Idle Valve options

2 Wired Valves (MS1, 2 and 3 FIdle wire – MS3X setup use MS3X Idle wire)

These valves are wired between an ignition switched 12V and the Megasquirt Idle Valve wire in the loom. (The MS ECU switches ground to make them work.) Make sure the 12v is switched off when the megasquirt is off. Many looms contain a protection diode, leave it there.

Some valves will have a spring return mechanism to shut them, others have a spring to open them, so the duty cycle at high and low temps depends if the MS ECU has to drive it open against the spring or shut against the spring.

If the ECU has to shut the valve down against the spring to reduce air going through it as temp increases then the duty cycle will need to increase with temp, so the value at low temp will be around 0 and the duty at higher temp will be 100 or so. The opposite if the MS ECU has to force the valve open against the spring to increase air flow.

3 Wired Valves (MS1, 2 and 3 FIdle wire – MS3X setup use MS3X Idle wire)

e.g. Bosch Valve 0280 140 505

Three wired valves can also be made to work via the IdleValve output from an MS1 or an MS2 (Note that all ExtraEFI.co.uk MS1 and MS2 ECU's are modified during the build process so they can drive a valve, standard ECU's can not drive them directly!) The centre pin of the valve goes to an ignition switched +12V, one of the other 2 pins will hold the valve shut when its connected to ground (0V). This pin needs to go to earth via a resistor (30-40Ohms 50W), the other pin goes to the Idle valve output in the wiring loom from the MS ECU.

On a 3 wired valve there are effectively 2 windings that fight against each other, one opens the other closes it. So on a MegaSquirt ECU *(without an MS3X card)* we put a resistor in line to ground with one winding, this shuts (or opens it depending on what winding you use) the valve, so its like having a spring holding it one way. The MS ECU then forces it either shut or open, it can do this as the resistor in the other winding limits how much it can **force it one way.**
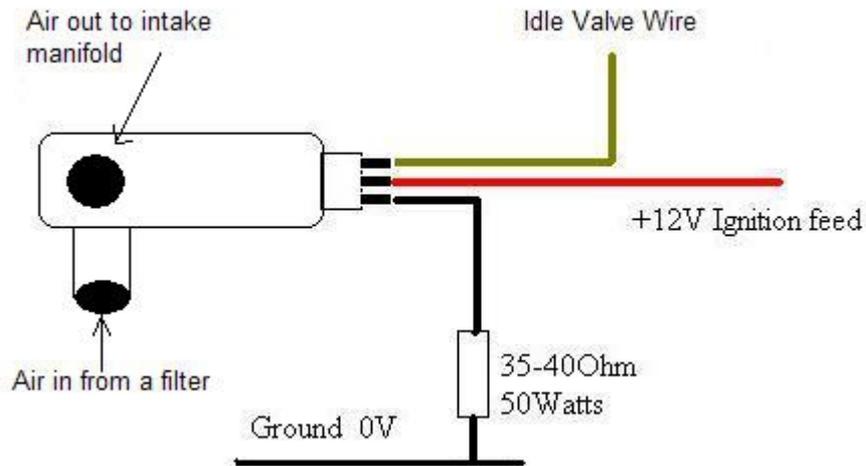
Note: If you have an MS3X setup (2 x db37 looms) then these don't need a resistor and can run a 3 wired valve directly. See picture for MS3X.
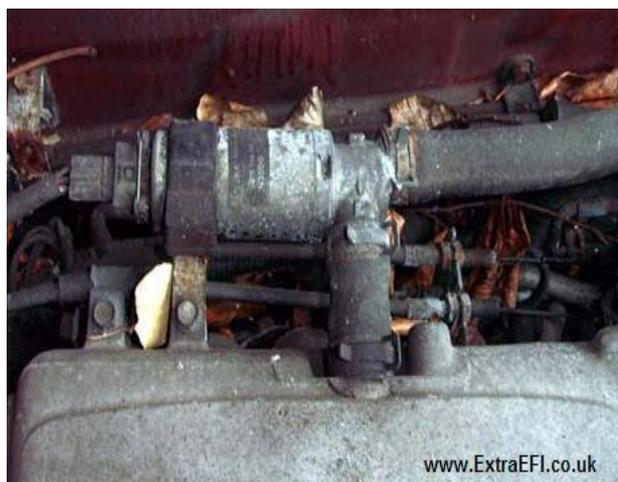
Bosch Idle valve
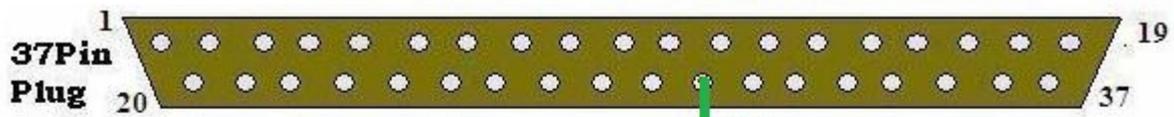Can be found on a Hyundia as pictured above, or on some Audis, Peugeots, etc

The original pipe on a Rover/TVR V8 setup that fed the stepper has been cut to allow the bosch idle valve to fit in line. The stepper motor can be left in place.

