89-93 Miata Install Manual for the Adaptronic Engine Control Unit

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This manual puts together the basics of installing the Adaptronic on the 89-93 Mazda Miata. It is designed to minimize the time necessary in order to get the car up and running.

Table of Contents

Adaptronic Installation Manual: Miata 89-93

Installation components:

Components supplied with kits:

- Adaptronic e420C ECU
- Plug and Play (PNP) Harness
- MAP sensor (1 or 3 Bar depending on needs)

Additional required tools and hardware:

- GM open element sensor IAT
- 12-20 gauge wire to mount MAP and IAT
- Soldering Iron and solder
- Wire cutters
- One DB9 serial cable
- DB9 Serial to USB interface (If computer doesn't have serial connection)

Highly Recommended components not supplied with kits:

- Wide band oxygen sensor- *Required for use with ECU auto tune.*
- *EGT gauge – For high horsepower tuning*

WB02 without serial cable connection if you intend to use a serial cable connection:

- One additional DB9 serial cable

WB02 can be installed with analog only (requiring no serial cable) if your WB02 does not support serial cable interface.

About the Manual:

It is always up to the installer to make the final call on the installation. Regardless of how easy a standalone installation has been made to be, it is not to be taken lightly. ***IT IS IMPORTANT TO READ THESE INSTRUCTIONS COMPLETELY FROM START TO FINISH IN ORDER TO AVOID CATOSTROPHIC ENGINE FAILURE, OR DAMAGING ELECTRICAL COMPONENTS.*** I also recommend the reading of the entire Adaptronic manual and taking notes on its important points. This is a distilled down version to get the product in the car and you driving as soon as possible. This quick start guide will not explain any advanced features which might dramatically improve performance, and drivability.

The use of a digital multi-meter to double check connections is an invaluable tool, and I encourage everyone to do so when installing the systems. The Adaptronic, and other electrical components on the motor should be treated with great respect, as poor connections, or inaccurate connections can damage components beyond repair, and even start electrical fires. This is particularly true of the MAP sensor as a single incorrect connection will permanently damage the sensor which is expensive to replace.

Contact Information:

If you have further questions about the installation process please feel free to email Travis@Boundaryengineering.com or call at (812) 989-3308. The return of goods can also be sent to: 1087 Baylor Wissman Rd. Georgetown IN 47122

Boundary Engineering has no store front, but I am more then happy to meet people in person to help them work out the install. These arrangements must be made in advance.

Contributions:

Contributions by customers on their installs are invaluable to others, and it helps me understand the difficulties and ways to make installation easier on the different models. I appreciate everyone's contribution to this manual, including John Kunkle (Stein of www.miataturbo.net) as well as many MiataTurbo.net forum members have proved to be very helpful as a whole in bringing together the necessary information for the installation of these units. If you have a write up you would like to further add please direct it to Travis@boundaryengineering.com and I'll make sure it gets put into the next edition.

Successes:

Of course above and beyond anything else I'm a performance purist at heart. I love to hear how the installs went and the dynamometer numbers produced. Feel free to forward that as well! I hope the install goes great and it is nothing but smooth boosting!

Description of Parts:

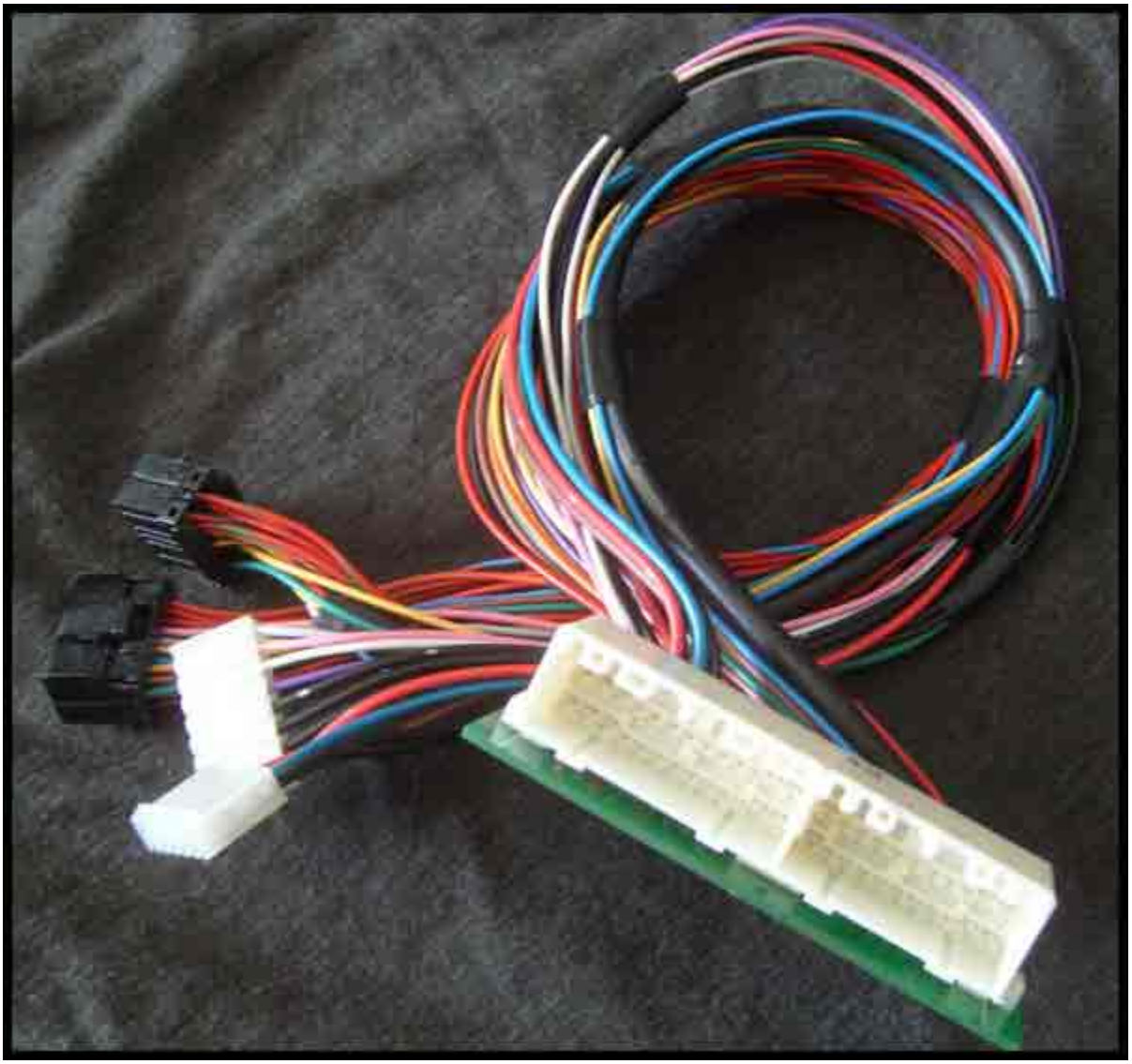
Adaptronic:

The engine control unit has 2 DB9 interface serial ports on one end and 4 standard connectors which send all the engine controlling signals on the other end. The holes in the flange are the preferred mounting point, but holes maybe drilled in the flanges for other mounting arrangements.

Adaptronic e420C ECU

The Plug and Play Harness:

This device plugs directly into the factory wiring harness and into the Adaptronic ECU. This connection carries all the signals from the Adaptronic to the car's engine control interfaces to run the motor. On the 89-93 the plug and play harness completely replaces the stock E.C.U.

