

Flyin' Miata

tech line: 1 970 242 3800



Flyin' Miata ECU installation instructions for '94 & '95 Miatas

Revision 1.0
4-4-03



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Section 1: Introduction

The FM ECU completely replaces the factory ECU to take full control of the engine's functions. The ECU fits into the factory ECU case and plugs into the factory ECU harness. Since the ECU was first designed, we have added one new feature, intake air temperature measurement, that requires moving one wire in the factory wire harness. This modification is outlined in Section 3 of the following instructions.

For all of the wire splicing required for the modifications in this manual we recommend, and include, heat shrinkable crimp connectors. A crimp connection is better both structurally and electrically than a solder connection. If you do not believe us, try to find one soldered connection in the entire wire harness in your Miata. The integrity of a crimp connection depends on the quality of the tools used for the installation. Go to Sears and invest in a high quality pair of wire crimping pliers. These can be bought for \$25 to \$30 and will quickly pay for themselves in this, and future, projects.

The included crimp connectors use a heat shrinkable coating. Once the wires are crimped in place, heat the connector with a heat gun (buy one of these at Sears with your crimping tool) to shrink down the outer covering. This will provide a water tight seal for the life of your car.

Section 2: Mounting the FM ECU

The factory ECU is found under the carpet behind the passenger seat.

- 1) Disconnect one of the terminals on the battery.
- 2) Slide the passenger seat all the way forward then pull up the carpet behind the seat. The ECU is bolted to the rear bulkhead.
- 3) Remove the wire harness by pressing down on the tab in the center of the connector and pulling down on the plug. The ECU can now be removed from the car.
- 4) Take the ECU to a workbench where it can be worked on. Remove the phillips screws that hold the mounting brackets and the top and bottom covers on the ECU case. Remove the two small screws holding the heat sink to the side of the ECU case.
- 5) Remove the phillips head screws that are holding the printed circuit board and remove the stock board. Install the Link board in place of the stock board and reinstall the screws.
- 6) Make a slot in the lid to allow the ribbon cable to pass through without being pinched by the lid. Plug the ribbon cable from the keypad into the ECU socket, then put covers and the mounting brackets back on. Mount the ECU back in the car. Do not plug the wire harness into the ECU just yet.



Section 3: Wire Harness Change

Since the FM ECU's initial design we have added an intake air temperature sensor. To utilize this new feature one wire will have to be moved in the ECU plugs.

Note: The intake air temperature sensor is not optional, it must be used in order for the FM ECU to work properly.

Intake Air Temperature Sensor

- 1) Look carefully at the back (side that the wires go in) of the connectors, a hinged flap on top and bottom of the connectors holds them in place. Slip a knife or thumbnail under both edges of the flaps to release them. This exposes the individual terminals.
- 2) The Blue/Yellow wire in position 1P will be moved to 1M. If there is a Green/Red wire in position 1M, remove it and tape it off because it will no longer be used. To do this, slip a sharp pointed tool, like a dental pick, into the back of the metal connector above the wire. The tool must slide through the little loop of metal above the wire—this will release a plastic lock tab to let the connector pull out. Pull back on the tool and the wire, both will slide out the back of the plastic connector.



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

21	20	26	29	33	23	24	25	27	28	22	25	24
B/W	L/O	Y	L/W	L/W	R/W	R/B	LG/W	B/W	Y/L	W	B/L	B
D	Y/R	Y/B	LG	Y/B	R/B	R/L	L/R	LG/R	LG/Y	B/R	B/L	B
22	24	27	21	28	28	24	25	22	24	27	22	28

10	18	12	13	16	14	11	15	17	10	12
R/B	L/O	LG/B	B/B	B/R	B/L	L/W	BR/Y	Y/B	Y	L/O
BR/W	Y/R	Y	L/Y	R	B/G	L/B	BR	*	W/B	B/O
10	17	15	18	16	12	12	14	17	12	18

Note: On some cars without power steering the Blue/Yellow wire will not be in the harness. In this case a new wire must be run from position 1M on the ECU to the engine bay, long enough to reach the radiator.

Ballast Resistors

The 550 cc/min fuel injectors, supplied from Flyin' Miata, are low impedance while the FM ECU is designed for high impedance fuel injectors. Ballast resistors must be added in series with the fuel injectors to keep the ECU happy.