Air out to intake manifold

Idle Valve Wire

+12V Ignition feed

Air in from a filter

35-40Ohm 50Watts

Ground 0V

MS2 or MS3 (without MS3X card)

2 or 3 wired Idle Valve Options

37Pin Plug

1

19

20

37

Pin 30

www.ExtraEFI.co.uk

FIdle Output

3 wired Idle Valve

20-30ohm 50Watt

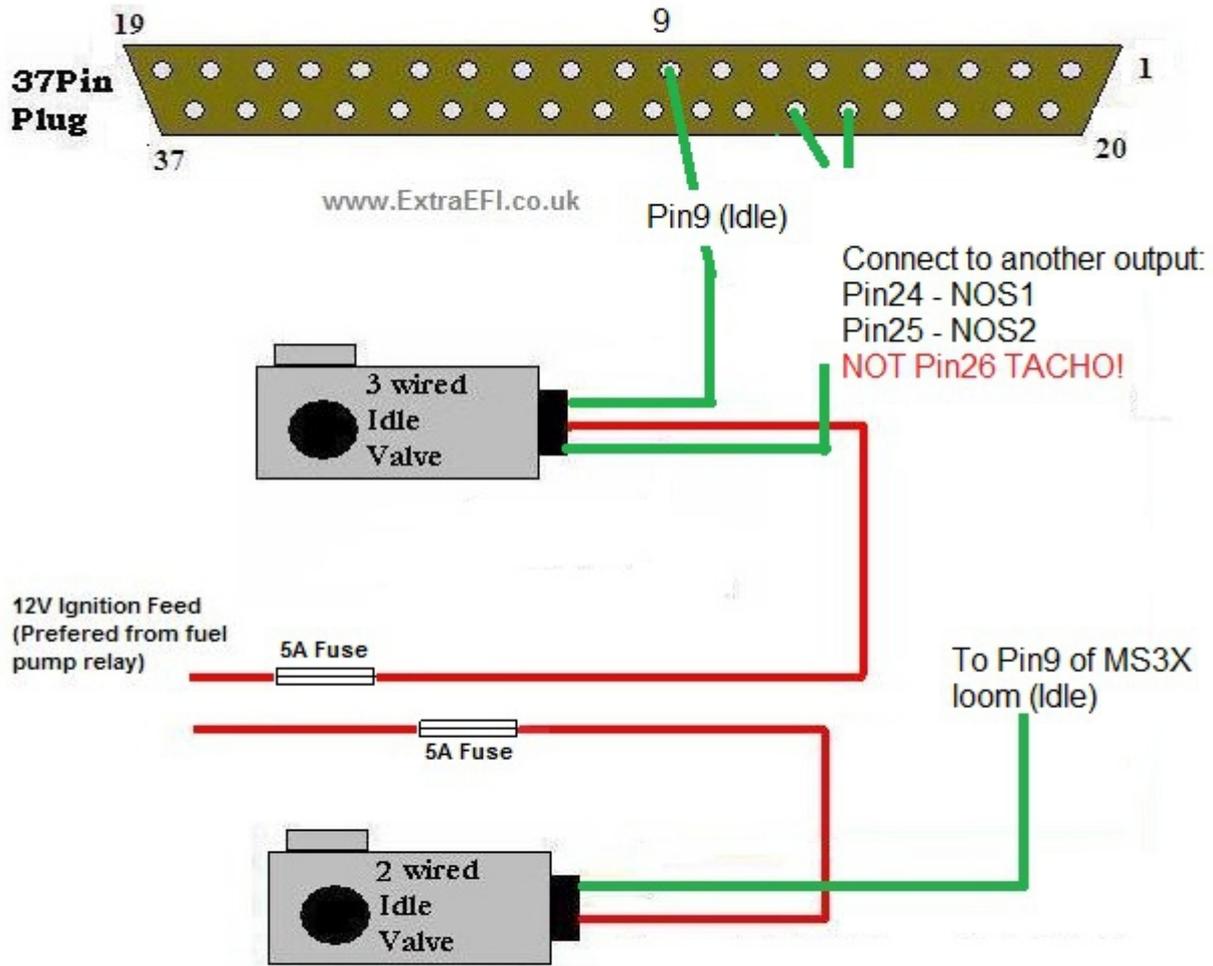12V Ignition Feed (Prefered from fuel pump relay)

