

Setting idle on the MX-5 Miata using the Adaptronic



BOUNDARY ENGINEERING

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This tutorial is to help you setup the idle on the MX-5 Miata. It is a complete setup guide, which addresses both cold and hot running idle.

Basic Terms:

Interpolation: This is a term for taking the split between two cells. An example would be that the current rpm of the vehicle is 1250; the map is set at 500 rpm increment. The rpm spacing of the fuel map becomes 0, 500, 1000, 1500 etc. The computer takes the values of the 2 closest cells adds them both together and divides them by two. So really the computer has a line between each load cell. Each cell box is not just an on off switch. The same thing would happen at 1100 rpm, except it wouldn't be just divided by two, the 1000 rpm point would get more weight. The ECU also does the same thing in the load direction, so the map is very comprehensive. It is not just the values you see but, also all the ones in between.

MAP Manifold Absolute Pressure (LOAD): This is the pressure reading which determines the amount of air going into the engine. The computer uses this to understand how much fuel to add to the engine.

Open loop: Open loop means that the computer doesn't try to change the value with respect to other factors. For example if we're talking about idle, the car would respond the same way if coming off of a 7000 RPM rev the same as it would if it was just started. It is a simple system, but you can imagine the two very different situations would require very different idle air amounts to get a stable idle.

Close loop: Closed loop takes other values like how fast the idle is falling and meters more or less air in to get a solid idle. So as stated above in the situation of startup vs. a 7000 rpm fall to idle the closed system WILL respond differently.

Closed loop idle air function: The way this system actually functions is that it takes the rpm the motor is currently at, and the rpm the motor wants to get to and tries to correct for it. The more complicated part is that it actually looks at how the rpm is moving to the idle point. If it is coming off of a steep fall from high rpm, then the controller starts correcting to slow its dissent. If the controller sees the RPM gently falling from 2000 RPM its actions are less aggressive. This is why modern cars can smoothly idle in every condition. In order to get it to do that you have to tune in the closed loop system. Read on to learn about closed loop correction values.

Closed Loop Correction Values:

Proportional Gain: This value responds to quick changes. So if you are having problems with the idle dropping after coming down from high RPM this proportional gain helps to correct that. It is very coarse; it adds lots of air in a short amount of time. This value has a tendency to make the idle unstable if too much is added.

WHEN TO ADD: Add proportional gain if the car goes to a very low RPM after a rev drop.

WHEN TO REMOVE: Remove proportional gain if the idle rapidly jumps up and down becoming unstable.

NORMAL VALUES: Normal values for proportional gain are between 0-3. Some setups may work with higher proportional gains then 3, but most become unstable at that point.

Integral Gain: This value isn't as off/on as proportional gain, so it serves to meter the air to the engine a little more gently. If the car is really over shooting the mark and causing rapid hunt you can add this value instead of proportional gain to reduce the over shoots. It always takes a combination of proportional and integral gain to tune the car; you don't select one over the other.

WHEN TO ADD: Add integral gain when the car jerks up and down in rpm quickly around idle.

WHEN TO REMOVE: The idle will seem to surge back and forth when this value is set to high.

NORMAL VALUES: Normal values would be between 2 and 8. Values as high as 12 have been used, but you could begin to see instability at that level.

Differential Gain: This value stabilizes the whole system. So regardless of how much integral gain or proportional gain you throw at the car this will help to remove the idle hunt. It does not correct for high rpm drops, or low rpm drops. It just corrects the idle hunt.

WHEN TO ADD: Add this value to increase idle stability.

WHEN TO REMOVE: Remove this value if after increasing the idle condition becomes worse.

NORMAL VALUES: Normal values will tend to be between 0-3.

System description:

The Miata idle system is comprised of two parts. One is the manual set idle air adjustment screw. On some vehicles this actually very slightly props open the throttle blade, but on the Miata it opens a port. It's the same function just a different way to go about it. This lets air in and allows the vehicle to idle in case there is some sort of electronic failure with the more complicated part of the idle system. Clockwise rotation increases air flow, and counter clockwise rotation reduces air flow.

The second part of the idle system, and the only other way air can enter is the Idle Air Control valve (IAC). This system meters air according to what the ECU tells it to. So it's a definite step up from just a one setting screw letting air in. If the car is coming down fast from a high rpm the IAC catches the motor and gently lets it down to the idle speed. It eliminates idle hunt and helps improve cold start performance.

Setting up the system:

When setting idle the first thing you want to do is start with open loop mode. Closed loop mode varies the Idle Air Control (IAC) valves air metering to compensate for droops in idle. Starting out with the closed loop on just adds complexity to what is a pretty complex system already.

Step one: To disable closed loop go to the idle tab of the Wari software. Under the closed loop box set all the values under proportion, integral, and differential to zero. This changes the idle mode to open loop.

In open loop mode the vehicle uses only one output to the IAC valve per an engine temperature. This should stabilize the idle while not revving the motor, or just after start up oscillations stop. If the idle is

stable after some time continue with step two. If the idle is not steady skip to step 2b. Now is when you want to take the time to set the idle air/fuel ratio values to where they should be.