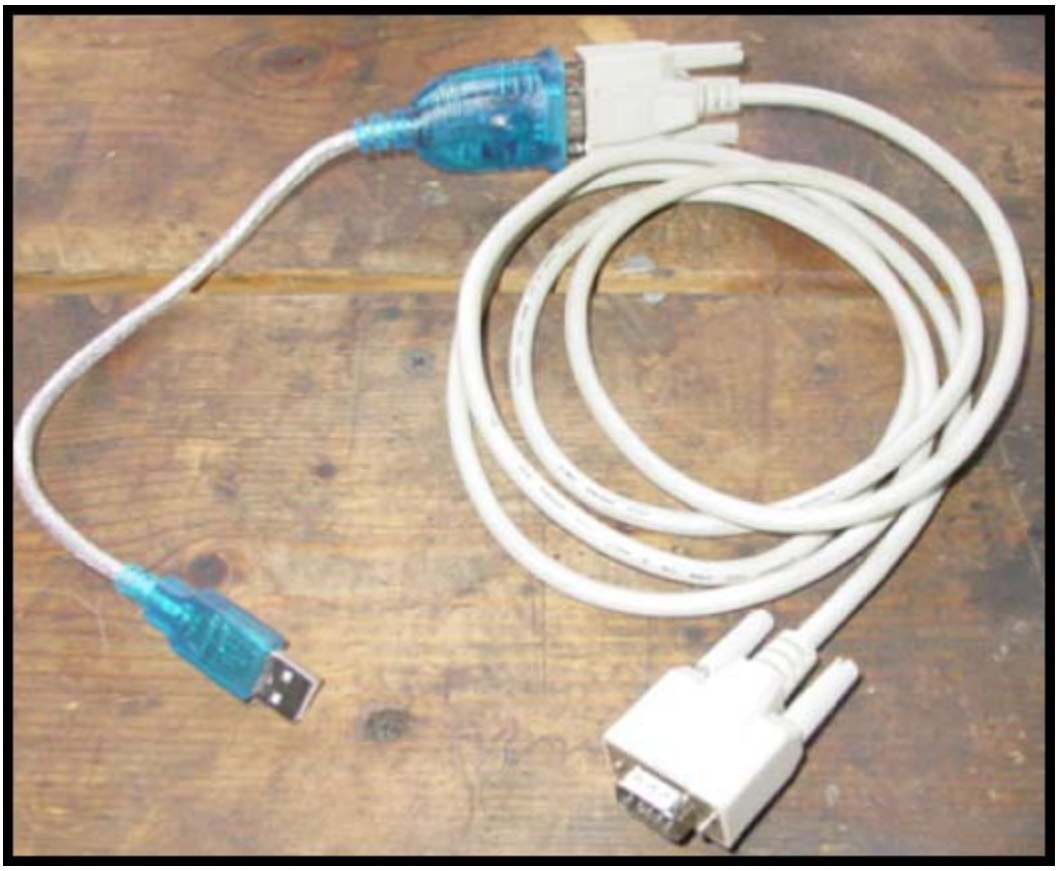


Plug and play harness for 89-95

DB9 Serial Cable:

The DB9 Serial cable is the standard “serial” interface used in computers. The serial cable is used to interface a computer with the Adaptronic hardware for tuning. If you are installing a wideband without plug and play serial interface you will need another DB9 serial cable to attach to the Adaptronic’s other serial port. Your computer may not have the DB9 port so a serial to USB interface is necessary to connect to the Adaptronic.

Make sure to install the drivers for the USB convertor if you are using one. Otherwise the Adaptronic may not be recognized, or may crash your computer.



The DB9 Serial cable with a USB to serial convertor (blue).

Intake Air Temperature (IAT) Sensor:

If the car is to be used with a forced induction application you will have to replace the stock sensor with an aftermarket sensor. The stock sensor is a plug into intake tube style which will pop out of the intake pipe under positive pressure so its just not suitable for use in a forced induction motor. The sensor from www.DIYAutoTune.com is recommended and be sure to match the kit to the material of the pipe (aluminum, or steel). This sensor threads in making it secure under the harshest boost conditions.