5A Fuse

5A Fuse
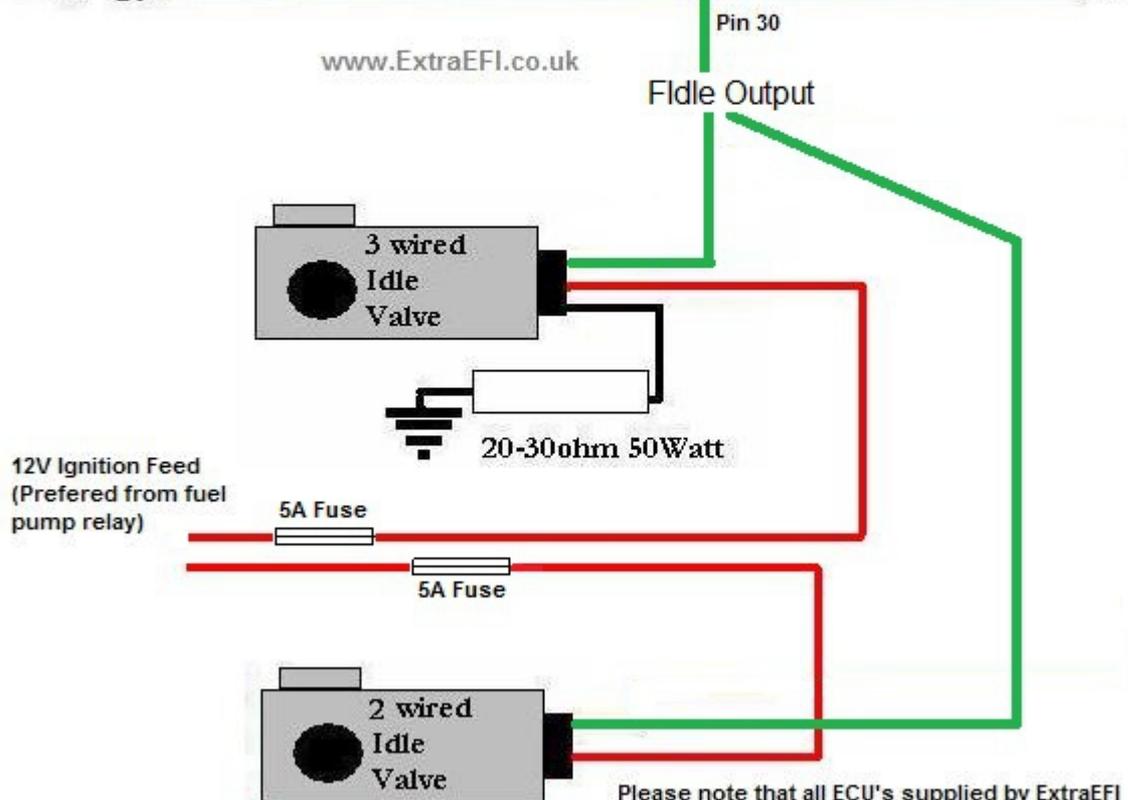
2 wired Idle Valve

Please note that all ECU's supplied by ExtraEFI can directly drive an idle valve, there is no need for a relay!

MS3X Setups for 3 wired Idle Valves
Upper connector (MS3X) loom

37Pin Plug

19
9
1
37
20

www.ExtraEFI.co.uk

Pin9 (Idle)

Connect to another output:
Pin24 - NOS1
Pin25 - NOS2
NOT Pin26 TACHO!

3 wired Idle Valve

12V Ignition Feed (Prefered from fuel pump relay)

5A Fuse

5A Fuse

To Pin9 of MS3X loom (Idle)

2 wired Idle Valve

Please note: MS3 ECUs that are supplied with an MS3X card should be wired as this drawing, the FIdle output (Pin 30 of the main MS loom) will not be suitable) but can be used as a programmable output to switch a relay, etc.

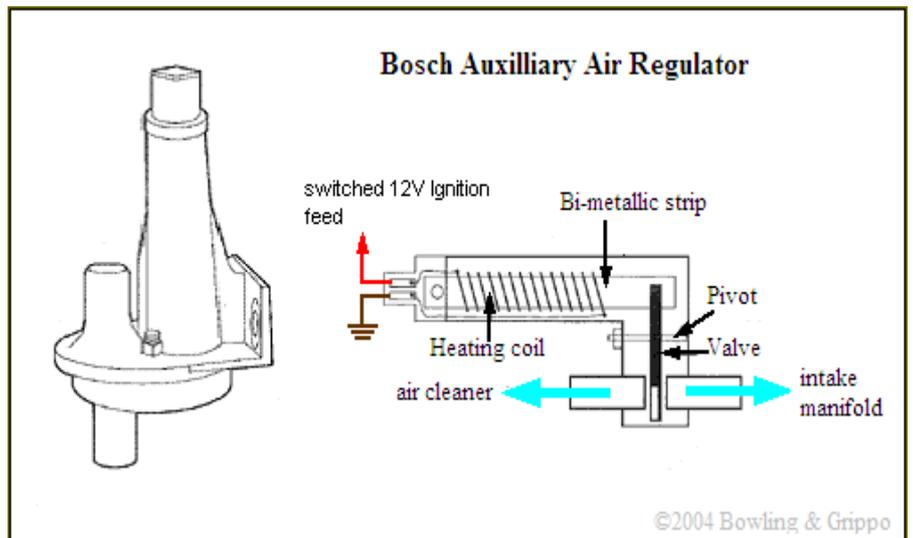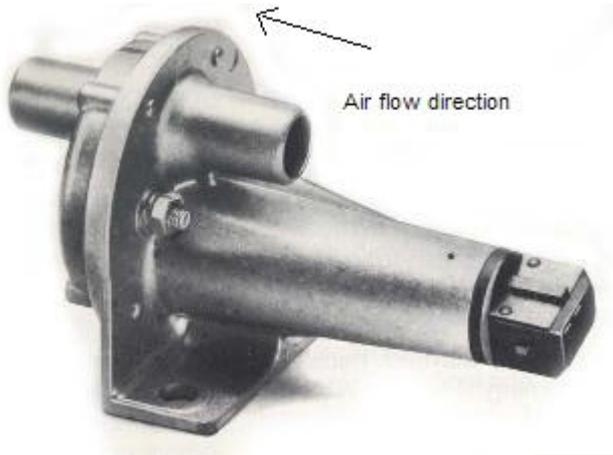### 4 Wired Valves (IAC1A-2B) Stepper Motors

If you have a 4 wired valve then its a stepper motor, these can NOT be controlled with MS1-Extra, but can be controlled by MS2 and MS3 ECUs. If you want to use the stepper outputs on the MS2 ECU as a programmable output or Boost or NOS, etc, then you may lose the stepper function as there is a limited amount of output pins that can be used. See HERE for more details on the output pads available.

If you use a stepper output for an option then you can still fit a suitable 2 or 3 wired valve from an older vehicle and use the FIdle output. This is the route most people take for MS1 anyhow. (See above)

Other Idle Valves

There are valves that need no control other than a 12V supply when the ignition is on. These heat up a bi-metalic strip that rotates a plate inside the valve and shuts the air down as the engine heats up, these are known as Extra Air Valves. They are becoming rare and hard to get hold of, they were fitted to various engines, like the Flapper type RV8 EFI's. The Idle Speed has to be controlled with the throttle stop when using these type of valves, as the valve is only used to add air when the engine is cold.