Step two: First you want to get to the appropriate tuning rpm. To do this you should open up the WINDOWS>GAUGES window located at the very top along with file, port etc. Then open up the base idle value temperature table. Look at the gauges menu and find the current temperature (the car should be warmed up) then modify the idle pos columns at your current temperature (and 3 temperature rows on each side) to the same value hitting update each time until the idle is at the correct level.

Step two B: (SKIP STEP IF IDLE IS NOT HUNTING OR TOO LEAN TO IDLE) If idle is hunting go to the tuning tab. select all fuel cells from 0-60 KPa and from 0-1500 rpm and add 15% fuel. To do this select the cells and right click. From the box click add percentage. This will make the car run rich, and stabilize idle. You will notice an increase in rpm when you do this. Go back to the idle tab and use step two to put the car at the correct idle speed.

Step three: Selecting the proper idle air fuel ratios is crucially important to stabilizing idle. You must use an air fuel ratio between 14.5:1 and 15.5:1. To set the idle fuels amounts go to the tuning tab in Wari. Once here go to the far left side and select under map colors *highlight current cell*. On the map find the cell that the car is currently idling at. By hand change the fuel in the cell until the proper AFR is achieved. (USE WINDOWS>GAUGES to observe AFR) REMEMBER: This computer interpolates between cells. The map tells you what cell you're mostly in; if the car is actually sitting between cells make sure to make cells close to the home cells adjust as well. Otherwise this can add to idle instability.

After AFR is set in all the idle cells, then there is one further step in setting base values. We need to turn the idle air control valve completely off, and tune the idle in by the screw only. This way if there is some kind of electrical failure the car will still run. This also helps the car idle more steadily.

Step four: Go to the idle tab in Wari. Go to the overall control box, and change maximum, and minimum duty cycle values to zero. It is likely at this point revs will drop or the car will die. If the vehicle dies give the screw a full clockwise twist. Restart the vehicle, and see if it will settle and idle. Once the car will idle, adjust the screw until the optimal idle is met for your car. It is best to do this step while the car is warm.

After this step we need to turn the idle air control valve back on, and set the proper idle air control values so that the car maintains its current idle.

Step five: Go to the idle tab and under master control set the maximum duty cycle to 100 and the minimum duty cycle to 0. This will cause revs to surge. Then go to the base idle table. Move the values back around for your current warmed up operating temperatures hitting apply after each change until the idle is set at the desired level.

Air Conditioner Setup Step five b: If you have an air conditioner installed you also need to configure its open loop idle settings. In the idle tab under the open loop control box select the extra effort for A/C box. Input a value of 5-6. Turn the A/C on. Observe the change in RPMs. Change the value in this box up or down according to how the car responds. Turn the A/C off, and back on several times to make sure the A/C is setup correctly so that after the idle stabilizes it is at the same RPM.

Now we finally need to setup the closed loop controls. Make sure you read pages 86-89 in the official Adaptronic manual so you understand what each setting means that we did not specifically talk about. All of these features will help the car idle better after this initial setup.

Step six: Go to the closed loop section of the idle tab. First it is important to set your target idle speed table. Put in the values for all temperatures greater than 60 degrees at the idle value you have setup on all of your other steps in this process. For less than 60 I recommend a 25 rpm increase per every row (5°C) in the column above this until you hit 1200 rpm. Then it's 1200 RPM for the rest of the rows.

Step seven: In this step we are setting up the actual idle air control values. Go to the idle tab in Wari, and add proportional gain. Stab the throttle. Keep doing this until the idle begins to hunt. Add differential gain to stabilize the hunting of the idle. Then add more proportional gain. Once you've reached a limit where more proportional gain or differential gain makes the idle hunt add as much integral gain as you can without making the idle unstable. Refer to the first section of this setup manual to see what each does, and how they influence idle.

Cold idle:

After setting up warm idle completely there are only a few more steps to getting the car completely stable under all conditions.

Step one: First you have to let the car cool down completely. Start the car and let it try to let it idle. After short post crank, and long post crank expire (the duration is located under corrections tab in the middle of the fuel control box) see what the AFR is (Use WINDOWS>GAUGES). Go to cold map correction located in the middle of the window and increase the percentage of cold correction for the current temperature of the car until it is at about 12.5:1, ~ 13.0:1. You have to be quick as water temperature will rise fast. Remember to hit apply after each change. Stop increasing cold enrichment at about 65 degrees C.

The BP motors like to run rich until they are warmed up. Do this as the car warms up. This should eliminate idle instability at start up and give you a smooth idle as you drive the car. If this does not do it, add more fuel until the idle becomes stable.

Step two: Take all of these values from the low map coolant enrichment and put them in the high coolant enrichment box and add 10 to every value. This will keep the car responding at higher loads just as it does at lower ones while cold.

After setting the AFR to a level that stabilizes the cold temperature idle you now need to finish putting in the cold base idle values. This will further help to give you cold idle stability. Let the car cool completely before starting this process.

Step three: Write down your current PID values, and change them all to zero. This puts the car back into open loop again. After the car is in open loop start the vehicle and let the idle level. Go to the target idle air values table, and find the cars current temperature. Change the values until the correct idle speed is reached and remember to hit apply after each change. Change each water temperature value up or down until you get the car to settle on the correct value. Do this all the way up to your full operating temperature.

Step four: Input the PID values back into the closed loop controller.

This concludes the tutorial, and you should have a 100% stock feeling idle at this point.