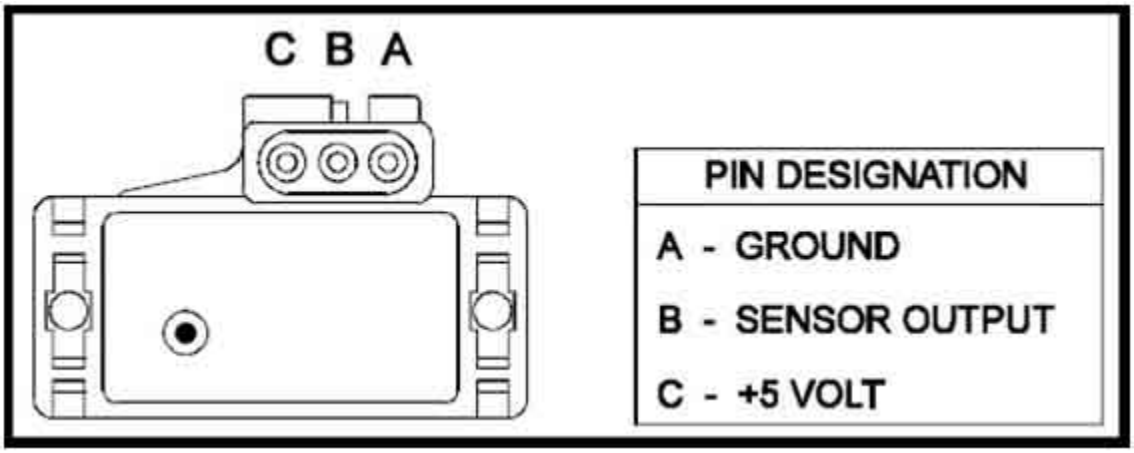
The calibration for the sensor at DIY Auto Tune has already been performed. This is why the sensor from DIY is recommended, but you can use any IAT open element sensor with a 0-3v range.

Open Element AIT Sensor with necessary mounting hardware

Manifold Absolute Pressure (MAP) Sensor:

This sensor reads the pressure of the engine in order to determine how much air is entering the motor. This replaces the mass air flow sensor (MAF) on the vehicle. This sensor is critical to prevent engine damage. Check all connections thoroughly for correct wiring, and connectivity before turning on the ignition key. An incorrect wiring to this sensor will permanently damage it the first time incorrect voltage is applied.

Standard MAP sensor



Connections diagram

Physical Installation of the Adaptronic System:

Intake Air Temperature (IAT) Sensor:

Turbocharged Install:

The sensor needs to be mounted in the intercooler charge pipes after the intercooler as close to the throttle body as possible without getting it near hot spots in the engine bay. The hotspots can cause heat soak, and throw the sensor off. On the 89-95 models a wire must be ran directly from the Adaptronic to the wiring as the stock IAT wire is used for the fuel pump. The IAT should be grounded to the factory grounding point, but then soldered to the wire from the Adaptronic. The GM IAT is indifferent to positive or negative, so it doesn't matter which wires you solder together.

Naturally Aspirated Install:

With naturally aspirated vehicles the stock IAT sensor maybe used, and the location of the IAT should be in the intake tube tract or next to where the air is being drawn from. If you are using independent throttle bodies the IAT should be mounted in the middle of the stacks so it can read the average air temperature that the stacks are using.

IAT Calibration:

The IAT sensor has to be calibrated for every 5*C. The GM IAT sensor and the stock IAT sensor are nearly identical in response. This has already been loaded into the base maps for the Miata's. Creating a new map is easy, and could account for variations of 5% or so between sensors. It is also important to map as much of the temperature range as possible. The provided map was created by heating a cardboard box with the sensor placed inside to 80*C. The temperature was negative 15*C in the shop so using the learn function and a meat thermometer it was calibrated for every 5*C. The sensor could also be calibrated for by going in the opposite direction with blow drier and from ambient.

MAP Sensor:

Next you need to install your MAP sensor. There are three wires in the installation. Those are negative (ground), 5V positive, and signal. There is a diagram showing the connection placement in the description section.

MAP Wiring:

Cut off the stock connector that leads to the MAF sensor. Then wire the MAP as the following. Signal wire B (Orange) is attached to the light green / black wire. Ground wire A (Brown) is attached to the Black w/ red trace. The C wire (Yellow) is attached to the red wire.