3) Find the 4 signal wires for the fuel injectors in the ECU harness plugs. They are:

Location	Wire Color	Fuel Injector
2U	Yellow	Injector #1
2V	Yellow/Black	Injector #2
2Y	Green	Injector #3
2Z	Green/White	Injector #4

4) Cut the Yellow wire about 1" to 2" back from the harness plug.

5) Crimp one male spade connector to one end of the Yellow wire just cut. Crimp one female spade connector to the other end of the Yellow wire just cut.

6) On one of the ballast resistors, connect the male spade connector to the female connector on the fuel injector wire. Connect the female spade connector to the male spade connector on the fuel injector wire.

7) Repeat steps 5 and 6 for the other three fuel injector wires.

8) Mount the ballast resistors to the top two cover bolts on the ECU case.



Section 4: Air Temperature Sensor

Turbocharged Cars

The intake air temperature sensor is a required part of the ECU and its function. The sensor must be installed properly in order for the ECU to function.

1) On FM turbo kits the temperature sensor fits inside the boss on the throttle inlet pipe. New turbo kits will have a slot machined in this part from the factory. On existing kits cut a 1/16" wide 1/4" deep slot vertically in the boss as shown in the photos.



2) Take off the rubber hose that connects the IAC valve to the throttle body inlet pipe and drill a 1/16" diameter hole in the side for the two wires from the air temperature sensor to come through.

3) On the air temperature sensor, tie both wires together in a single knot about 2" from the sensor board. Run the wires out of the hole in the IAC hose. Pull them through the hole until the knot stops the wires from going any farther.

4) Slide the air temperature sensor into the boss on the throttle body inlet pipe all the way down so that the ears on the board set in the two slots on the boss. Then slide the IAC hose over top the boss.

5) Secure the hose on the boss with a hose clamp. Seal the hole in the IAC hose with a small dab of silicon sealant.



- 6) Mount the throttle body pipe back on the car.
- 7) Crimp the ring terminal to the black wire on the temperature sensor and connect it under the 6mm nut that holds a few other grounds to a bracket just below and inboard of the throttle body. (See photo on the previous page.)
- 8) Crimp the bullet connector to the white wire.
- 9) On the top of the power steering pump is a Blue/Yellow wire. This is the same wire moved at the ECU plug. Pull this wire off the power steering pump by pulling it straight up. Connect the white wire from the air temperature sensor to the female bullet connector on this wire.
- 10) If the car is not fitted with power steering, but the Blue/Yellow wire was moved at the ECU harness, the Blue/Yellow wire will be tied off to the breather line behind the thermostat housing. Connect the white wire from the air temperature sensor to the female bullet connector on this wire.
- 11) If the Blue/Yellow wire was not in the wire harness down at the ECU, then the new wire run out to the engine bay will now be connected to the white wire on the air temperature sensor.

Supercharged Cars

Warning: The intake air temperature sensor can only be used in the following location (after the blower) if the system uses an intercooler or water injection. On non-intercooled systems the temperature sensor must be mounted before the blower because the air exiting the blower will exceed 100°C and trigger the ECU's intake over temperature limit.

The intake air temperature sensor is a required part of the ECU and its function. The sensor must be installed properly in order for the ECU to function. In JR supercharged installations the air temperature sensor can be mounted in the dummy throttle body on the intake manifold as long as an intercooler is used.

- 1) Remove the dummy throttle body from the motor.
- 2) Drill a 1/2" diameter hole in the dummy throttle body as shown in the photo on the next page. Drill two holes in the side of the body for the wires to go through.
- 3) Mount the intake air temperature sensor in the hole and run the wires out the two small holes. Secure the sensor in place with a small dab of silicone sealant.
- 4) Mount the dummy throttle body pipe back on the car.
- 5) Crimp the ring terminal to the black wire on the temperature sensor and connect it under the 6mm nut that holds a few other grounds to a bracket just below and inboard of the throttle body.

6) Crimp the bullet connector to the white wire.

7) On the top of the power steering pump is a Blue/Yellow wire. This is the same wire moved at the ECU plug. Pull this wire off the power steering pump by pulling it straight up. Connect the white wire from the air temperature sensor to the female bullet connector on this wire.

8) If the car is not fitted with power steering, but the Blue/Yellow wire was moved at the ECU harness, the Blue/Yellow wire will be tied off to the breather line behind the thermostat housing. Connect the white wire from the air temperature sensor to the female bullet connector on this wire.

9) If the Blue/Yellow wire was not in the wire harness down at the ECU, then the new wire run out to the engine bay will now be connected to the white wire on the air temperature sensor.

