Flyin' Miata
We make Miatas fly!

Flyin’ Miata ECU installation and tuning instructions for 1.6L and 1.8L Miatas

Revision 1.5
For software revisions 16M1206 & 18M1206 and later

Table of contents

Section 1: Theory of operation

The Flyin' Miata ECU replaces the factory ECU taking full control of the car's engine functions including fuel delivery and ignition timing. The Flyin' Miata ECU uses a manifold absolute pressure (MAP) sensor to measure airflow so the stock airflow meter can be removed eliminating a restriction in the intake tract. The Flyin' Miata ECU uses the signal from the oxygen sensor to calibrate fuel delivery so it can control larger fuel injectors for high performance normally aspirated engines as well as forced induction engines.

The Flyin' Miata ECU is user programmable, so it can be configured for virtually any engine configuration. The programming variables, called zones, operate all aspects of the engine and are viewed and adjusted using a hand held keypad. The zones are utilized as follows. Zones Z0 through Z31 control general operating parameters of the engine. Zones Zf100 through Zf675 are used as a grid of 6 rows and 16 columns to control fuel delivery to the engine. Zones Zi100 through Zi675 use the same grid layout but control ignition timing advance. Zones Z700 through Z775 control a few other operating parameters as well as the manifold pressure targets for turbocharged engines when using the remote boost control solenoid.

Most of the zones from Z0 to Z31 are displayed in the main menu on the keypad with a text description so the user will not have to remember the different zones based on their number (i.e. Z1 being master fuel). A full list of the zones can be found on page 11 and a detailed description of all the zones follows in this section. The words in bold type are exactly as the keypad displays. Zones not listed with text descriptions are noted. The zones are viewed by scrolling through the keypad using the select buttons. When the ECU is powered up the keypad always displays the same zone, "TEST RPM". Use the select up button to view the other zones. The last display shows "EDIT Z0". This is the first of the EDIT Z windows. EDIT Z is a submenu where you can make manual adjustments to any zone. The edit buttons are used to scroll through the zones in sequence denoted by their zone number (i.e. Z16). In all windows, the adjust buttons are used to change the value. Note: You can perform a "store" from anywhere in the EDIT Z submenu by holding both "edit" arrows down until you get a full row of asterisks.

The software chip includes 4 different programs of default values for all of the operating zones, two for normally aspirated and two for turbo use. These default values will be very close to the final values required to make the car run at peak efficiency and power. The ECU features a self-learning mode called Lambda, where the ECU uses the air/fuel ratio signal from the O2 sensor to adjust the fuel delivery to the engine.

Below is a detailed list of all the operating parameters of the computer. The text in bold print reflects exactly how it displays on the keypad if that particular zone is listed. Words in red are displayed on the key pad. Words in blue are not listed and can only be modified in the EDIT Z menu. The number in parentheses is the data location in the EDIT Z menu. Green refers to the buttons on the keypad.

TEST RPM: Displays the engine RPM. To the right of the RPM readout the ECU displays the fuel correction factor number. Pressing the adjust up button displays the data log type and the engine temperature. Pressing the adjust down button displays the manifold pressure (MAP) and the air/fuel ratio from the oxygen sensor (O2). Pressing the edit up arrow will display the ECU type and the software release code. Pressing the edit down button will display the atmospheric pressure and the wastegate duty cycle. Pressing both adjust buttons together accesses the security feature. Pressing the edit up button (while holding both adjust buttons) turns the security feature on or off. When security is turned on the car will not start when the keypad is disconnected from the ribbon cable.

STORE: The ECU works like a PC. Any information changed in the memory while the car operates must be saved before turning the car off. Scroll to the window that says STORE and press both adjust buttons down together and hold until the screen fills with asterisks. Once the asterisks are gone all new information is saved into permanent memory. The ECU will not STORE above idle speed. A STORE can also be done anywhere in the EDIT Z menu by holding both edit buttons down until a row of asterisks fill the screen. The ECU displays the fine tuning status to the right of the STORE window.

ZONEF: FUEL ZONES (Zf100 to Zf675) These zones represent a grid, 6 rows by 16 columns, of fuel correction values used to fine tune the operation of the engine. See the grid on page #11. The first digit of the zone number indicates manifold pressure row. The second and third digits indicate RPM column. Example: zf 105 would mean “row 1” (high vacuum), between 500 and 1,000 RPM (05). Rows are divided by manifold pressure as follows:

Row	Pressure for turbo application		Pressure for N/A application	
1	0 to 40kPa	30 to 18 inHg	0 to 33kPa	30 to 19.8inHg
2	41 to 80kPa	17 to 3 inHg	34 to 47kPa	19.5 to 15.7inHg
3	81 to 120kPa	2inHg to 3psi	48 to 60 kPa	15.4 to 11.8inHg
4	121 to 160kPa	4 to 9psi	61 to 73kPa	11.5 to 8.0inHg
5	161 to 200kPa	10 to 15psi	74 to 87kPa	7.7 to 3.8inHg
6	201 to 254kPa	16 to 22psi	88 to 100kPa	3.5 to 0inHg

The columns are divided by engine RPM, 0-8000 in 500RPM steps.

INJ % OXY: Instantaneous display of the fuel injector duty cycle and the value from the oxygen sensor. In this screen the MAP type can be changed on **(1.6L cars only)** by pressing both adjust buttons together and either the edit up or edit down button. The default value is the Mk2 sensor, which is fitted with all Mk2 ECUs. The only reason to change would be to retrofit an old Mk1 MAP sensor

ZONEIGN: IGNITION ZONES: (Zi100 to Zi675) The same grid used for fuel values, but for ignition advance values. All values in the ignition zone grid must be added to the static timing set by the cam angle sensor (CAS). The timing readings in the edit z ignition zones will be four times actual values. So a reading of "40" is actually 10 degrees. All ignition timing values are now set for a CAS setting of 0^{o} BTDC.

KNOCK: (Z13) Knock sensor threshold sets the value at which the ECU will distinguish detonation from background noise. The number to the left is the instantaneous level of "noise" heard by the sensor. This is useful to verify that the sensor is functioning. When running the car over 200RPM and full throttle, the number on the left will flash instantaneous values from the knock sensor. The number in parentheses counts the number of times noise exceeded the threshold (knocks) since the last save or when the car was turned off. When knock is heard the ECU will take up to 6 degrees of timing out of the ignition zone in which the knock occurred. This amount of reduction will be not be stored permanently. The user must perform a "store" to permanently save the ignition timing change. Pressing both edit buttons, while in the knock window, will reset the knock count without saving the timing change. The number to the right of the parentheses is the current level of the "knock sensitivity". Higher numbers mean lower sensitivity, in other words, the higher the sensitivity threshold, the louder or higher value the noise must be to be considered a knock.

IDLE % RPM: (Z8) Two pieces of information are displayed in this window. The right side of the window displays the target idle RPM value. The left side displays the duty cycle of the Idle Air Control (IAC) valve. With the engine fully warm, adjust the bypass screw on the throttle body so that the IAC value is between 30% & 40%, with the ideal reading of 35%. When the throttle is closed an * will appear to the right of the idle target value. When the car is in neutral, an "n" will appear to the right of the idle target value. If these two characters are not showing the car will not idle properly.

IDLE MAP: (Z0) Sets the hot idle MAP value in the ECU. With the engine fully warm the idle MAP should be set to equal the number in parentheses. The ECU automatically subtracts 3kPa from this value for its use. If 28 is entered in IDLE MAP, Z0 will be 25. If the MAP reading varies set IDLE MAP equal to the lowest number.

TPS SPAN: This is a combination of zones Z10 & Z11. On the 1.8L cars the ECU monitors the throttle position. With the car "on" but not running adjust the

number on the right to 10. Open the throttle fully and adjust the number on the right to 100.

AC IDLE: (Z20) The amount the IAC valve increases when the air conditioner is turned on. Used to prevent idle droop when the AC compressor turns on.

COLD: (Z16) Amount of additional fuel added to the engine during cranking and warm up. This amount of fuel decays to zero as the engine warms to 80°C. The current engine temperature is shown in parentheses.

CSTART: This window displays the cold start enrichment, similar to the choke on a carburetor. The choke fuel (Z6) is shown after the "f" and is adjustable using the adjust buttons. The choke decay time (Z710) is shown after the "t" and is adjustable by using the edit buttons.

HOT RESTART: (Z17) Amount of additional fuel added to the engine during hot restart. This additional fuel decays to zero over ninety seconds. Due to the PRC valve on the 1.8L cars a value of 70 in the HOT RESTART window indicates no additional fuel added by the ECU. The PRC valve cuts vacuum to the fuel pressure regulator on a hot restart, giving additional fuel. A value below 70 will deduct hot start fuel. If value of 70 does not provide enough fuel raise it.

MASTER FUEL: (Z1) Sets the overall fuel delivery to the engine. Unless you are using an injector size not supported by our defaults, the default values included with the software should be used. In master fuel the type of number display can be changed. Pressing edit up button displays an "a" in this window. This mode allows the ECU to alter master fuel if it finds a majority of the fuel zones to be too rich or too lean. When the ECU has to change master fuel it undoes all the zone changes and starts tuning again.

TEMP SWITCH: (Z9) Sets the temperature, in °C. at which the primary engine cooling fan will energize. This feature applies to 1.8L cars only.

TEMPERATURE LIMIT: (Z705) If your engine exceeds this setting, ECU will drop rev limit to 3,000 RPM, to "suggest" that you might want to take a look at your engine temp gauge. This limit is adjustable (temp, not rpm).

IGN TRIM: (Z21) Provides an overall ignition timing adjustment for all the ignition zones. If the car is filled with low octane fuel, ignition timing can be removed using this screen to prevent detonation and having the knock sensor take timing out of the ignition zones. When the fuel is used up, the retard can be removed restoring all the previous zone ignition settings. The value in IGN TRIM will not take any ignition zones below 0. It is also handy for making overall timing changes when dyno-tuning.

Pressing both edit buttons together will change the screen to the Cam Angle Sensor (CAS) set up screen. The screen will display IGN SETUP +10°. Any time the CAS is set this screen must be used. In this mode the CAS will be set to 10° BTDC because the ECU is adding 10° of timing to stabilize the idle.

RPM LIMIT: (Z2) Sets the rev limit for the engine. Hard limit, fuel cut off, occurs at set point. Boost is reduced starting 300 rpm before rev limit. For normally aspirated settings the limit is 9000RPM with no soft limit.

MAP LIMIT: (Z3) Overboost protection. This sets the manifold maximum pressure anywhere from 0 to 254kPa. When the manifold pressure reaches the MAP limit, the wastegate setting goes to 0kPa for one second then the ECU shuts off the fuel delivery. Setting MAP limit to 255 eliminates the manifold pressure limit. We do **not** recommend doing this. Map limit should be set 10kPa above the target boost pressure.

BOOST TGT: (Z725 to Z775) Manifold pressure targets when using the remote boost control solenoid. Zones are separated in 500RPM increments from 2500 to 7500RPM. When a value is entered in the BOOST TGT window all zones from 725 to 775 are filled with the same value. If a boost curve is desired, different target values can be entered into each zone in the edit Z menu. Making adjustments in the BOOST TGT window in the main menu will over-ride all individual targets.