Here is a Bosch example:

Air flow direction

Bosch Auxilliary Air Regulator

switched 12V Ignition feed

Bi-metallic strip

Heating coil

Pivot

Valve

air cleaner

intake manifold

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Algorithm

Warmup Only modes: (These modes are for open loop control, they do not try to control the engine speed using the rpm as a reference, it is simply an open loop mode to increase engine speed during the warmup period using the coolant temperature. Once the engine is warm they can be set to allow a fixed amount of air through to control the idle rpm.) 2 or 3 Wired Valves: On/Off Valve For an on/off fast idle valve (these are rare and only found on old vehicles), you can also set your Fast Idle Threshold if you have installed a fast idle solenoid. Enter a coolant temperature to turn on the fast idle solenoid. A typical value is 70º C. The Fast Idle valve will be activated below this temperature (70ºC) and turned off above 70ºC. The Fast idle Threshold is independent of any warm-up enrichment. Fast idle valves generally have one or two wires, the FIdle output wire is used for these (Pin 30 in the loom)

PWM Warmup: This is for the 2 or 3 wired valves as found on Ford's, Vauxhalls, VWs from the early 80s and onwards. Many companies used a Bosch valve. These use the FIdle output wire in the loom (Pin 30).

4 Wired Idle Valves:

Idle Air Controller (IAC): If you have a stepper motor IAC, you can set ten intermediate steps based on the coolant temperature to allow a decreasing amount of "extra air" as the engine warms up. These are set under 'Idle Steps' in MegaTune. Stepper motor IACs usually have four wires, use the 4 wires IAC1A - IAC2B Click here for a wiring diagram

IAC Stepper Moving Only: Powers the stepper only when changes in pintle position are requested. This is the most common type, it holds its position if not powered, and is difficult to turn by hand

IAC Stepper Always On: Powers the stepper at all times. Required if your stepper 'free wheels' when you spin its pintle un-powered with your hand.

15 Minute IAC: This operates the IAC stepper motor as 'always on' for 15 minutes, then switches to 'moving only'. This can be useful in some situations in which the stepper moves unreliably if moving only at the lower voltages of cranking and warming up, etc.

Closed Loop modes: (These modes use the engine RPM, TPS, MAP and Coolant temperature as feedback to control the engine speed in a closed loop mode)

2 or 3 Wired Valves:

PWM Closed Loop:

This mode is for a 2 or 3 wired PMW idle valve.


IAC Closed Loop Moving Only:

This mode only powers the stepper only when changes in pintle position are requested. This is the most common type, it holds its position if not powered, and is difficult to turn by hand

IAC Closed Loop Always On:

Powers the stepper at all times. Required if your stepper 'free wheels' when you spin its pintle un-powered with your hand.

To select the appropriate 'Idle Control/Algorithm' for stepper motor control in MegaTune you may need to do some testing. In some cases setting the stepper motor to "IAC Stepper Always On" will cause the IAC to get hot. However setting it to "IAC Stepper Moving Only", might cause a problem with idle speed changing from one start to another if the stepper moves freely.

You can test if your IAC is suitable for 'always on' by leaving your stepper powered on the bench for 15 min or so. If it doesn't feel too hot to you, then set it to "Always On". Apparently this is what GM does. But if you want to be safe they should test it on the bench for 15 min or so, or monitor it closely in the car while not moving for at least 15 minutes, checking the IAC temperature frequently with your fingers. It may get warm, but it shouldn't burn your fingers just touching it.
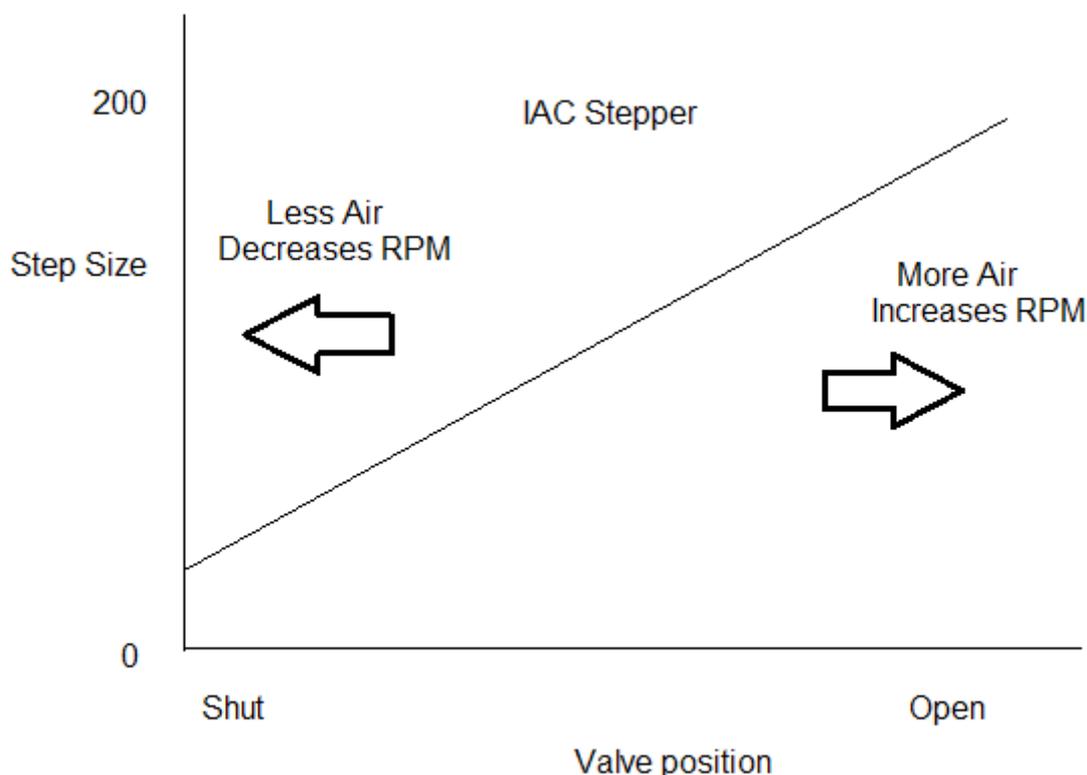
Closed Loop Idle RPM Targets:

This is the Idle RPM the closed loop code aims for at different coolant temps. At low coolant temps the engine will need to run at a higher RPM than when its up to operational temperature.
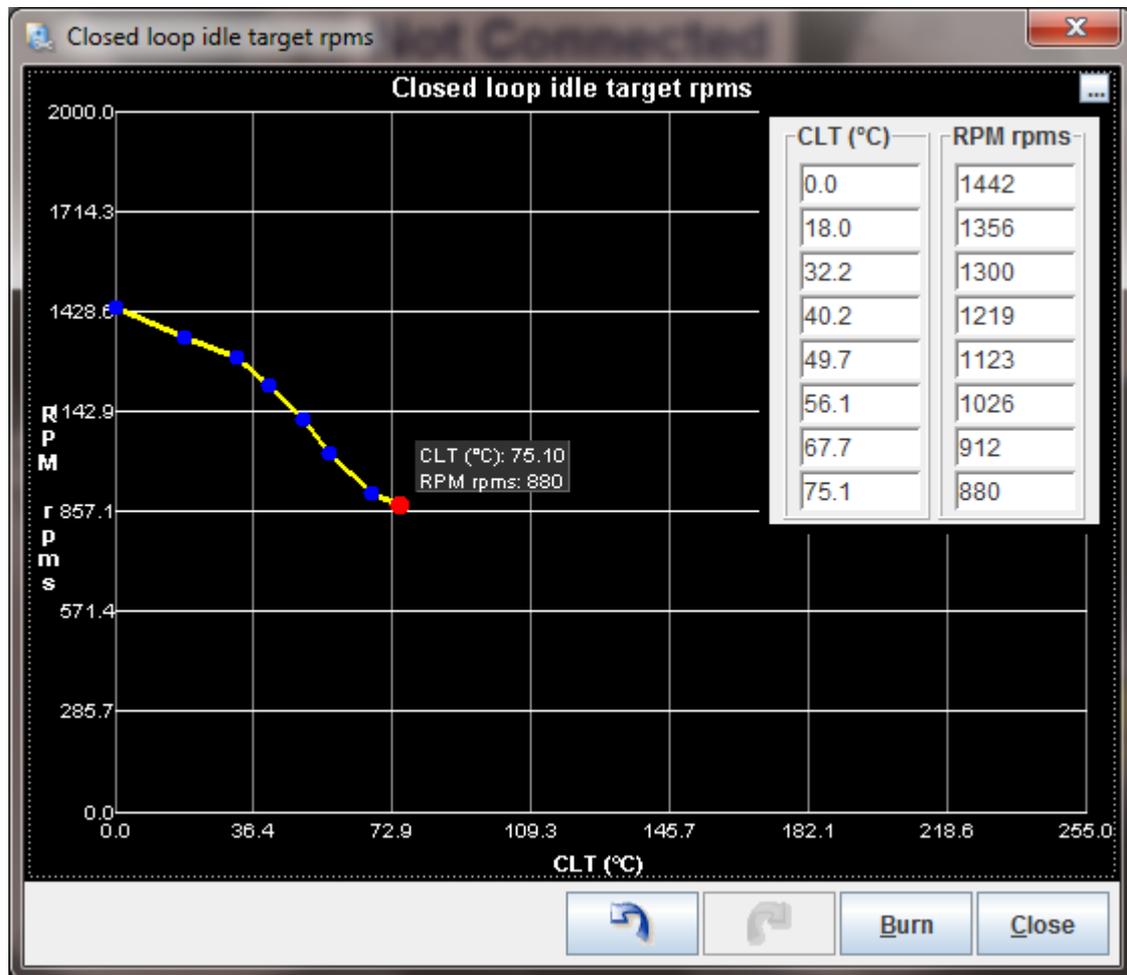
Coolant Based Cranking steps:

This is to allow more air in when the engine is cold to aid starting. Tuning this will be trial and error, the settings below are from an RV8.
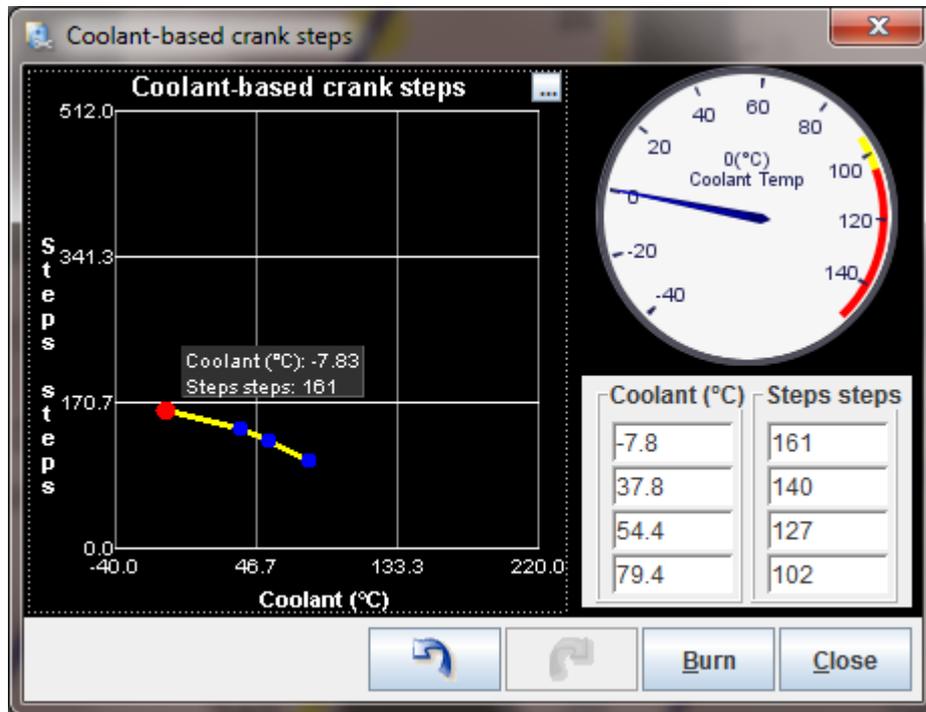
Idle Control:

Time Step Size (ms):

(Both Modes) IAC stepper motor nominal time between steps (i.e., 2.5 milliseconds gives pulse frequency of 400 Hz). If your stepper doesn't move very well this could be increased to help.

Initial Time Step Size (mS):

(Non-Always on modes) This is the delay the ECU will wait from turning the stepper motor outputs back on to actually driving the motor.

Minimum Step Size:

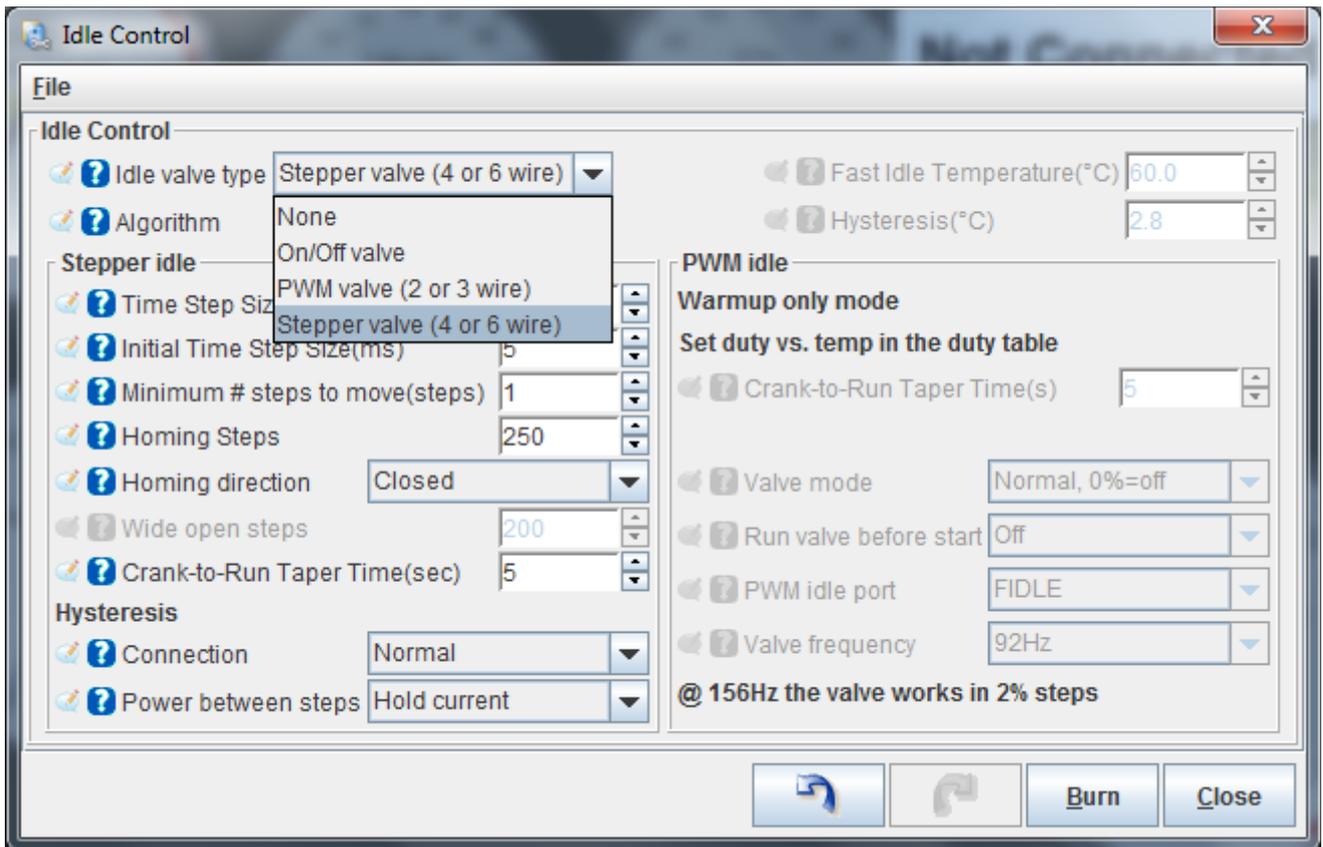(Both Modes) The code calculates how much movement is needed depending on the actual RPM or Coolant temp. Setting this to 1 means it will make lots of tiny steps which may not make any difference due to the actual movement generated by the motor. A setting of 4 - 6 is a good starting point for this, meaning it will need to calculate a larger movement (see a bigger discrepency between target points) before it drives the motor.

Start Value:

(Both Modes) The number of steps applied to shut the valve at power up. Because the valve could be anywhere on power up, the ECU drives it to its home position, so any steps from this point are from a known position (Closed). To find this value you need to see the Test Mode Page. This value should be just above the amount of steps the valve needs to go from open to closed, so if its fully open on power up it will reach fully closed. (200-250 is a usual value).

Crank-to-Run Taper Time:

(Open Loop Modes) This is the time over which the cranking position of the idle (either the stepper steps or the PWM%) is moved to match the table value (see diagram below). Higher values give a higher idle for longer periods, which can improve starting performance.