Normally Aspirated Cars

Since the intake system on a normally aspirated cars can vary greatly and there is no compression of the intake charge, the intake air temperature sensor can be mounted almost anywhere. For example, if an open element air filter is used, the sensor can be secured to the outer surface of the filter with a zip tie. On systems using the factory plastic cross over pipe, the sensor can be mounted somewhere in the pipe. Just make sure the sensor does not move or vibrate. It must be held securely in place.

Follow the wiring instructions for either the supercharger or turbocharger section.



Section 5: Fuel Injectors

This section covers replacing the stock fuel injectors with the 550 cc/min fuel injectors required for boosted operation. On normally aspirated installations the stock injectors will be used, so skip this section.

- 1) Remove the gas cap to relieve pressure in the fuel tank.
 - 2) Unplug the electrical connectors for the fuel injectors.
 - 3) Cut off the stock fuel injector connectors about 2" back from the connector.
 - 4) Take the four new fuel injector connectors supplied with the fuel injectors and cut the wires down to 2" in length.
 - 5) Splice the new connectors on the harness just as the stock connectors were configured using the red butt connectors. Polarity does not matter.
 - 6) Remove the three 8mm bolts holding the fuel rail in place. There are three black plastic spacers between the fuel rail and the head that will be loose when the bolts are removed, don't lose them!
- NOTE: Some fuel will spray out at this point so have a disposable towel ready and do NOT have a droplight nearby.**
- 7) Once the bolts are out, wiggle the fuel rail off the injectors and pull the injectors out, being very careful not to lose the little black rings on the lower ends of the injectors. These rings will be re-used.
 - 8) Prepare the new injectors by transferring the lower rings from the old injectors. Use a small amount of grease to make the rings slide on easier. Lubricate the o-rings at the top of the injector with grease as well to help them slide into the fuel rail. Be careful not to get any grease into the injectors.
 - 9) Fit the new injectors into the holes in the cylinder head with the electrical connectors up. Slide the fuel rail down over the rubber o-rings. The o-rings fit tightly into the fuel rail, so push the fuel rail down firmly.
 - 10) Install the 8mm bolts and the spacers to secure the fuel rail to the head.
 - 11) Plug in the electrical connectors.

Section 6: MAP Sensor

The Flyin' Miata ECU uses its own MAP (Manifold Absolute Pressure) sensor to measure the airflow so the factory airflow meter will no longer be used. On Flyin' Miata turbo kits the piping is already designed to eliminate the airflow meter. On supercharged and normally aspirated applications the installer will have to fabricate a pipe to take the place of the factory airflow meter. The air flow meter could be left in place, but it presents a considerable restriction to the intake air charge.

1) Plug the supplied rubber vacuum hose into the hose barb in the MAP sensor. Plug the RCA jack on the knock sensor wire into the MAP sensor.

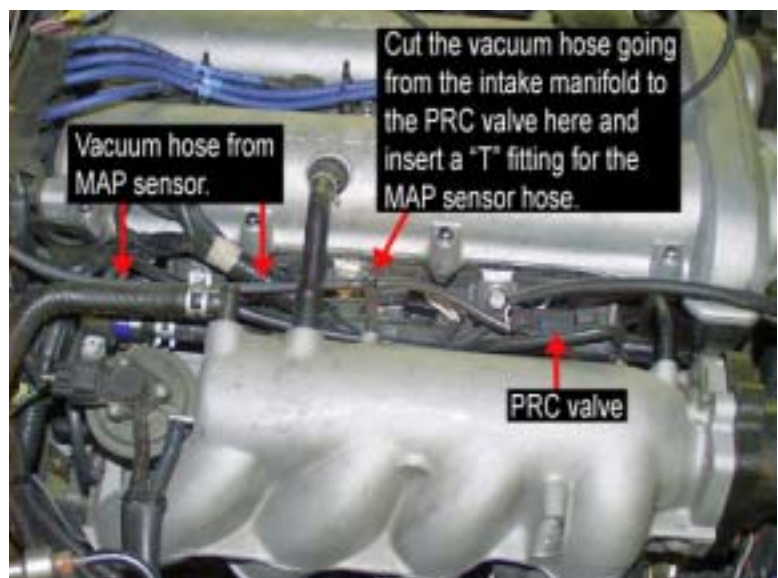
2) Mount the MAP sensor on the black plastic electrical cover on the driver's inner fender by using the provided double sided tape.

