG/R	BR/B	R/B	R/L	R/W
4Z	4X	4V	4T	4R	4P	4N	4L	4J	4H	4F	4D	4B	3P	3N	3L	3J	3H	3F	3D	3B

Here are diagrams of the #3 & #4 ECU terminals viewed from the wire side

- 5) Run the red, black and white wires over to the passenger side of the car behind the passenger seat. All the electrical connections will be made at the ECU harness. The white wire is only used with the Link standalone ECU.
- 6) Connect the red wire to switched 12 volts. This will be the white/red wire in terminal 4B.
- 7) Connect the black ground wire to the black/green wire in terminal 4A.

**STOP HERE IF YOU DON'T HAVE A LINK ECU. THE FOLLOWING STEPS ARE ONLY FOR THE LINK STANDALONE ECU. IF YOU HAVEN'T REPLACED THE ECU, DON'T FOLLOW THE REST OF THE INSTRUCTIONS. IF YOU'VE PURCHASED A VOODOO KIT, YOU'RE USING THE STOCK ECU AND SHOULD NOT FOLLOW THE REST OF THE STEPS.**

The next step will require the removal of one of the ECU terminals. YOU ONLY NEED TO DO THIS FOR THE STANDALONE LINK ECU. THESE DIRECTIONS DO NOT APPLY TO ANY OTHER ECU. To do this, use a sharp, straight tool like a pin. You need to unsnap the latch on the wire side of the terminal first. Looking into the plastic connector opposite the wires, there is a plastic tab that locks each metal terminal into the plastic. Lift up this tab with the pin and pull the terminal out of the plastic. On these cars we use one of the signal lines for the EGR valve for the WBO2 input. This means the WBO2 sensor and the EGR function cannot be used at the same time. Later in these instructions we will cover how to disable the EGR system.

- 8) At the ECU locate terminal number 3J in the ECU harness. Cut the light green/red wire a few inches from the ECU plug, and connect the white wire from the WBO2 here. If you'd rather not have a connector inline on the wire, remove the ECU terminal and connect the new wire. If you need an ECU terminal for this, please contact us as we have them.
- 9) Tape off the original light green/red wire and tuck in under the carpet.

## Hooking up the Link ECU to use an AEM WBO2 sensor

**DO NOT FOLLOW THESE DIRECTIONS IF YOU DON'T HAVE A STANDALONE LINK ECU. THE FOLLOWING STEPS ARE ONLY FOR THE STANDALONE LINK ECU. THEY DO NOT APPLY TO THE PIGGYBACK LINK.**

When using a WBO2 sensor, the O2 sensor targets programmed into the Link ECU must be changed to reflect the output voltage of the WBO2 sensor. The default values are for the OEM O2 sensor. The O2 sensor targets are stored in zones Z26 through Z31.

- 1) Go to the edit Z menu with your keypad and enter the O2 targets for the “AEM WBO2 gauge type” in zones Z26 through Z31 as shown in the table below.
- 2) On 94-97 cars, the EGR function will need to be turned off. This is done with the keypad in the **TPS** screen. While pressing both Select keys, press the Edit down key to turn off the EGR. Pressing the Edit up key turns EGR back on.
- 3) On 90-97 cars, in the **INJ/O2** screen, choose **WBO2** sensor instead of **OEM O2** sensor. To do this, press both Adjust keys and press the Edit up key for the WBO2 sensor or Edit down for the OEM (4-wire) sensor.
- 4) Now, when the car is running, the reading on the far right in the **INJ/O2** screen will be the voltage from the WBO2 sensor multiplied by 25.6 then subtracted from 128 as shown in this equation:  $WBO2 = 128 - (WBvoltage * 25.6)$
- 5) At this point the FM ECU will auto tune using the signal from the WBO2 sensor just as it tunes with the standard OEM sensor, but the boosted rows can now be safely tuned as well. The 400, 500 and 600 rows can now be tuned in the same manner as the 100,200 and 300 rows, by driving the car in the center of each row in the ZONEF screen. Please refer to the current ECU tuning manual for details on fuel tuning.

The 400, 500 and 600 rows can now be tuned in the same manner as the 100,200 and 300 rows, by driving the car in the center of each row in the ZONEF screen. Please refer to the current ECU tuning manual for details on fuel tuning.

<b>Forced Induction</b>	<b>Vacuum</b>			<b>Boost</b>		
Row Pressure Center	29 kPa	60 kPa	100 kPa	140 kPa	180 kPa	227 kPa
Link Zone	Z26	Z27	Z28	Z29	Z30	Z31
AEM WBO2 (display)	66	68	76	96	108	122
Desired A/F ratio	14.8	14.7	14.0	12.5	11.5	10.5