MAP Mounting:

The MAP sensor can be zip tied or free hanging. One popular mounting location is on the windshield fluid reservoir bolt.

Ground Loop Correction:

In some cases the wire shown below causes ground loop interference resulting in sensor malfunctioning. If you have this problem the intake air temperature sensor will change when the RPM of the vehicle changes, and cause poor idle, and running characteristics.

Proximity of the wire

Close up of wire

Wide Band installation:

First mount and wire your wideband as per the factory instructions.

LC-1:

Installations using the LC-1 are very straightforward. The LC-1 unit is supplied a plug in mini-din to serial port convertor. To install the unit plug the serial port into the Adaptronic. Make sure as per the factory instructions that you plug the serial to mini-din convertor into the “out” plug of the LC-1 and make sure you use the other mini-din plug in the “in” port or the the system will not work.

AEM UEGO:

The AEM UEGO requires additional wiring and a spare serial harness if it is to be used with a serial connection. To connect to the Adaptronic you need a DB9 cable, female end only. Cut the end of the cable off with another 12-18" of cable with it. Then strip back the wires. In order to make sure you have the correct wires it is best to match them to the pins. The colors vary depending on manufacturer of the serial cable. Pin 5 and Pin 2 are what is used on the AEM UEGO.. Use a voltmeter to check continuity. Don't trust the color codes. The AEM manual says that they usually are red and green, but in one example they were yellow and brown. The AEM manual was a little unclear as to which pin was which. It is listed as "wire view" so it is opposite of the diagram when looking at the end of the female connector.

The pin numbers are molded in place on the connector as shown in the photo. Pin 5 is the upper LEFT pin. Pin 2 is the 4th pin from the left in the top row. Probe the two pin holes to find which wire is Pin 2. That is the signal wire. Solder the BLUE wire from the AEM UEGO harness to this wire. Pin 5 is the ground wire. Solder a length of wire to this wire sufficiently long to reach a convenient chassis ground point. Ground this wire to the chassis. Mount the rest of the wideband according to the AEM directions.

Universal Oxygen sensor input:

If you have selected a wideband which does not support a serial connection or you don't want to use this connection technique then you may run the wideband signal through the stock narrowband harness. Find the signal wire of the harness, and connect the wide bands linearized output into the stock harness signal lead and the Adaptronic will use this as the primary WBO2 input.

ECU Installation:

The ECU is very robust, and can hang free, but for operating safety, and cleanliness of install It is best to mount the unit. Kits will soon be available for mounting the Adaptronic in the stock position, or it can be easily mounted on any of the flange points, and in any orientation. Care should be taken to keep water out of the ECU as it is not rated for being water proof.

Basic connections mapping:

Check all MAP connections with a digital multi-meter:

- MAP sensor +5v -> Connect to +5V on the factory MAF sensor Red
- MAP sensor GND -> connect to GND on the factory MAF sensor Blk/red
- MAP sensor Signal -> connect to the LtGrn/Blk signal wire that was used for the MAF sensor

Outputs of e420c as used on plug-in loom adapter

- Aux out 1 -> Idle control (PWM @100Hz)
- Aux out 2 -> PRCV
- Aux out 3 -> Air Conditionner
- Aux out 4 -> Free output Formerly Purge Valve Solenoid Line
- Aux out 5 -> Fuel Pump
- Aux out 6 -> Check engine light
- Aux out 7 -> Radiator fan
- Aux out 8 -> A/C fan

Inputs of e420c as used on plug-in loom adapter

- Aux in 1 -> PSP (act low)
- Aux in 2 -> A/C switch (act low)
- Aux in 3 -> Coolant fan (act low)
- Aux in 4 -> Cabin Blower (act low)
- Aux in 5 -> TNS relay (act hi)
- Aux in 6 -> Clutch (act low)
- Aux in 7 -> Closed throttle (act low)
- Aux in 7 -> Unused

Software Setup:

Flash the ECU:

For you to use the most up to date features you must first flash the ECU unit. What this does is actually update the operating system of the ECU in a similar way as you would see from one windows version to the next.