Hysteresis (°):

(Open Loop Modes) This input can be used to avoid continuous motor motion (and wear) for small coolant temperature changes. Changes to the motor are only made when new coolant temperature > coolant temperature on the last move, or, new coolant temperature < (coolant temperature on the last move - Hysteresis temperature). What this does is allow constant motor motion while the coolant temperature is rising, but when it peaks, there will be no further motion unless things cool back down - which is unlikely.

Time Based After Start (extended warm-up):

(Open Loop Modes) You should NOT use the Time Based After Start (extended warmup) option unless you find you need it, and very few will. Disable it by setting the 'cold temperature to a value lower than you will see in winter. Then this feature will not be used unless the coolant temperature at startup (ECU first powered on) is below the figure you enter. This feature is used toward the end of the warmup sequence when the coolant temperature is close to its final operating temperature. In this case, fast idle will normally come off, but SOME cars (very few) may need extended fast idle. An example is a car that uses heavy weight oil, which is nowhere near at operating temp when the coolant gets there, plus a hot cam with not enough idle torque to overcome the oil drag.

This feature is implemented by inputting a 'Cold Position' that is the step position at start of extended warmup, typically about 80% of the final, fully closed step position. The IAC behaves normally until the step position commanded from the table just exceeds this Cold position value (either PWM or stepper). From that point on, the steps are tapered in so as to reach the last step value in the table over the 'cold taper time' period. (see the diagram). This slows the reduction in idle air as the engine continues to warm up (increasing the idle speed for longer than the coolant temperature alone would do).

Cold Temperature (°):

(Open Loop Modes) This defines the initial coolant temperature below which the afterstart taper will be extended, based on the Cold Position and Cold Taper Time. It should be set fairly cold, generally not more than -10C.

Cold Position (steps):

(Open Loop Modes) The Idle PWM values at which time based afterstart tapering is initiated. Note that this value must be higher than the lowest value in your IAC PWM table, or you can get strange operating results.

Cold Taper Time (sec):

(Open Loop Modes) This is the number of seconds that MegaSquirt® takes to move from the 'cold position' to the position indicated in the IAC step table for the current coolant temperature.

PID Control (Closed Loop Modes)

PID (Proportianal Integral Derivitive) is a control method widely used in industry to control systems in a closed loop setup. It starts by calculating an error between its current position and the target position, in this case RPM. There are 3 parts to the control system:

P (Proportianal Gain): Determins the reaction to the current error calculated.

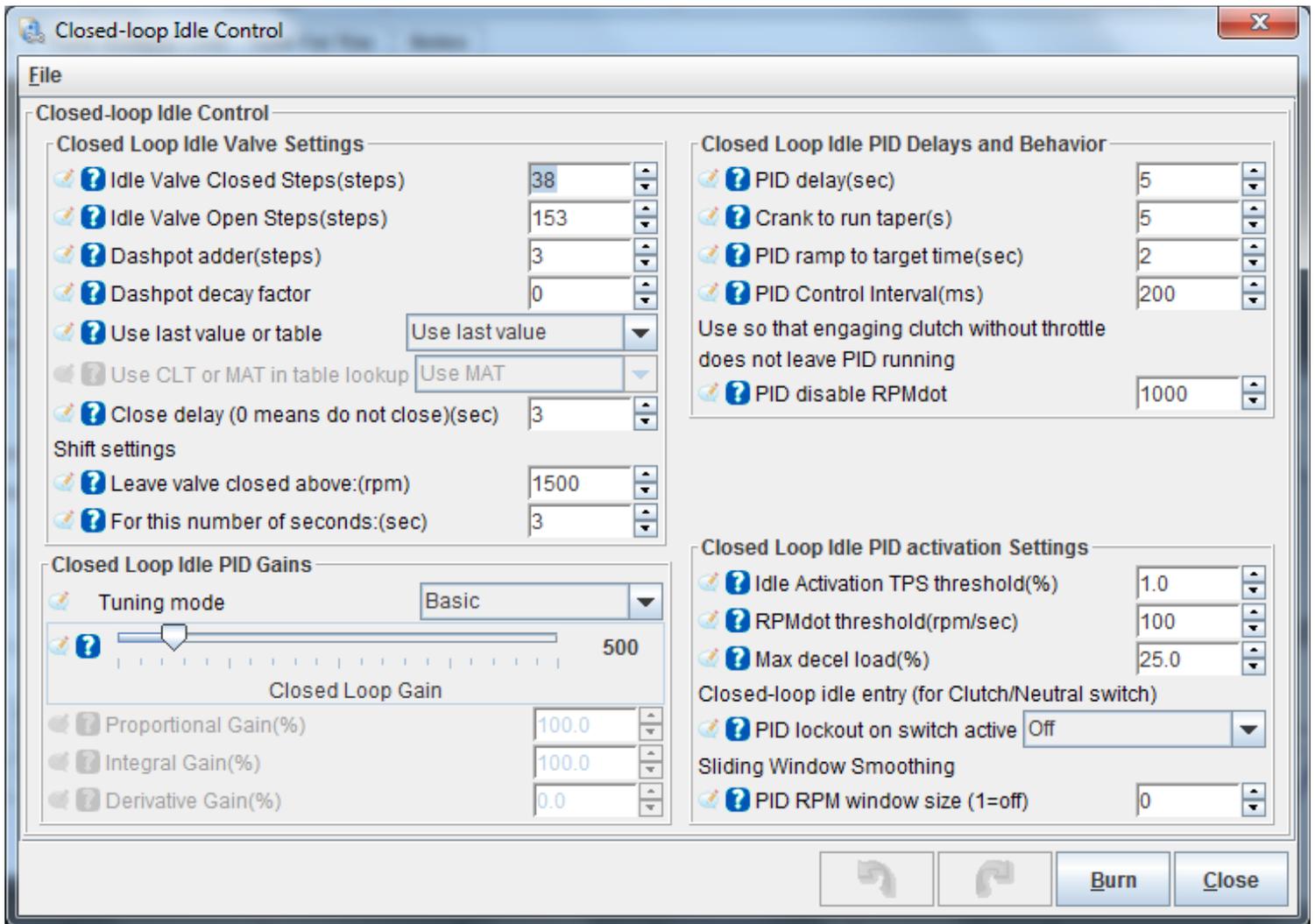I (Integral Gain): Determins the reaction based on previous calculations.