3) Run the vacuum hose and the knock sensor wire across the engine bay securing them to the metal vacuum line that goes to the brake booster. Let the knock sensor wire hang down on the passenger side of the engine. It will be connected in the next section.



4) The signal for the MAP sensor comes from the intake manifold. The hose to cut is shown in the photo below. It comes out the the intake manifold toward the cam cover then turns forward to connect to the PRC valve. Cut this hose about 1" from the manifold and insert the "T" fitting from the ECU.

5) Connect the vacuum hose from the MAP sensor, to the "T" fitting.



Section 7: Knock Sensor

The knock sensor replaces the upper front mounting bolt on the passenger (right side) motor mount.

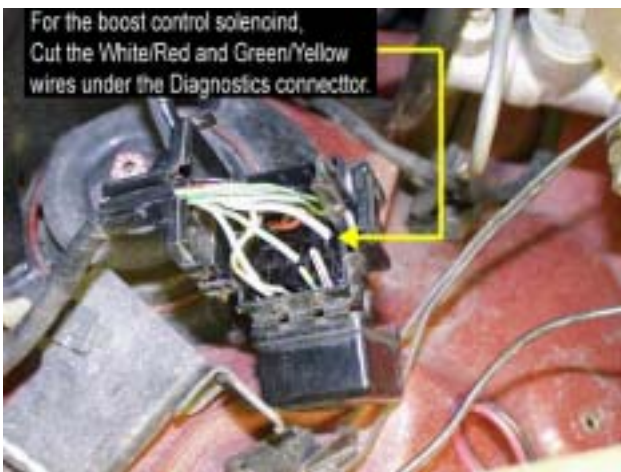
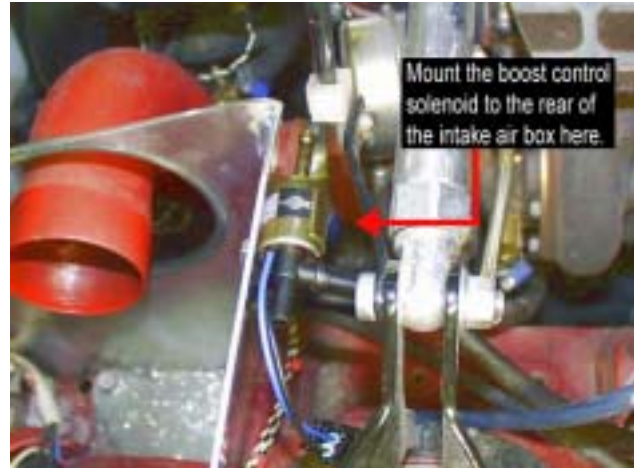
- 1) Remove the 10mm bolt in the upper forward corner of the motor mount.
- 2) Replace this bolt with the supplied adapter bolt and tighten to 20 ft/lbs.
- 3) Install the knock sensor with supplied 8mm allen bolt. Tightening this bolt to 12 ft/lbs, using blue Locktite on the threads. **PLEASE TORQUE CAREFULLY!**
- 4) The harness for the knock sensor will be hanging down on this side of the engine from the previous section. Plug the harness onto the knock sensor. The plug is rather tight so make certain it is fully engaged on the sensor.



Section 8: Boost Control Solenoid

The electrical signal for the boost solenoid will travel back to the ECU through the Green/Yellow wire in the TEN terminal in the diagnostics connector. 12 volts will also be needed to power the solenoid. The air pressure signals to and from the boosts control solenoid are best supplied with 1/4" hose. FM turbo kits include this hose as part of the kit. If this installation is not using an FM turbo kit, get some 1/4" hose for the signal lines

- 1) Mount the boost control solenoid to the air box as shown.
- 2) Open the bottom of the diagnostics connector to expose the wires. Cut the Green/Yellow and the White/Red wires as close to the connector as possible.
- 3) Using the supplied butt connectors connect the blue wire from the boost control solenoid to the White/Red wire. Connect the black wire from the solenoid to the Green/Yellow wire. The wires on the solenoid may have to be extended to make this connection.