Before loading a new firmware update make sure to save your current tune to your computer if you have one loaded. The flash procedure can corrupt tunes on the ECU. If you are reading this with a fresh install then there are no maps preloaded to the ECU.

Flashing Procedure:

To upgrade the firmware of an Adaptronic ECU, you will need to run the software called "Flashit" This is located in the "Flash Software" directory of the installation package.

1. When the Flashit software has first been run it will read "No comms with ECU. Connect and rest ECU"
2. Turn the key to vehicle to the on position.
3. This should cause the ECU to show "ECU Connected"
    a. If this does not happen select different serial ports until you find the ECU
4. Next load the firmware you want to flash to the ECU by clicking the "Load button"
    a. You will find an up to date flash in the packet with the same directory as the software
5. Click "Program" button on the Flashit software. Your ECU will not be reprogrammed.
    a. If the Flashit software presents many errors upon hitting the program file it is likely you are using a USB to serial convertor, and have not updated or installed these drivers.
6. Once the reprogram is successful click the "Verify" button.
7. If the verification was successful without errors click the "Run" button
8. The Flashit software should now read "No comms"
9. To finish turn the key off, and back on again.
10. You can open the WARI program and it is recommended you reload your current tune.

Loading a tune:

1. To load a tune open the WARI software and select "Load." Once this is done a screen will come up waiting for you to navigate to the tune you want to load.
2. Select the directory that corresponds to your model year. Then open a tune you would like to load.
3. After this the WARI software will display the tune you have just loaded. Now cycle the vehicle ignition to the on condition and connect your computer to the Adaptronic.

4. If the computer automatically connects it will be displayed in the upper right of center position of the WARI software. If the software still doesn't connect go through the "port" tab all the way at the top. Select each port in the tab going one by one until the software connects.
5. Once the software is connected select the button called "Write all" This will write the current tune you loaded to the ECU.
6. Wait for the write process to be complete. The car should now be ready to start.

Tips and Tricks:

Tuning map:

In the WARI software over on the fuel tuning tab there are a couple of things to help you along with the tuning process.

- On the left hand side on the tuning tab there is drop down box that is called "Text map colors" Using the highlight current cell option takes the guess work out of where you are on the current map.
- Right click on the number cells below the map. There are a range of options here that are invaluable to speeding up the tuning process. To use these options you left click and drag to highlight the cells. Then once you've highlighted the cells right click to bring up the options. The percentage changes and interpolation options are the most important of the list.

General Software:

- Use the "windows" tab at the very top and then "gauges" selection to help with understanding on what your vehicle is doing.
- Use the logging feature located under "file" and then begin logging to generate logs and show you where the tune may need more auto tuning, or hand tuning time.

Megalog Viewer:

- The logs from the WARI software can be opened in megalogviewer which will give you a graphical representation of the log the Adaptronic outputs. This can really help with pinning down bad fuel tuning cells.

To use the megalogviewer:

1. Save the file from the Adaptronic as a *.CSV file.
2. Open the megalogviewer included in this software package (install first from megalogviewer directory to your comptuer).
3. Load the file generated by the Adaptronic.

a. If an error occurs open the file in excel and find the “replace” button. In 2007 its located all the way on the right in the “home tab” in the same vicinity as the find.
b. In the find what box type “-“ without quotations around it.
c. In the replace with box type “0” without the quotations around it.
d. Save the file again as a *.csv
e. The file should now load properly in megalogviewer. The problem is that the megalogviewer cannot read the “-“ values that the Adaptronic sometimes use to show that a sensor is not ready. By getting rid of these values and replacing them with 0s the mega log viewer can open it.

Additional information:

Forums:

http://www.miataturbo.net/forum/f63/ The board Boundary Engineering predominately posts on.

http://www.adaptronic.com.au/forum/ The Official Adaptronic Forum.

Adaptronic Website:

www.adaptronic.com.au/

Boundary Engineering Website:

www.boundaryengineering.com

Phone Support:

Boundary Engineering United States: 1-812-989-3308