D (Derivitive Gain): Alters the reaction based on how much the error has changed.

So a PID setup weighs these reactions together and gives a calculated output for the difference in engine speed.

PID Delay:

Delay the ECU waits for all conditions to enter closed loop to be satisfied before entering closed loop. 1-3S is usually best here.

Closed-loop Idle Control

File

Closed-loop Idle Control

Closed Loop Idle Valve Settings

Idle Valve Closed Steps(steps)	38
Idle Valve Open Steps(steps)	153
Dashpot adder(steps)	3
Dashpot decay factor	0
Use last value or table	Use last value
Use CLT or MAT in table lookup	Use MAT
Close delay (0 means do not close)(sec)	3

Shift settings

Leave valve closed above:(rpm)	1500
For this number of seconds:(sec)	3

Closed Loop Idle PID Gains

Tuning mode	Basic

Closed Loop Gain — 500

Proportional Gain(%)	100.0
Integral Gain(%)	100.0
Derivative Gain(%)	0.0

Closed Loop Idle PID Delays and Behavior

PID delay(sec)	5
Crank to run taper(s)	5
PID ramp to target time(sec)	2
PID Control Interval(ms)	200

Use so that engaging clutch without throttle
does not leave PID running

PID disable RPMdot	1000

Closed Loop Idle PID activation Settings

Idle Activation TPS threshold(%)	1.0
RPMdot threshold(rpm/sec)	100
Max decel load(%)	25.0

Closed-loop idle entry (for Clutch/Neutral switch)

PID lockout on switch active	Off

Sliding Window Smoothing

PID RPM window size (1=off)	0

Burn   **Close**

Crank to Run Taper:

The ECU positions the idle valve at a fixed position during cranking (See the IAC Cranking Table). Once the engine starts the IAC will need to take up the closed loop position, this is the delay to allow for a smooth transition from cranking position to closed loop position.

PID Ramp to Target Time:

This is how long the code will take for it to reach the target RPM once in closed loop. Larger times here can allow you to increase the P of the PID control. A value of 2-3S works well here.

PID Controller Interval:

How often the code for closed loop runs, 80-100mS is a good starting point.

Proportianal Gain:

This is best kept reasonably low to stop hunting. See the description for PID Control above.

Integral Gain:

This is the gain based on previous calculations, try to keep this over 100%. See the description for PID Control above.

Derivative Gain:

This is the gain based on how much the error has changed, zero is a good setting here. See the description for PID Control above.

PID Lockout RPMdot Threshold:

This should be set just above the rate of change that the RPM would naturally move at and around idle. If the rate of change goes above this settng it is assumed the engine needs to come out of closed loop mode. This value can be found by looking through datalogs and finding roughly what RPMdot you have just before you enter closed loop and around idle during closed loop. Set this just above the max RPMdot you find, typically 50-150. If you find the closed loop drops out without touching the throttle, try increasing this a little.

PID lockout Max Decel Load:

This should be set so that the ECU doesn't go into closed loop mode during overrun (engine in gear during decel). During overrun the throttle will be at zero and the ECU could assume the engine is idling too high and therefore close the idle valve (to reduce the amount of air and bring the engine speed down). When the clutch is then pressed in, the engine will no longer be turning through the car's inertia and the idle valve could be closed causing the engine to stall. This setting is to stop the closed loop starting to work during overrun. To find the ideal value, find the KPa value of the MAP at idle and set this to 5 KPa less than the idle MAP, so if you idle at 45KPa set this to 40KPa.

Idle Open Duty/Steps:

This is the value needed to open the valve fully (allow max air through it).

Idle Valve Closed Duty/Steps:

This is the value the code runs the valve to when it goes out of closed loop mode (minimum air flow). To tune this, increase the throttle at idle to just over your Idle Activation threshold (e.g. TPS 1.5%) so the code no longer runs closed loop. The idle valve will then shut to this position. If the engine tries to stall then increase this value. This helps for very slow driving in traffic. (Adjust the RPM with valve closed value to just below the RPM you find this setting gives you, see above).

Idle Activation RPM Adder:

The ECU can enter closed loop mode even when on overrun if the engine speed is within this Idle Activation Adder value + the target rpm value. So if your idle target is 900RPM and Idle Activation Adder is 200 then closed loop will begin when the engine speed gets to 900+200=1100RPM. Ideally this needs to be set failry low, 50-150 is typical. (Note that if the Idle TPS Activation threshold isn't satisfied then it will NOT enter closed loop).

Idle Activation TPS Threshold:

This is the value te TPS must be below to enter closed loop. It is very important to calibrate the TPS correctly and set this to as low a value as you reliably acheive when the throttle is at rest. 0.5-1.0%.

Dashpot Adder:

The code remembers it's last good value that it had control of the engine speed. This value is added to the last good value for its starting point next time the throttle is lifted. A value of 5-15 is a good starting point, this helps to get the valve close to where it should be when entering closed loop.

Closed Delay:

The ECU closes the air valve after leaving the open loop mode (once TPS rises), this is the delay for that to happen (see Idle Valve Closed Duty).