There is an alternate method of controlling boost. Instead of setting the WG BASE and WG RPM and the WG SNS, a duty cycle can be entered into the boost set point zones (Z725-Z775). For instance, if a wastegate duty cycle of 35% gives you 12psi of boost, then setting Z740 to 35 will operate the boost control solenoid at 35% duty cycle at 4000RPM, resulting in 12psi of boost at that point. When setting individual wastegate duty cycles, each zone, from 725 to 775, must be set to the value of duty cycle that gives the desired boost level. Using data logs make this process a lot easier.

In the BOOST TGT window the type of boost control can be selected. When the "n" shows the boost control is normal meaning the boost target is always the values in Z725 to Z775. When the "t" shows the boost target is varied depending on the position of the throttle. On 1.6L cars the boost target is WG BASE until the throttle is wide open. At that point the boost target goes to BOOST TGT. On 1.8L cars as the throttle opens the boost target increases from WG BASE to BOOST TGT as the TPS goes from 63% to 95%.

WG SNS: (Z12) The sensitivity of the ECU when controlling the boost under open-loop conditions. This value is used for calculating a base line duty cycle of the solenoid which the software uses to initially guess the final value. This base line is used mainly during the turbo spool up time when the system is unable to control the boost and holds the wastegate setting close to the final (settled)

value. Higher numbers increase boost response at the expense of oscillation. Adjust wastegate sensitivity as high as possible without over shooting the target boost level when WG RPM is set to 7000.

WGIg: (Zf600 & Zf605) Wastegate loop gain. On some turbo systems steady boost control is not possible. The turbo boost will waver up to 4psi under closed loop control. These two settings allow the user to adjust the up and down rate of change to achieve stable boost control. See Section 7 for directions use this setting.

WG BASE: (Z14) Wastegate base is the mechanical wastegate setting. The value of boost made by the mechanical wastegate controller mounted on the turbo gets entered into WG BASE. Z14 is the wastegate spring pressure, which is WG BASE minus ambient atmospheric pressure. These two values are not exactly the same value but they are closely related. After setting WG BASE as described in section #8, the ECU will calculate Z14. Each time the car starts the ECU measures atmospheric pressure and adjusts WG BASE accordingly, so do not be concerned when it changes. Also, this requires you to pause for 3 seconds after tuning the car "on" before hitting the starter.

WG RPM: (Z15) The RPM point at which the ECU goes into closed loop boost control, attempting to hit its boost target zones. WG RPM should be set at the minimum RPM value that the car physically can produce the target boost.

LAMBDA: The ECU uses 3 different kinds of auto-tuning schemes to alter the fuel delivery curve to ensure the car operates at the proper air/fuel ratio at all times.

COARSE TUNING: occurs when the ZONEF window is selected on the keypad. Coarse tuning make changes often and in a wide range of the fuel zone so the values may not be perfect, but close. This is the first step in tuning the ECU

FINE TUNING: occurs in the STORE window. Here the adjustments are small and occur within 100RPM of the center of the fuel and MAP zone. This tuning adjusts the fuel zones as closely as possible to ideal. This is the second step in tuning the ECU. By tuning only the exact zone centers, excellent interpolation is ensured.

The two types of tuning above get performed once after a new chip is installed. These values are saved and then they do not have to be performed again.

L3 TUNING: This third type of tuning is used strictly for day-to-day driving. L3 tuning occurs in all windows on the keypad except STORE and ZONEF and alters the MASTER FUEL delivery to the engine to compensate for temperature and/or humidity differences from day-to-day. The function of this feature can be seen in the TESTRPM window. The number to the far right will indicate the

compensation. The range goes from 1-9 with 5 being no compensation. Lower numbers indicate less fuel higher numbers indicate more fuel.

Another way to describe the third lambda mode: Once you have done fine and coarse tuning, you have basically set your fueling to mirror the volumetric efficiency requirements of your engine. The shape of this curve will stay pretty constant, so if one of your fuel zones needs more or less fuel under given conditions, then all of your fuel zones would need about the same correction. When in L3, the entire curve will be shifted up or down. This does your daily housekeeping type tuning.

Pressing adjust up turns on the L3 tuning. Pressing adjust down turns off L3 tuning. Pressing edit up turns on the coarse and fine tuning. Pressing edit down turns off the coarse and fine tuning. We recommend leaving all three tuning modes on all the time after finishing the fine tuning process.

RELOAD: Used during the initial setup to transfer the default data table in to the ECU's permanent memory. RELOAD fills the ECU memory with the default settings from one of the following tables:

Turbo 1	Turbo defaults
Turbo 2	Turbo defaults with lower ignition timing values
N/A OEM INJ	Defaults for N/A stock injectors
N/A Big INJ	Defaults for N/A 440 or 550 injectors (1.6 or 1.8)

The different defaults can be selected by pressing and holding a combination of the edit buttons that displays the desired title in the window. While holding the edit button(s) down press and hold both adjust buttons until the window fills with asterisks. The new defaults are now loaded in the ECU. Any changes made before the reload will be lost.

EDIT: Enables the zone editor function, which allows access to all zones for viewing and editing. The EDIT function may be used at any time, with or without the engine running. Use the edit buttons to select the appropriate zone(s) and the adjust buttons to change the selected zone. The zones are identified by a number, which may be correlated to its function by consulting the zone editor sheet. ZONE FUEL and ZONE IGN are identified by an "f" or "i" respectively to discriminate between fuel and ignition values. Storing of edited values may be done by pressing both edit buttons together until display shows a row of asterisks and then releasing. This method of storing works only when in the Edit menu. Alternatively, STORE may be selected and used as normal.

MODE: (Z5) This number corresponds to 8 different bit flag settings. They have no user functions. Do not change this setting.

CHOKE SCALE: (Z6) Cold start fuel enrichment during starting. A higher number delivers more fuel. This value appears in the CSTART window next to the "f".

VOLTS: (Z7) Battery voltage correction factor used to compensate for heavy electrical loads. As the battery voltage drops, injector duty cycle drops, leaning out the mixture. The default value works well. Probably a good zone to stay away from.

HOT ID: (Z18) Default duty cycle of the IAC valve when the engine is warm and the engine is under high vacuum.

COLD ID: (Z19) Default duty cycle of the IAC valve when the engine is cold and the engine is under high vacuum.

The purpose of Z18 and Z19 is to keep the idle from drooping when coming to a stop. Anytime the "*" is showing in the idle window and the engine is under high vacuum, the idle duty cycle will default to Z18 (hot) or Z19 (cold). As you come to a stop, the duty cycle will stay at Z18/19 for a second or two, then go into closed loop idle control. Settings between 38 and 42 provide good prevention of idle droop when coming to a stop. When properly set, the engine will hang at 1300 RPM for a second when coming to a full stop before falling to the idle setpoint. To view Z18 without going into EDIT Z, look in the idle window in the main menu. Any time the * is not showing (denoting idle switch closed), edit Z18 (or Z19, if engine temp is below 80C) will show.

ACCEL: (Z22-Z25) Simulates the accelerator pump on a carburetor by increasing the amount of fuel upon sudden throttle opening. The zones affect the following RPM ranges:

Z22 0 to 2000 RPM
Z23 2001 to 4000 RPM
Z24 4001 to 6000 RPM
Z25 6001 to 8000 RPM

LAMBDA TARGETS: (Z26-31) Target O2 sensor output used during closed loop, LAMBDA ON, operation. The ECU adjusts the fuel delivery in each fuel zone to reach these values of O2 sensor richness. We have found on a few cars running 93 or 94 octane that the O2 target for row 5 & 6 to be too high and cause mis-fires. If this happens reduce the O2 target in row 5 & 6 to 89.

Z26 row 1&2 idle O2 sensor target = 76
Z27 row 1&2 "cruise" O2 sensor target = 77
Z28 row 3 O2 sensor target = 78
Z29 row 4 O2 sensor target = 87
Z30 row 5 O2 sensor target = 90
Z31 row 6 O2 sensor target = 91

CHOKE DECAY TIME: (Z710) The amount of time the additional fuel added in the CSTART window will take to decay to zero.

PRIME FACTOR: (Z715) All 4 fuel injectors will squirt fuel when the key is turned on.

MINIMUM ATMOSPHERIC PRESSURE: (Z720) The ECU uses the current atmospheric pressure to control the wastegate and it measures this value every time the car is started. If the ECU does not get the chance to measure the ambient atmospheric pressure, (the car is started too quickly) the ECU uses the value in Z720.

Below a few terms used in the set up instructions are defined in detail.

Store – the ECU works like a PC. Any information changed in the memory while the car operates must be saved before turning the car off. Scroll to the window that says STORE and press both adjust buttons down together and hold until the screen fills with asterisks. Once the asterisks are gone all new information is saved into permanent memory. When the ECU is storing information the tach will jump around and the car will misfire. DO NOT store while driving. The best way is to pull over into a parking lot to store. If you stall while storing, allow the store to finish ("STORE" reappears) before turning key off. A "store" can also be done anywhere in the EDIT Z menu by holding both edit buttons down until a row of asterisks fill the screen. Remember, if you have had knocks while driving or tuning, the retarded timing will be stored.

Tuning – This is the process of allowing the ECU to self-calibrate its fuel correction numbers through feedback from the oxygen (O2) sensor so that the O2, air/fuel ratio (A/F), signal equals targets programmed for each row of manifold pressure. Since the tuning depends on the accuracy of the O2 sensor, we strongly recommend the single wire O2 sensor in the 1.6L cars be replaced with the 4-wire sensor.

As the engine operates throughout its RPM and manifold pressure range, the ECU interpolates from one zone to the next to make the transitions smooth. To make tuning quick and accurate there are two types of tuning, coarse and fine. Coarse tuning occurs only in the ZONEF window. During coarse tuning the ECU samples the O2 sensor voltage very rapidly and adjusts the fuel correction numbers accordingly. The samples are taken anywhere in the operating zone in order to make tuning go quickly at the expense of accuracy. Tuning close to the edge of a zone will affect the adjacent zone. Fine tuning occurs in the STORE window. During fine tuning the ECU samples the O2 sensor less rapidly and averages the readings together giving more accurate values. Also, when in fine tuning, the ECU only tunes in a narrow range at the center of each zone. This provides more accurate values at the expense of being harder to do.

To perform tuning go to the ZONEF window and drive the car. The ECU will do the tuning while you drive. The ZONEF window constantly displays the current fuel zone. Use this to identify the current operating zone. Tuning works best in the upper gears, where you can stay in one zone long enough for it to tune itself.