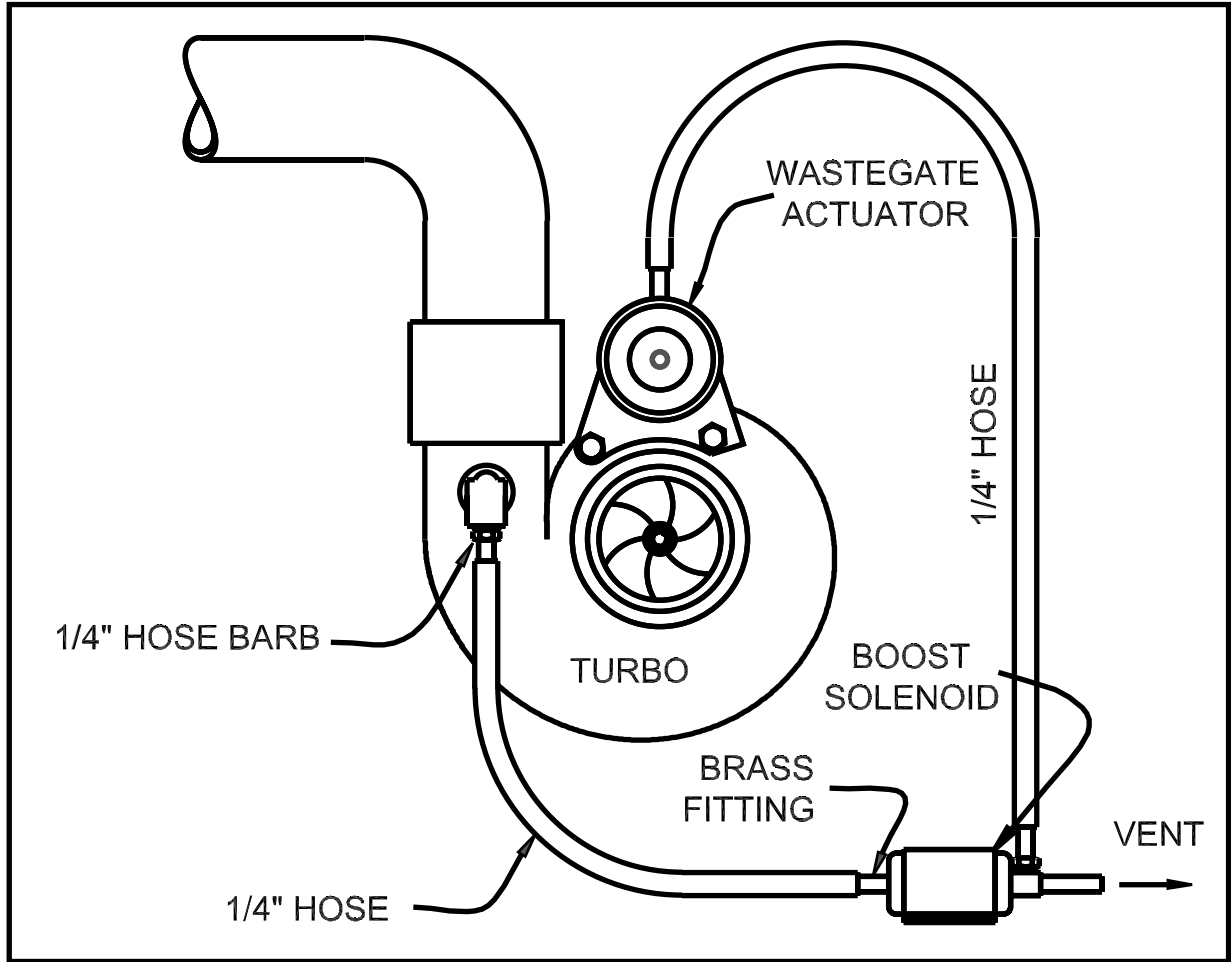
Wires from the boost control solenoid connected to the White/Red and Green/Yellow wires under the diagnostics connector.

Note: See the diagram on the next page for the boost control hose routing.

- 4) The boost control solenoid needs to sense the pressure created by the turbo. On our FM2 turbo kits a 1/4" hose barb is mounted on the turbo for this purpose. Use the 1/4" hose to connect to the brass nipple on the solenoid.
- 5) Connect the black plastic nipple, at the opposite end of the solenoid, pointing at a right angle to the brass nipple, to the wastegate actuator on the turbo. The second plastic nipple

pointing straight out the end of the solenoid vents to atmosphere. Leave it open.

6) Secure the connections of the hoses with hose clamps. If these hoses blow off, control of the wastegate will be lost and the turbo will make enough boost to damage the engine.



The ECU installation is now complete. Refer to the ECU tuning manual to get the car up and running.