While tuning is occurring the ECU will show different characters next to the zone display. They are listed below:
A – Acceleration, the car is accelerating and the ECU will not tune.
D – Deceleration, the car is decelerating and the ECU will not tune.
V – High vacuum, the ECU will not tune.
T – Timer, the ECU will not tune for 90 seconds after the car is started.
E – Engine temperature, the ECU will only tune after the engine has warmed to over 80^{o}C. The "E" is displayed until that time. When in L3 mode, autotune will start at 40C.
P – Additional fuel being added during hot restart. Tuning will not occur during this time. This is on 1.8L cars only.
"+" The ECU is adding fuel to the engine.
"-" The ECU is subtracting fuel from the engine.
"=" The ECU has reached its a/f target for that zone.
"?" The car is not operating in the center of a fuel zone. During coarse tuning the ECU still tunes while "?" shows. During fine tuning the ECU will not tune with "?" showing.
"X" indicates that the fuel has been changed 3%, during fine tuning only, and will not change any more without storing. This feature is to keep the ECU from tuning itself to death in the event that you have a sensor problem, such as a bad 02 sensor.

The ECU can only tune the zone that the car is currently operating in. The 3 digit number in the center of the "ZONEF" window displays the current operating zone. When tuning the car must be driven in different situations to ensure that the engine operates in as many different zones as possible. Start by driving the car around a suburban setting, accelerate slowly and try to stay in the 200 row. Then move to an area where the car can be accelerated somewhat harder, keeping the car in the 300 row (zero on your boost gauge). Finally, find a road where the car can be accelerated from 1500RPM to redline in 4th gear. Do a run with very light throttle to keep the car in the 200 row all the way to redline, trying to stay in each zone long enough to get "=". Repeat for each row, modulating the throttle to keep the car in the 300 row, then 400, then 500 (and 600, if N/A or turbo running over 15psi).

While the car is driven in these conditions the ECU will display the characters shown above. Have a co-pilot read off the tuning information, specifically when the ECU shows "+" and "-" signs. These are important because they indicate when the computer is tuning. Try to hold the car in a particular zone until the "+" or "-" sign turns into an "=" sign. Each zone usually tunes within 2 to 4 seconds. After driving for 15-20 minutes, pull over and store the changes.

Miscellaneous										TPS		Wastegate			
IDLE MAP	MAST F	REV LIM	MAP LIM		MODE	CH SCL	VOLTS	IDLE	FAN	LOW	HIGH	SENS	KNOCK	SPRING	RPM
Z0	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8	Z9	Z10	Z11	Z12	Z13	Z14	Z15

						Acceleration				Lambda Targets					
COLD	HOT RST	HOT ID	COLD ID	AC IDLE	IG OSET	0-2K	2K-4K	4K-6K	6K-8K	ROW1	ROW2	POW3	ROW4	ROW5	ROW6
Z16	Z17	Z18	Z19	Z20	Z21	Z22	Z23	Z24	Z25	Z26	Z27	Z28	Z29	Z30	Z31

Zone Fuel

kPa	0		1000		2000		3000		4000		5000		6000		7000	
40	Zf100	Zf105	Zf110	Zf115	Zf120	Zf125	Zf130	Zf135	Zf140	Zf145	Zf150	Zf155	Zf160	Zf165	Zf170	Zf175
80	Zf200	Zf205	Zf210	Zf215	Zf220	Zf225	Zf230	Zf235	Zf240	Zf245	Zf250	Zf255	Zf260	Zf265	Zf270	Zf275
120	Zf300	Zf305	Zf310	Zf315	Zf320	Zf325	Zf330	Zf335	Zf340	Zf345	Zf350	Zf355	Zf360	Zf365	Zf370	Zf375
160	Zf400	Zf405	Zf410	Zf415	Zf420	Zf425	Zf430	Zf435	Zf440	Zf445	Zf450	Zf455	Zf460	Zf465	Zf470	Zf475
200	Zf500	Zf505	Zf510	Zf515	Zf520	Zf525	Zf530	Zf535	Zf540	Zf545	Zf550	Zf555	Zf560	Zf565	Zf570	Zf575
254	WGlg up Zf600	WGlg dn Zf605	Zf610	Zf615	Zf620	Zf625	Zf630	Zf635	Zf640	Zf645	Zf650	Zf655	Zf660	Zf665	Zf670	Zf675

Zone Ignition

kPa	0		1000		2000		3000		4000		5000		6000		7000	
40	Zi100	Zi105	Zi110	Zi115	Zi120	Zi125	Zi130	Zi135	Zi140	Zi145	Zi150	Zi155	Zi160	Zi165	Zi170	Zi175
80	Zi200	Zi205	Zi210	Zi215	Zi220	Zi225	Zi230	Zi235	Zi240	Zi245	Zi250	Zi255	Zi260	Zi265	Zi270	Zi275
120	Zi300	Zi305	Zi310	Zi315	Zi320	Zi325	Zi330	Zi335	Zi340	Zi345	Zi350	Zi355	Zi360	Zi365	Zi370	Zi375
160	Zi400	Zi405	Zi410	Zi415	Zi420	Zi425	Zi430	Zi435	Zi440	Zi445	Zi450	Zi455	Zi460	Zi465	Zi470	Zi475
200	Zi500	Zi505	Zi510	Zi515	Zi520	Zi525	Zi530	Zi535	Zi540	Zi545	Zi550	Zi555	Zi560	Zi565	Zi570	Zi575
254	Zi600	Zi605	Zi610	Zi615	Zi620	Zi625	Zi630	Zi635	Zi640	Zi645	Zi650	Zi655	Zi660	Zi665	Zi670	Zi675

Boost Targets

SP FAC	RPM LT	CH DEC	PRIM FAC	MIN A.P.	2500	3000		4000		5000		6000		7000	
Z700	Z705	Z710	Z715	Z720	Z725	Z730	Z735	Z740	Z745	Z750	Z755	Z760	Z765	Z770	Z775

KEYPAD DESCRIPTION	DESCRIPTION	ZONE NUMBER	KEYPAD SEQUENCE
TEST RPM	Current engine RPM		1
STORE	Save any and all changes		2
ZONEF (current zone)	Fuel correction for the current operating zone	ZF100-ZF750	3
INJ= % OXY=(O2 volts)	Injector duty cycle & oxygen sensor voltage		4
ZONEIGN (current zone)	ignition correction for the current operating zone	ZI100-ZI750	5
KNOCK # (# of knocks)	Knock threshold	Z13	6
IDLE % RPM (engine RPM)	Idle control solenoid duty cycle & idle set point	Z8	7
IDLE MAP (MAP)	Hot idle MAP value	Z0	8
TPS SPAN	Throttle position switch scale factor 1.8L only	Z11	9
A/C IDLE	Idle compensation for A/C	Z20	9
COLD (engine temp)	Cold start enrichment scale factor	Z16	10
CSTART f(Z6) t(Z710)	Cold start choke, f= fuel, t=decay time		11
HOT RESTART	Hot restart enrichment scale factor	Z17	12
MASTER FUEL	Overall fuel delivery	Z1	13
TEMP SWITCH	Radiator fan energize temperature 1.8L only	Z9	14
TEMP LIMIT	Maximum allowed engine temperature	Z705	14
IGN TRIM	Overall ignition adjustment	Z21	15
RPM LIMIT	Maximum allowed engine RPM	Z2	16
MAP LIMIT	Maximum allowed manifold pressure	Z3	17
BOOST TGT	Turbo boost setting for all boost zones	Z725-Z750	18
WG SNS (MAP)	Wastegate sensitivity	Z12	19
WG lg	Wastegate loop gain	Zf600-Zf605	20
WG BASE	Boost value set with integral waste gate	Z14*	21
WG RPM	RPM at which the ECU begins controlling boost	Z15	22
LAMBDA	Self learn mode on or off		23
RELOAD	Loads default values into memory		24
EDIT Z	Entrance to the zone editor		25
	On/off bit flags	Z5	
	Choke fuel enrichment value	Z6	
	Throttle position switch offset 1.8L only	Z10	
	Throttle position switch span 1.8L only	Z11	
	Hot default IAC duty cycle	Z18	
	Cold default IAC duty cycle	Z19	
	Acceleration scale factor 0 to 2K RPM	Z22	
	Acceleration scale factor 2K to 4K RPM	Z23	
	Acceleration scale factor 4K to 6K RPM	Z24	
	Acceleration scale factor 6K to 8K RPM	Z25	
	Row 1&2 idle oxygen sensor target	Z26	
	Row 1&2 cruise oxygen sensor target	Z27	
	Row 3 oxygen sensor target	Z28	
	Row 4 oxygen sensor target	Z29	
	Row 5 oxygen sensor target	Z30	
	Row 6 oxygen sensor target	Z31	
	Choke decay time scale factor	Z710	
	Prime factor	Z715	
	Minimum atmospheric pressure	Z720	

*Z14 is actually calculated from the value entered in WGBASE. They are similar but not exactly the same.

Section 2: Chip installation instructions

Note: If you are installing a new ECU for the first time, skip this step. You already have a chip loaded into the ECU. This only applies to upgrading to newer software.

Please stop by your local Radio Shack and invest in a chip puller for a 52 pin processor. Using paperclips, etc to try to remove your chip will probably damage the chip or socket. The chip can be found in the picture of the circuit board below. After removing the old chip with the proper puller, install the new chip by pressing it into place firmly with your thumb. The chip must be properly oriented. If you look very closely at the edges of the chip, you will see that one edge is beveled and has a small dot in the middle of the edge. This is the top of the chip. With the multiplugs on the printed circuit board at the bottom, the top of the chip should face up. You can also go by the printing on the chip, if the printing is right side up, the chip is facing up.

Chip, beveled edge up

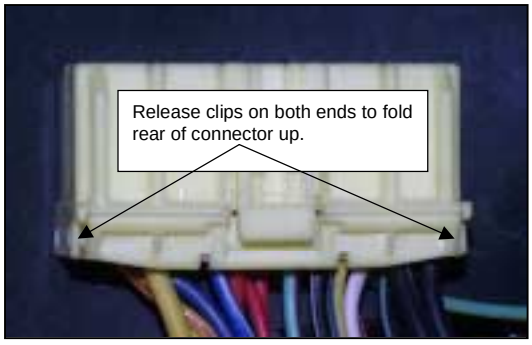
Once the chip is in place, you can close up the computer. If you are running 440cc or 550cc injectors on a turbo car, you don't need to reload, just fire it up. If you are running stock injectors on an N/A car, go to reload, push the edit arrow to read "n/a stock injectors", then, while holding the edit arrow, hold both adjust arrows down until you get a row of asterisks across the screen. Release the buttons and wait for the asterisks to clear. If you are running 440s on your n/a car (perhaps while you wait for your aerodyne to return), refer to the section of this document that corresponds to your engine set up for more information on set-up procedures.

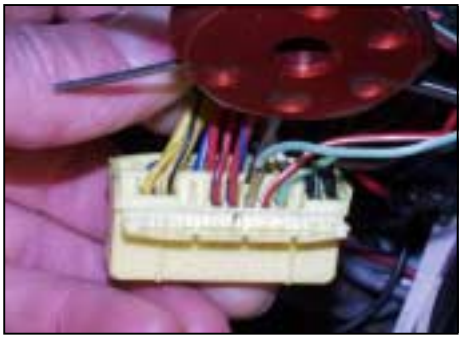
Section: 3 Flyin' Miata ECU installation instructions for 1.6L Miata

The Flyin' Miata ECU installs directly into the factory ECU case and plugs into the factory harness. Two wires have to move to use the boost control solenoid and knock sensor. We also show how to perform a ground wire modification that helps the ECU work better.

1. Pull back the carpeting on the passenger's side of the car, right under where the passenger's feet would go. Once the carpeting is pulled down, you will see a large silver colored metal plate. This plate has three nuts and two bolts holding it in. Remove the plate and you will see the stock ECU (computer). Squeeze the tabs in the center of the two yellow connectors and pull the plugs out of the computer. There is also a zip tie holding the harness to the ECU mounting bracket, disconnect this. Set the ECU aside for now.

2. To use the boost control solenoid and the knock sensor two wires have to be moved in the ECU plugs. If you look carefully at the back (side that the wires go in) of the connectors, you will see that there is a hinged flap on top and bottom of the connectors. You have to slip a knife or thumbnail under both edges of the flaps to release them. This exposes the individual terminals.





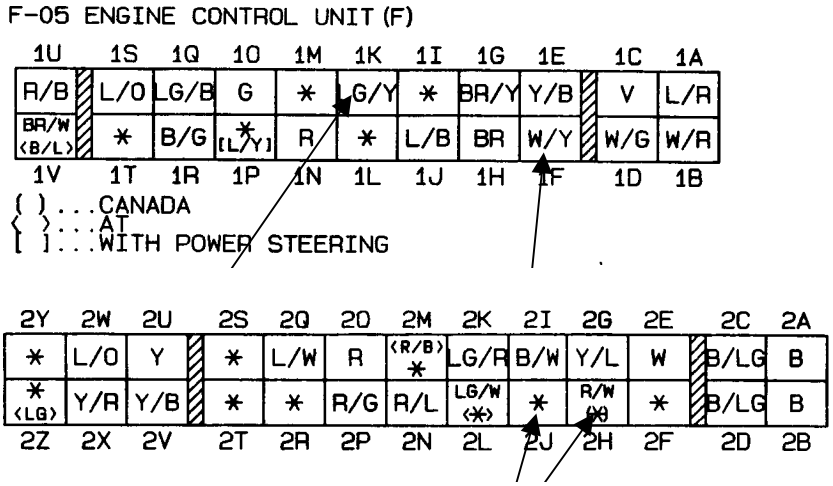
3. You will need to slip a paper clip or something similar into the back of the metal connectors that you want to move, (see picture). You must slide the clip through the little loop of metal above the wire--this will release a plastic lock tab to let the connector pull out.

4. You will need to move these terminals:

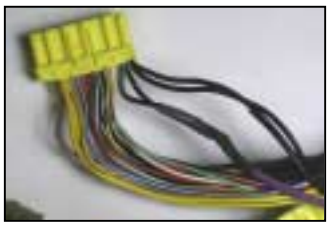
1K (light green/yellow) must be moved to 2H. The (red/white) wire in 2H gets removed and taped off.

1F (White/yellow) must be moved to 2J. The (black) wire in 2J gets removed and taped off.

Connectors below are as viewed from the wire side.



5. Sever the two BLK/LG wires coming from the 2C and 2D pins on the ECU connector (see the diagram above for the location of these terminals). Solder them to a new length of 16 gauge wire and run it through the firewall to the bolt that holds the ground strap that connects to driver's side rear of the cylinder head.



6. Do not get fancy and add 2A and 2B to this connection, as these are power grounds and they will negatively affect the signal grounds that we are moving. Clean and solder (or replace) the ground strap. This will help as well.

7. **'93 CA cars <u>only</u>:** You must rewire two wires at the ECU. '93 CA went to sequential injection, where all other 1.6 Miatas fire their injectors in pairs,(#1,3 firing together and #2,4 firing together). You must convert the '93 CA car into a 49 state car by tying the injectors together into two pairs. You must cut the wire at 2Y and splice the harness end of it to 2U, then cut 2Z and splice the harness end to 2V. (see the diagram above for the location of these terminals)

8. Under the hood, you will need to eliminate your airflow meter since the FM ECU uses a MAP sensor to measure airflow. Mount the MAP sensor that comes with the kit on the black plastic electrical cover on the driver's inner fender by using the provided double stick tape. Plug the connector that you removed from the factory airflow meter onto the MAP sensor. Connect the provided vacuum hose to the MAP sensor, then neatly route it to a good signal source on the intake plenum. Do NOT use the hose that leads to the

carbon canister solenoid. Best spot is probably to tee into the short vacuum hose that goes to the stock fuel pressure regulator or into the signal source provided with an FM turbo kit, if you are installing that as well.

9. Injector installation: You must first replace the injector connectors. Pull the connectors off the stock injectors, then cut the stock connectors off the harness. Strip a little bit off the stock harness wires, then crimp the new connectors on, (these are heat shrinkable crimp connectors). Use a real wire crimper because this is a critical connection. Polarity is not critical on these wires. Once all is crimped, use a hair dryer or heat gun to shrink the connectors.

10. Remove the four 8mm bolts holding the air valve on the side of the intake plenum. You will not lose any coolant removing this piece. Remove the gas cap to relieve pressure in the tank. Remove the two 12mm bolts holding the fuel rail in place (Watch out for the two black plastic spacers that the end bolts go through, don't lose them.) You will have some gas spraying out at this point so have a throw away towel ready and do NOT have a droplight nearby. 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 seals on the lower ends of the injectors- these seals will be re-used.

11. Prepare the new injectors by lubing the o-rings with grease or silicon, be careful not to get any into the injectors, and transferring the lower spacer/seal from the old injectors. Put the new injectors in place, slide the fuel rail over them and tighten. Make sure you have the two black plastic spacers in place under the ends of the fuel rail.

12. Plug the new connectors over the new injectors, replace the fuel cap.

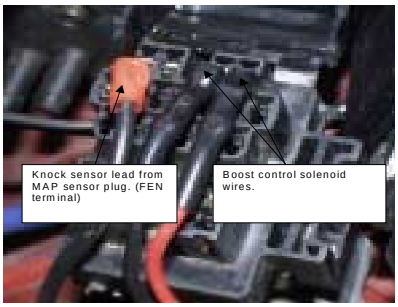
13. The knock sensor replaces the upper front mounting bolt on the passenger (right side) motor mount. Replace it with the supplied adapter bolt and tighten to 20 ft/lbs. Use the supplied 8mm allen bolt and mount the knock sensor to the adapter, tightening this bolt to 12 ft/lbs, use blue Locktite on this bolt. **PLEASE TORQUE CAREFULLY!**

14. Plug the harness onto the knock sensor, then route the harness up to the map sensor and plug into the map sensor RCA jack.

15. To get the knock signal back to the ECU the supplied Knock Jumper has to be connected to an unused wire in the MAP connector. Snip the BLK/G wire in the MAP sensor connector about three inches back from the connector. This wire is the third wire from the right end of the connector (looking at the connector from the wire side) next to the two red wires. The jumper gets spliced to the connector side of the cut wire. The other end of the cut wire should be taped off.

16. The Knock Jumper will then connect to the FEN terminal in the diagnostics connector.

17. Mount the boost control solenoid to the shock tower as shown.



18. Connect the red wire from the solenoid to the B+ terminal. Connect the black wire to the TEN terminal. Follow the MAP under the lid on the connector to find these two terminals.

19. Connect a vacuum hose to the brass nipple on the solenoid. This hose then goes to the brass fitting on the turbo outlet, for a standard turbo, or the hose barb in the first pipe coming out of the turbo if you are using a ball bearing turbo. Connect a second vacuum hose from the wastegate actuator to the cast nipple on the solenoid that points in the same direction as the brass nipple. Secure these connections with safety wire or zip ties. These hoses control boost and you do not want them coming loose while driving under boost.

20. Take the ECU to a workbench where you can work on it, remove the mounting brackets and the screws holding top and bottom lids on. If you look on one side, you will see that there is a small heat sink. There are two tiny screws holding this heat sink, they must also be removed. 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. Plug the ribbon cable from the keypad into the ECU socket, then put lids back on. Mount the ECU back in the car and plug in the modified wire harness.

Section 4: Flyin' Miata ECU installation for 1.8L Miata

The Flyin' Miata ECU installs directly into the factory ECU case and plugs into the factory harness except for the '96-'97 cars. See the directions at the end of this section for special instructions for these cars.

1. Pull back the carpeting behind the passenger's seat. The stock ECU (computer) mounted to the bulk head. Squeeze the tabs in the center of the two yellow connectors and pull the plugs out of the computer. Once you have the ECU out where you can work on it, remove the mounting brackets and the screws holding top and bottom lids on. If you look on one side, you will see that there is a small heat sink. There are two tiny screws holding this heat sink, they must be removed also. Remove the phillips head screws that are holding the printed circuit board in and remove the stock board. Install the Link board in place of the stock board and reinstall the screws. Plug the ribbon cable from the keypad into the ECU socket. Put the white washer included with the ECU under the lid on the corner closest to the ribbon cable. This will give the ribbon cable room to pass though without getting pinched by the lid. Put lids back on and reassemble everything you've taken apart.

2. The 550cc/min fuel injectors will need ballast resistors tapped into the factory wiring harness to match the impedance of the ECU. These provide the resistance necessary to run low impedance high flow injectors. You will want to slit the tape covering the factory harness, so that you can cut the injector wires a couple of inches back from the ECU connector. The wires to cut are: Yellow (term 2U), Yellow/Black (term 2V), Green/White (term 2Y) and Green (term 2Z). See the photo "Plug #2" on page #23 for the location of these wires. Strip the ends of the cut wires back about ¼" and crimp the supplied female connectors to the ECU side. (Use a real crimper, not pliers or vise grips.) Crimp the male connectors to the harness side. At this point, you can plug the wires from the ballast resistors into the factory harness, using one resistor for each wire that you cut. Plug the factory plugs back into the ECU. Once you have everything plugged back together, you can mount the bracket with the ballast resistors, using the top two cover screws.

3. Under the hood, you will need to eliminate your airflow meter, either by installing our FM parts or improvising your own. You can mount the MAP sensor that comes with the kit on the black plastic electrical cover on the driver's inner fender by using the provided double stick tape. Plug the connector that you removed from the factory airflow meter onto the MAP

sensor. The locking tab on the factory harness goes out toward the engine. Connect the provided vacuum hose to the MAP sensor, then neatly route it to a good signal source on the intake plenum. Do NOT use the hose that leads to the carbon canister solenoid. Best spot is probably to tee into the short vacuum hose that goes to the stock fuel pressure regulator.

4. Injector installation: You must first replace the injector connectors. Pull the connectors off the stock injectors, then cut the stock connectors off the harness. Strip a little bit off the stock harness wires, then crimp the new connectors on, (these are heat shrinkable crimp connectors). Use a real wire crimper because this is a critical connection. Polarity is not critical on these wires. Once all is crimped, use a hair dryer or heat gun to shrink the connectors.

5. Remove the gas cap to relieve pressure in the tank. Remove the three bolts holding the fuel rail in place (Watch out for the three black plastic spacers that the end bolts go through, don't lose them). You will have some gas spraying out at this point, so have a throw away towel ready and do NOT have a droplight nearby. Once the bolts are out, wiggle the fuel rail off the injectors, then pull the injectors out, being very careful not to lose the little black seals on the lower ends of the injectors-these will be re-used.

6. Prepare the new injectors by lubing the o-rings with grease or silicone, being careful not to get any into the injectors, and transferring the lower spacer/seal from the old injectors. Put the new injectors in place, then slide the fuel rail over them and tighten. Make sure you have the three black plastic spacers in place under the ends of the fuel rail.

7. Plug the new connectors over the new injectors, replace the fuel cap.

8. The knock sensor replaces the upper front mounting bolt on the passenger (right side) motor mount. Replace it with the supplied adapter bolt and tighten to 20 ft/lbs. Use the supplied 8mm allen bolt and mount the knock sensor to the adapter, tightening this bolt to 12 ft/lbs use blue Loctite. **PLEASE TORQUE CAREFULLY!**

9. Plug the harness onto the knock sensor, then route the harness around the rear of the engine along the brake booster tube up to the map sensor and plug into the map sensor RCA jack.

10. The boost solenoid may be mounted under the rearward shock mount bolt, as shown. The two wires need to be plugged into the black diagnostic connector on the driver's fender. Open the lid and follow the map in the lid to find the B+ and TEN terminals. Plug the two wires from the actuator into these terminals (polarity does not matter).

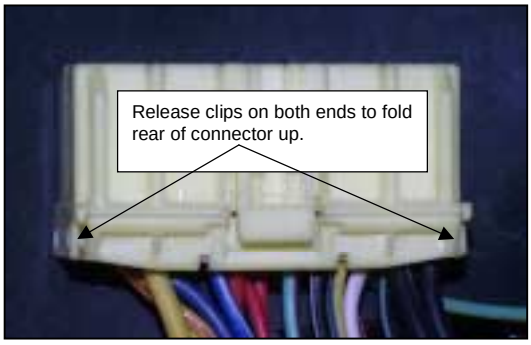
11. Connect a vacuum hose to the brass nipple on the solenoid. This hose then goes to the brass fitting on the turbo outlet, for a standard turbo, or the hose barb in the first pipe coming out of the turbo if you are using a ball bearing turbo. Connect a second vacuum hose from the wastegate actuator to the cast nipple on the solenoid that points in the same direction as the brass nipple. Secure these connections with safety wire or zip ties. These hoses control boost and you do not want them coming loose while driving under boost.

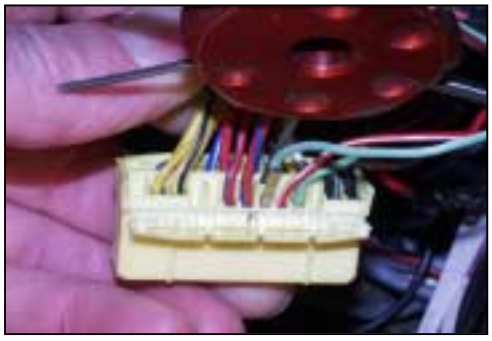
Section 5: Installing the FM ECU into an OBDII Miata ('96-'97)

The FM ECU will work fine in the '96-'97 Miatas, but will require substantial pin shuffling within the ECU connectors. This is a step by step guide to safely accomplish the mods.

The basic problem is that Mazda has added a third connector to the ECU. Not only that, but the two connectors that do match the earlier ECU have all the wires shuffled within them, just to make it challenging. What Mazda calls the "#3" plug gets eliminated. The Mazda "#4" plug in the '96-'97 cars is physically the same as the "#2" plug in the '95 car. The Mazda "#1" plug in the '96-'97 is physically the same as the "#1" plug in the '95 car. Confused yet?

If you look carefully at the back (side that the wires go in) of the connectors, you will see that there is a hinged flap on top and bottom of the connectors. You have to slip a knife or thumbnail under both edges of the flaps to release them. This exposes the individual terminals.
You will need to slip a paper clip or something similar into the back of the metal connectors that you want to move, (see picture). You must slide the clip through the little loop of metal above the wire--this will release a plastic lock tab to let the connector pull out.





Shown below are the views of the stock '96-'97 ECU connectors, as viewed from the back (wire) side. ECUs for '97 cars will have two differences, there will be no violet wire in 1C and the wire in 4Z will not be used.

Factory plugs from a ’96 or ’97 OBDII car

This is the “#1” plug.

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

This is the “#3” plug.

3O	3M	3K	3I	3G	3E	3C	3A
B/L	R/W	R/B	LG/W	L/W	*	R/G	*
L/Y	B/Y	R	LG/R	BR/B	R/B	R/L	R/W
3P	3N	3L	3J	3H	3F	3D	3B

This is the “#4” plug.

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

Factory plugs from a ’95 car Please realize, this is not what your modified plugs will look like after moving the wires from you OBDII plugs.

This is “#1” plug.

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

This is the “#2” plug.

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

You will be removing all wires from your car’s #3 plug, and will have to shuffle the majority of the wires in the #4 and #1 plugs. Charts showing what wires go where are on the next two pages.

Color chart

Color	Code	Color	Code
Blue	L	Orange	O
Black	B	Pink	P
Brown	BR	Red	R
Dark Blue	DL	Purple	PU
Dark Green	DG	Sky Blue	SB
Green	G	Tan	T
Gray	GY	White	W
Light Blue	LB	Yellow	Y
Light Green	LG	Violet	V
Natural	N		

OBDII connector	Wire color	NEW ECU connector	Signal
4A	B/LG	2C	ECU ground
4B	W/R	1B	Switched +12volts
4C	B	2A(spliced to wire that came from 3M)	Fuel injector ground
4D	B	2B	Ground
4E	Y/B (poss G/Y)	NOT USED	
4F	W	2E	Cam pos. sensor, SGT signal
4G	Y/L	2G	Cam pos. sensor, SGC signal
4H	Y/W (poss G/B)	NOT USED	
4I	L/R	1A	Battery +12volts, constant
4J	Y/G	2R	PRC solenoid
4K	EMPTY		
4L	B/W	1F	Tachometer signal
4M	EMPTY		
4N	BR/Y	1G	#1, #4 ignition signal
4O	Y	1R	EGR valve, vent
4P	Y/W	1T	EGR valve, vacuum
4Q	L/O	2W	Idle Air Control (IAC) valve
4R	BR	1H	#2, #3 ignition signal
4S	EMPTY		
4T	Y/R	2X	Purge solenoid valve
4U	Y	2U	Fuel injector #1 control
4V	Y/B	2V	Fuel injector #2 control
4W	G/W	2Y	Fuel injector #3 control
4X	G	2Z	Fuel injector #4 control
4Y	L/W	NOT USED	
4Z	EMPTY		

OBDII connector	Wire color	NEW ECU connector	Signal
3A	EMPTY		
3B	R/W	2O	Mass airflow sensor
3C	R/G (poss R/L)	2N	O2 signal, front
3D	R/L	NOT USED	
3E	EMPTY		
3F	R/B	2M	Throttle position sensor
3G	L/W	2Q	Engine coolant temp.
3H	BR/B	NOT USED	
3I	LG/W	2K	Voltage reference
3J	LG/R	2J	EGR valve position
3K	R/B	2P	Intake air temp
3L	R	1N	Closed throttle position switch
3M	R/W	2A(spliced to wire that came from 4C)	Fuel injector ground
3N	B/Y	NOT USED	
3O	B/L	2D	Ground, input
3P	L/Y(poss L/LG)	NOT USED	

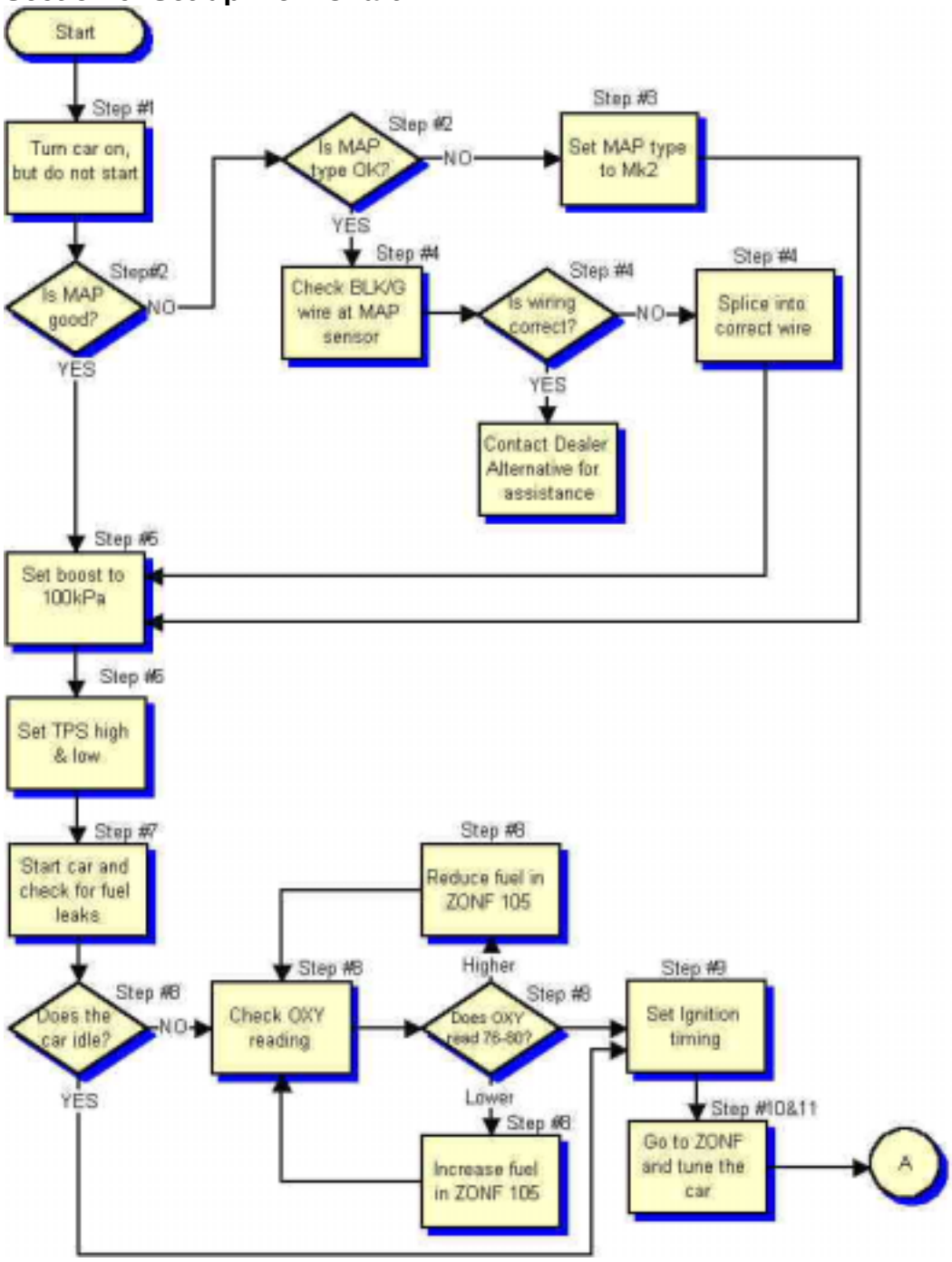
OBDII connector	Wire color	NEW ECU connector	Signal
1A	B/G	1L	Coolant fan relay
1B	L/W	2S	AC fan relay
1C	V	1C	Ignition switch (not on ’97 cars)
1D	W/B	NOT USED	
1E	Y/B	1E	Diagnostics connector (FEN)
1F	EMPTY		
1G	L/B	1J	A/C relay
1H	R/B	IU	Headlight switch
1I	LG/Y	2H	Diagnostics connector (TEN)
1J	R/W	NOT USED	
1K	LG/B	1Q	A/C switch
1L	BR/W	1V	Neutral switch
1M	G/R	1M	Vehicle speed sensor
1N	EMPTY		
1O	B/LG	2F	Mass air flow sensor
1P	L/O	1S	Heater fan switch
1Q	G/B	1O	Brake switch
1R		NOT USED	
1S	EMPTY		
1T		NOT USED	
1U	LG	2T	Fuel pump relay
1V	EMPTY		

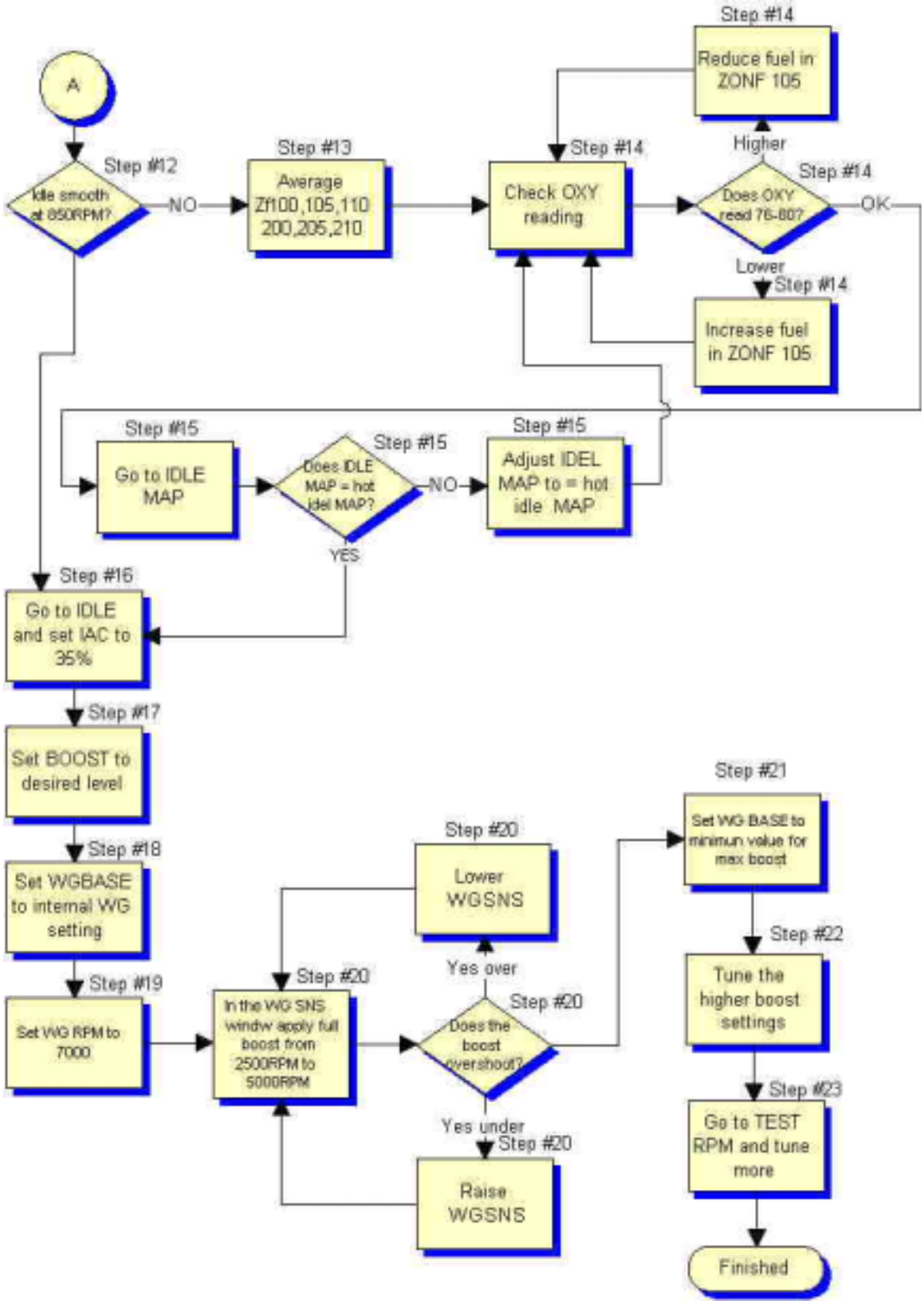
Any wires shown in the charts as “NOT USED” should be taped off individually to insulate the ends and carefully stored next to the ECU.

For the 1997 model year Mazda changed the shape of the box so the corners of the printed circuit board may need to be trimmed. Also, only one of the screw holes will match up with the board. Another hole can be drilled on the other side with out interfering with the solder traces. We would also recommend trimming a piece of thin cardboard to cover the entire back of the printed circuit, so that it is insulated from the rear cover of the ECU box.

Follow section 4 for 1.8 cars after the wiring change has been made.

Section 6: Set-up Flow Chart




A
Step #12
Idle smooth at 850RPM?
NO
Step #13
Average Zf100,105,110 200,205,210
Step #14
Check OXY reading
Step #14
Does OXY read 76-80?
Higher
Step #14
Reduce fuel in ZONF 105
OK
Lower
Step #14
Increase fuel in ZONF 105
Step #15
Go to IDLE MAP
Step #15
Does IDLE MAP = hot idel MAP?
NO
Step #15
Adjust IDEL MAP to = hot idle MAP
YES
Step #16
Go to IDLE and set IAC to 35%
Step #17
Set BOOST to desired level
Step #18
Set WGBASE to internal WG setting
Step #19
Set WG RPM to 7000
Step #20
In the WG SNS windw apply full boost from 2500RPM to 5000RPM
Step #20
Does the boost overshoot?
Yes over
Step #20
Lower WGSNS
Yes under
Step #20
Raise WGSNS
Step #21
Set WG BASE to minimun value for max boost
Step #22
Tune the higher boost settings
Step #23
Go to TEST RPM and tune more
Finished

Section 7 : Turbo setup

If you have not already done so, please read the Theory of Operation Section before attempting to use the ECU. You will have a difficult time trying to use the ECU if you do not know how the variables effect the car's operation. Initial tuning of the Flyin' Miata ECU is not difficult but having someone in the passenger seat to take some readings while the driver drives the car is a very good idea.

1. Turn the car "on" but do not start it. We recommend using Turbo1 for the default settings. Turbo1 Automatically loads when the ECU powers up for the first time. Turbo2 should be used on cars in California.

2. Press the adjust down button on the keypad. The MAP reading should be atmospheric pressure. Sea level equals approximately 100kPa. Higher elevations will read lower. Refer to the table below for the atmospheric pressure at your elevation. If this reading looks good go to line #5.

Elevation	Pressure	Elevation	Pressure
Sea level	100kPa	4920ft	84kPa
820ft	98kPa	5742ft	82kPa
1640ft	95kPa	6562ft	79kPa
2461ft	93kPa	8202ft	75kPa
3281ft	90kPa	9843ft	70kPa
4101ft	87kPa	11483ft	66kPa

3. Two problems are usually the cause of an incorrect MAP reading. First, on 1.6L cars, double-check the BLK/G wire that was used to tap into the MAP sensor wire harness. There are two BLK/G wires in the harness and tapping into the wrong one (or using the wrong end of the correct wire) will affect the MAP sensor's readings. On 1.8L cars double check the wire harness connector at the MAP sensor. The locking tab on the connector should point toward the engine not the fender.

4. If the MAP reading is still incorrect, use the select up button to scroll to INJ/OXY. Press both adjust buttons, it should read "Mk2 MAP sensor". Use the edit buttons to change the display if necessary. (1.6 only)

5. Set the boost target in the BOOST window to 100kPa. (This should be 100kPa as the default)

6. (1.8 only) Use the select button and go to TPS SPAN window. Use the adjust buttons and adjust the setting to 10 with the throttle closed. Open the throttle fully and adjust TPS SPAN to 100. Double check the settings because setting one may change the other.

7. Start the car and check for fuel leaks around the junction of the fuel injectors with the fuel rail.

8. At this point the car should idle, maybe not smoothly, but it should run. If the car idles poorly, scroll up to the OXY window and see what the O2 sensor is reading. If it is below 76-80, go to ZONEF and increase the number using the adjust buttons until you get a reasonable idle. Don't spend a lot of time on idle at this point, the car needs to be driven to operating temp before proper idle adjustment is possible. Sitting and heat soaking for twenty minutes will not yield good idle settings.

9. All of the ignition timing values in the ECU are set based on a Cam Angle Sensor (CAS) setting of 0^{o} BTDC. However, setting the CAS for 0^{o} BTDC can be difficult because the idle will be erratic and the timing mark will appear to jump around. The software has a special mode to make setting the timing easier. Go to the IGN TRIM window and press both edit buttons. A new screen will appear that reads IGN SETUP $+10^{o}$. With this mode selected, now set the CAS to 10^{o} BTDC. **DO NOT** use the jumper between terminals TEN and GND in the diagnostics connector. When finished press either of the edit buttons to return to the IGN TRIM screen.

10. At this point the car is ready to drive to do some auto tuning. Because the boost target was set to 100kPa back in step #5 the car will get about 5-6psi, or whatever boost pressure your mechanical wastegate controller is set to. At this point, you want to do some driving with the keypad set to the ZONEF window. The ECU can only tune the zone that the car is currently operating in. The 3 digit number in the center of the ZONEF window displays the current operating zone. When tuning, the car must be driven in different situations to ensure the engine operates in as many different zones as possible. Start by driving the car around a suburban setting, accelerate slowly and try to stay in the 200 row. Then move to an area where the car can be accelerated somewhat harder, keeping the car in the 300 row (zero on your boost gauge). Finally, find a road where the car can be accelerated from 1500RPM to redline in 4^{th} gear. Do a run with very light throttle to keep the car in the 200 row all the way to redline, trying to stay in each zone long enough to get "=". Repeat for each row, modulating the throttle to keep the car in the 300 row, then 400, then 500 (and 600, if N/A or turbo running over 15psi). While the car is driven in these conditions the ECU will display the characters shown above. Have a co-pilot read off the tuning information, specifically when the ECU shows "+" and "-" signs. These are important because they indicate when the computer is tuning. Try to hold the car in a particular zone until the "+" or "-" sign turns into an "=" sign.). Each zone usually tunes within 2 to 4 seconds. After driving for 15-20 minutes pull over and store the changes. **Do not forget to store before you shut off the car**

11. While tuning make a note of the maximum boost displayed in parenthesis in the WG SNS window.

12. After about 20-30 minutes of driving the car should be tuned pretty well. Pull off the road to a place where the car can sit for a few minutes. Does the car idle smoothly at 850RPM? If it does skip to step #15.

13. Many times after tuning the car will pulsate at idle. This can be solved with the following steps. Scroll up to the EDIT window and go to Zf100. Read the values in Zf100, 105, 110, 200, 205, and 210. Average these together and enter that number into all 6 zones. The idle should be much more steady.

14. Scroll down to the OXY window and read the O2 sensor voltage. The reading will jump around a bit, estimate the average value. If it is below 76-80, go to the ZONEF window and add fuel in the zf105 idle zone by increasing the fuel correction number. If the O2 sensor reads higher than 76-80, decrease the fuel correction number in ZONEF.

15. Scroll down to IDLE MAP. The number on the far right is the IDLE MAP setting. The number in parentheses is the current MAP value. These two numbers must equal each other. If not, adjust the IDLE MAP setting and go back and repeat step #14.

16. Go to the IDLE window. The car will idle best when the IAC valve operates at 35% duty cycle. Adjust the idle bypass screw on the throttle body until the IAC is 35%.

17. Now the maximum boost value can be set. See the table below for conversions from psi to kPa. Scroll to the BOOST window and increase the boost setting to the desired level. We recommend 183kPa, which equates to 12psi. A boost "curve" can be set by entering different boost targets into the 700 row. Zones 725 through Z775 are individual boost targets from 2500 through 7500RPM.

    Note: entering a value into the BOOST window over writes all zones from Z725 to Z775.

psi	kPa	psi	kPa
0	100	11	176
7	148	12	183
8	155	13	190
9	162	14	196
10	169	15	203

18. Scroll up to WG BASE and enter the number of the maximum boost attained during the tuning runs. Store this value and restart the car. Don't for get to pause for 3 seconds during startup.

19. Scroll up to WG RPM and change it to 7200RPM. This will keep the ECU from going to closed loop control while the sensitivity is adjusted.

20. Go out for a drive again. In fourth gear at 2500RPM, apply full throttle while observing the MAP value in the WG SNS window. This is where a co-pilot really helps. Adjust WG SNS so that the boost rises quickly to the target entered in BOOST window but does not over-shoot. If the boost rises slowly and/or never get to the target by 5000RPM, increase WG SNS. If the boost overshoots your target level decrease WG SNS. Change WG SNS by a few digits at a time, small numeric changes can make large changes in the boost response. When WG SNS is adjusted properly the boost will quickly rise up to target by about 3200 RPM and then slightly fluctuate (no more than 3kPa) around the boost target up to redline. Keep in mind that if you ever change the boost setting, the WG SNS will need to be re-calibrated. It will change by a few digits.

21. Go to WGRPM and enter the minimum RPM that maximum boost can be achieved.

22. Sometimes achieving stable boost response is not possible. This is where the WGlg window helps. If the boost oscillates more that 4kPa at the boost target altering WGlg can be used to smooth the response. The problem comes from the turbo not responding quickly to changes in WG duty cycle. Therefore, the WGlg must be lowered. Start by lowering both the "up" and "down" values by half. The following tips may help:

    If the boost creeps over the target and then comes back to the target only to go back up again, lower the "up" value.

    If the boost creeps over the target and then falls below the target, lower the "up" value and lower the "down" value.

    Remember, for the best response, WGlg should be a high as possible while still maintaining stable boost control.

23. Now that the boost has been increased, go to ZONEF and tune the higher boost zones that you can now hit with the increased level of boost. **Do not forget to store your new fuel settings.** Also, set MAP LIMIT to 10kPa above your target boost setting. This will protect the engine from over boost.

24. The tuning that the ECU performs in ZONEF is coarse, the ECU will tune in a wide area of the zone. To get even more accurate numbers, after getting "=" everywhere in ZONEF, set the keypad STORE. In this window the ECU tunes to a much finer degree, by only tuning in the zone centers, leading to

better interpolation. Drive in the STORE window for a few miles until "=" are common and save these fuel values. The RPM center of the zones is at the 250 RPM point, IOW, 2250, 2750 and so on. Remember that you need to be in the center of the zone both MAP and RPM wise.

25. At this point the ECU is tuned. Drive the car with Lambda "on" all the time. The ECU will boot up in the TEST RPM screen and perform L3 tuning all the time. These values are not to be saved. L3 tuning will make changes daily in reaction to atmospheric conditions. The keypad can be stored in the glove compartment. Be very careful with the keypad, the cases will melt in high temps. Do not leave in the sun.

Section 8: Supercharger setup

If you have not already done so, please read the Theory of Operation Section before attempting to use the ECU. You will have a difficult time trying to use the ECU if you do not know how the variables effect the car's operation. Initial tuning of the Flyin' Miata ECU is not difficult but having someone in the passenger seat to take some readings while the driver drives the car is a very good idea. The TURBO1 default program can be used as a starting point but the fuel values will have to be increased due to the parasitic nature of the super charger. Auto tuning will take care of this. Additional timing may need to be pulled out between 1500-2500 rpm where the supercharger will make more boost than the typical turbo. This will be accomplished with the knock sensor if fitted, otherwise zones Zi315,320, &325 need to be adjusted manually.

1. Turn the car "on" but do not start it.

2. Press the adjust down button on the keypad. The MAP reading should be atmospheric pressure. Sea level equals 100kPa. Higher elevations will read lower. Refer to the table below for the atmospheric pressure at your elevation. If this reading looks good, go to line #5.

Elevation	Pressure	Elevation	Pressure
Sea level	100kPa	4920ft	84kPa
820ft	98kPa	5742ft	82kPa
1640ft	95kPa	6562ft	79kPa
2461ft	93kPa	8202ft	75kPa
3281ft	90kPa	9843ft	70kPa
4101ft	87kPa	11483ft	66kPa

3. Two problems are usually the cause of an incorrect MAP reading. First, on 1.6L cars, double-check the BLK/G wire that was used to tap into the MAP sensor wire harness. There are two BLK/G wires in the harness and tapping into the wrong one (or using the wrong end of the correct wire) will affect the MAP sensor's readings. On 1.8L cars double check the wire harness connector at the MAP sensor. The locking tab on the connector should point toward the engine not the fender.

4. If the MAP reading is still incorrect, use the select up button to scroll to INJ/OXY. Press both adjust buttons, it should read "Mk2 MAP sensor". Use the edit buttons to change the display if necessary. (1.6 only)

5. (1.8 only) Use the select button and go to TPS SPAN window. Use the adjust buttons and adjust the setting to 10 with the throttle closed. Open the throttle fully and adjust TPS SPAN to 100. Double-check the settings because setting one may change the other.

6. Start the car and check for fuel leaks around the junction of the fuel injectors with the fuel rail.

7. At this point the car should idle, maybe not smoothly, but it should run. If the car idles poorly, scroll up to the OXY window and see what the O2 sensor is reading. If it is below 76-80, go to ZONEF and increase the number using the adjust buttons.

8. All of the ignition timing values in the ECU are set based on a Cam Angle Sensor (CAS) setting of 0^{o} BTDC. However, setting the CAS for 0^{o} BTDC can be difficult because the idle will be erratic and the timing mark will appear to jump around. The software has a special mode to make setting the timing easier. Go to the IGN TRIM window and press both edit buttons. A new screen will appear that reads IGN SETUP $+10^{o}$. With this mode selected, now set the CAS to 10^{o} BTDC. **DO NOT** use the jumper between terminals TEN and GND in the diagnostics connector. When finished press either of the edit buttons to return to the IGN TRIM screen.

9. At this point the car is ready to drive to do some auto tuning. Drive with the keypad set to the ZONEF window. The ECU can only tune the zone that the car is currently operating in. The 3 digit number in the center of the ZONEF window displays the current operating zone. When tuning, the car must be driven in different situations to ensure the engine operates in as many different zones as possible. Start by driving the car around a suburban setting, accelerate slowly and try to stay in the 200 row. Then move to an area where the car can be accelerated somewhat harder, keeping the car in the 300 row (zero on your boost gauge). Finally, find a road where the car can be accelerated from 1500RPM to redline in 4^{th} gear. Do a run with very light throttle to keep the car in the 200 row all the way to redline, trying to stay in each zone long enough to get "=". Repeat for each row, modulating the throttle to keep the car in the 300 row, then 400, then 500 (and 600, if N/A or turbo running over 15psi). While the car is driven in these conditions the ECU will display the characters shown above. Have a co-pilot read off the tuning information, specifically when the ECU shows "+" and "-" signs. These are important because they indicate when the computer is tuning. Try to hold the car in a particular zone until the "+" or "-" sign turns into an "=" sign.). Each zone usually tunes within 2 to 4 seconds. After driving for 15-20 minutes pull over and store the changes. **Do not forget to store before you shut off the car**

10. After about 20-30 minutes of driving the car should be tuned pretty well. Pull off the road to a place where the car can sit for a few minutes. Does the car idle smoothly at 850RPM? If it does skip to step #12.

11. Many times after tuning the car will pulsate at idle. This can be solved with the following steps. Scroll up to the EDIT Z window and go to Zf100. Read the values in Zf100, 105, 110, 200, 205, and 210. Average these together and enter that number into all 6 zones. The idle should be much more steady.

12. Scroll down to the OXY window and read the O2 sensor voltage. The reading will jump around a bit, estimate the average value. If it is below 76-80, go to the ZONEF window and add fuel by increasing the fuel correction number. If the O2 sensor reads higher than 76-80, decrease the fuel correction number in ZONEF.

13. Scroll down to IDLE MAP. The number on the far right is the IDLE MAP setting. The number in parentheses is the current MAP value. These two numbers must equal each other. If not, adjust the IDLE MAP setting and go back and repeat step #11.

14. Go to the IDLE window. The car will idle best when the IAC valve operates at 35% duty cycle. Adjust the idle bypass screw on the throttle body until the IAC is 35%.

15. The tuning that the ECU performs in ZONEF is coarse, the ECU will tune in a wide area of the zone. To get even more accurate numbers, after getting "=" everywhere in ZONEF, set the keypad STORE. In this window the ECU tunes to a much finer degree, by only tuning in the zone centers, leading to better interpolation. Drive in STORE for a few miles until "=" are common and save these fuel values. The RPM center of the zones is at the 250 RPM point, IOW, 2250, 2750 and so on. Remember that you need to be in the center of the zone both MAP and RPM wise.

16. At this point the ECU is tuned. Drive the car with Lambda "on" all the time. The ECU will boot up in the TEST RPM screen and perform L3 tuning all the time. These values are not to be saved. L3 tuning will make changes daily in reaction to atmospheric conditions. The keypad can be stored in the glove compartment. Be very careful with the keypad, the cases will melt in high temps. Do not leave in the sun.

Section 9: Normally aspirated setup

If you have not already done so, please read the Theory of Operation Section before attempting to use the ECU. You will have a difficult time trying to use the ECU if you do not know how the variables effect the car's operation. Initial tuning of the Flyin' Miata ECU is not difficult but having someone in the passenger seat to take some readings while the driver drives the car is a very good idea.

1. Turn the car "on" but do not start it.

2. Use the select up button to get to RELOAD. There are 4 programs stored in the chip. The default is "TURBO 1". If you are using the ECU with stock injectors press the edit up or edit down or both edit buttons simultaneously until the screen reads "N/A oem inj". The buttons must be held down for the screen to change. While holding down the combination of edit buttons to select the correct program, press and hold both adjust buttons. The screen will fill with asterisks. When they clear use the select up button to get back to TEST RPM. If you are using 440 or 550 injectors, use the combination of edit buttons so that the screen reads "N/A BIG inj.

3. Press the adjust down button on the keypad. The MAP reading should be atmospheric pressure. Sea level equals 100kPa. Higher elevations will read lower. Refer to the table below for the atmospheric pressure at your elevation. If this reading looks good go to line #5.

Elevation	Pressure	Elevation	Pressure
Sea level	100kPa	4920ft	84kPa
820ft	98kPa	5742ft	82kPa
1640ft	95kPa	6562ft	79kPa
2461ft	93kPa	8202ft	75kPa
3281ft	90kPa	9843ft	70kPa
4101ft	87kPa	11483ft	66kPa

4. Two problems are usually the cause of an incorrect MAP reading. First, on 1.6L cars, double-check the BLK/G wire that was used to tap into the MAP sensor wire harness. There are two BLK/G wires in the harness and tapping into the wrong one (or using the wrong end of the correct wire) will affect the MAP sensor's readings. On 1.8L cars double check the wire harness connector at the MAP sensor. The locking tab on the connector should point toward the engine not the fender.

5. If the MAP reading is still incorrect, use the select up button to scroll to INJ/OXY. Press both adjust buttons, it should read "Mk2 MAP sensor". Use the edit buttons to change the display if necessary. (1.6 only)

6. (1.8 only) Use the select button and go to TPS SPAN window. Use the adjust buttons and adjust the setting to 10 with the throttle closed. Open the throttle fully and adjust TPS SPAN to 100. Double-check the settings because setting one may change the other.

7. Start the car and check for fuel leaks around the junction of the fuel injectors with the fuel rail.

8. At this point the car should idle, maybe not smoothly, but it should run. If the car idles poorly scroll up to the OXY window and see what the O2 sensor is reading. If it is below 76-80 go to ZONEF and increase the number using the adjust buttons.

9. All of the ignition timing values in the ECU are set based on a Cam Angle Sensor (CAS) setting of 0^{o} BTDC. However, setting the CAS for 0^{o} BTDC can be difficult because the idle will be erratic and the timing mark will appear to jump around. The software has a special mode to make setting the timing easier. Go to the IGN TRIM window and press both edit buttons. A new screen will appear that reads IGN SETUP $+10^{o}$. With this mode selected, now set the CAS to 10^{o} BTDC. **DO NOT** use the jumper between terminals TEN and GND in the diagnostics connector. When finished press either of the edit buttons to return to the IGN TRIM screen.

10. At this point the car is ready to drive to do some auto tuning. Driving with the keypad set to the ZONEF window. The ECU can only tune the zone that the car is currently operating in. The 3 digit number in the center of the ZONEF window displays the current operating zone. When tuning, the car must be driven in different situations to ensure the engine operates in as many different zones as possible. Start by driving the car around a suburban setting, accelerate slowly and try to stay in the 200 & 300 row. Then move to an area where the car can be accelerated somewhat harder, keeping the car in the 400 & 500 rows. Finally, find a road where the car can be accelerated from 1500RPM to redline in 4^{th} gear. Do a run with very light throttle to keep the car in the 200 row all the way to redline, trying to stay in each zone long enough to get "=". Repeat for each row, modulating the throttle to keep the car in the 300 row, then 400, then 500 and 600. While the car is driven in these conditions the ECU will display the characters shown above. Have a co-pilot read off the tuning information, specifically when the ECU shows "+" and "-" signs. These are important because they indicate when the computer is tuning. Try to hold the car in a particular zone until the "+" or "-" sign turns into an "=" sign.). Each zone usually tunes within 2 to 4 seconds. After driving for 15-20 minutes pull over and store the changes. **Do not forget to store before you shut off the car**

11. After about 20-30 minutes of driving the car should be tuned pretty well. Pull off the road to a place where the car can sit for a few minutes. Does the car idle smoothly at 850RPM? If it does skip to step #15.

12. Many times after tuning the car will pulsate at idle. This can be solved with the following steps. Scroll up to the EDIT window and go to Zf100. Read the values in Zf100, 105, 110, 200, 205, and 210. Average these together and enter that number into all 6 zones. The idle should be much more steady.

13. Scroll down to the OXY window and read the O2 sensor voltage. The reading will jump around a bit, estimate the average value. If it is below 76-80, go to the ZONEF window and add fuel by increasing the fuel correction number. If the O2 sensor reads higher than 76-80, decrease the fuel correction number in ZONEF.

14. Scroll down to IDLE MAP. The number on the far right is the IDLE MAP setting. The number in parentheses is the current MAP value. These two numbers must equal each other. If not, adjust the IDLE MAP setting and go back and repeat step #11.

15. Now with the car idling smoothly and the O2 sensor reading between 76-80, go back to the "EDIT" window and set the 6 idle zones with the same number you have in Zf105. Except when setting Zf205 and 210, add about 5 to the number in Zf105 (i.e. if Zf105=120 make Zf205 and Zf210=125).

16. Go to the IDLE window. The car will idle best when the IAC valve operates at 35% duty cycle. Adjust the idle bypass screw on the throttle body until the IAC is 35%.

17. The tuning that the ECU performs in ZONEF is coarse, the ECU will tune in a wide area of the zone. To get even more accurate numbers, after getting "=" everywhere in ZONEF, set the keypad STORE. In this window the ECU tunes to a much finer degree, by only tuning in the zone centers, leading to better interpolation. Drive in STORE for a few miles until "=" are common and save these fuel values. The RPM center of the zones is at the 250 RPM point, IOW, 2250, 2750 and so on. Remember that you need to be in the center of the zone both MAP and RPM wise.

18. At this point the ECU is tuned. Drive the car with Lambda "on" all the time. The ECU will boot up in the TEST RPM screen and perform L3 tuning all the time. These values are not to be saved. L3 tuning will make changes daily in reaction to atmospheric conditions. The keypad can be stored in the glove compartment. Be very careful with the keypad, the cases will melt in high temps. Do not leave in the sun.

Section 10: Datalogging

Your Flyin' Miata ECU is capable of datalogging many parameters to a laptop computer, using the Serial Link interface. The Serial Link plugs into the ribbon cable in place of the keypad, then connects to the serial port of your laptop. Do not use the Telix software provided with the Serial Link, it will not work with our current software. Go to the FM Owners page of our website and download the "binary logging software". If you just purchased your Serial Link, we have included the binary datalogging software. Save it to your C root directory and it will create a couple of new icons on your desktop. To datalog, click on the "Record" icon on your desktop, wait for it to say "ready", then start the car. You can pause recording at any time by hitting "P" on your keyboard. You may resume by hitting any key. When you are done with your recording, hit "Q".

To view your datalog, go to "Miatalog.bin" icon on your desktop and drag it up to the "MS DOS CONVERT" icon. This will open up Wordpad and pop up your datalog. You must save your datalog from Wordpad, otherwise it will be replaced by the next one you do.

The columns in the datalog are:
Sample – (this is the line number)
E – Shows any cam angle sensor errors
RPM – Engine RPM
MAP – (manifold pressure)
L C – shows that lambda control is on (Lambda, tells tuning status, ie: + - =, V, E, etc)
02 – Oxygen sensor signal
W/E – (Wastegate duty cycle) (on 1.8 only, shows EGR position when no boost)
INJW – (injector pulse width)
INJ% - (injector duty cycle)
* - (shows * if idle switch is closed)
I/T – (idle duty cycle) (1.8 only, shows TPS position when * not showing)
S – shows neutral switch position (MKII ECU only)
KNK – (raw knock sensor loudness signal)
IADV – (ignition advance, must be added to base timing.)

Periodically, another line will show up, giving voltage, engine temp, speed (1.8 only), CF (1.8 only, shows condenser fan on), EF (1.8 only, shows main engine fan on),PR (1.8 only, shows PRC solenoid activated, giving extra hot start enrichment), CP (charcoal canister purge) and knock count (number of times knock level has exceeded z13 knock threshold).
At the end of the datalog, your starting maps will be printed, followed by two maps filled mainly with asterisks. Any changes made by lambda tuning or the knock sensor will show up in these maps. This can be a wonderful tuning aid, especially on the dyno.

There are 12.2 lines of info printed per second, so you can use the time frame for 0-60mph, etc. These is a slight lag in the speedometer cable, so these numbers won't be 100% accurate, they will actually read slightly slower times than reality.

Section 11: Frequently Asked Questions

When coming to a stop the idle droops and sometimes the car stalls. Why?

The ECU has two zones to control the IAC valve when the car is under high vacuum with the throttle closed, Z18 when the car is hot and Z19 when the car is cold. Increase the value in each of these zones to stop the idle drooping. They should typically be set in the low 40's, if you have your idle duty cycle (set with the idle air bypass screw) set in the 30-35% range.

When I increase IDLE MAP, my idle smoothes out. Why can't I just do that to get a great idle?

Increasing idle MAP richens up the idle zones, which will almost always give you a good idle. Unfortunately, it will be way too rich an idle. Once you set idle MAP equal to your hot idle MAP reading, leave it alone, make your idle adjustments in the idle fuel zones.

All my zones are hitting "=", I have no pinging, but the engine is breaking up under full boost. Why?

This is most commonly caused by ignition system problems. Try the following items in this order. Re-gap spark plugs to .030", replace spark plugs with NGK ZFR6F-11s gapped to .030", replace the spark plug wires with Magnecor 8.5mm wires. And lastly, replace one or both of the coil packs.

At 12psi and above my engine misses and stumbles. Why?

At 10psi and above the spark plug gap needs to be reduced from the factory setting of .043" to .028" to .030". At these boost pressures the incoming air and fuel literally blows out the spark on the plug at the stock gap. Another possible cause of this problem would be 02 target variation caused by different fuel octane ratings. We find that those of you lucky enough to get 93-94 octane fuel may want to reduce z29-30-31 down to 89.

Section 12: Operation warnings

Fitting the Flyin' Miata ECU to your car will increase performance. In the case of a turbo charged installation, the power output from the motor is more than doubled. An increase like this requires the driver to use good judgment when tuning and operating the car.

1. Always use the highest octane fuel available.

2. If you hear knock from the motor, lift off the throttle immediately. The forces from knock are the most damaging to an engine.

3. On turbo charged cars keep an eye on the boost gauge. If you see the boost pressure exceeding your target boost level lift off the accelerator pedal. Miatas can incur serious engine damage when exposed to boost pressures over 15psi.

4. Be kind to your transmission and differential. The stock transmission and differential have proven reliable in turbo charged cars provided "mechanical empathy" is exercised. This means no smoky burnouts from a standing stop and no "speed shifting".