

# Throttle Body Fuel Injection



## *Initial Calibration of the TBI*

### *Disclaimer*

*The author of this presentation assumes NO responsibility for information provided causing the owner to modify or alter their motorhome which shall result in problems or mishaps.*

# ***Why do we need to do this?***

***The Olds 455 & 403 engines in the MH were never fitted with a TBI from the factory, so there is no OEM data for a TBI for these engines.***

***By now, almost every coach engine has different characteristics from when it was OEM, due to changes in reworked heads, intake manifolds, etc.***

***When you install an “add-on” TBI on an engine, such as we are doing on the GMCMH, the TBI should have the initial calibration done for that specific engine so that the TBI will be matched to that particular engine.***

## ***What are we going to do?***

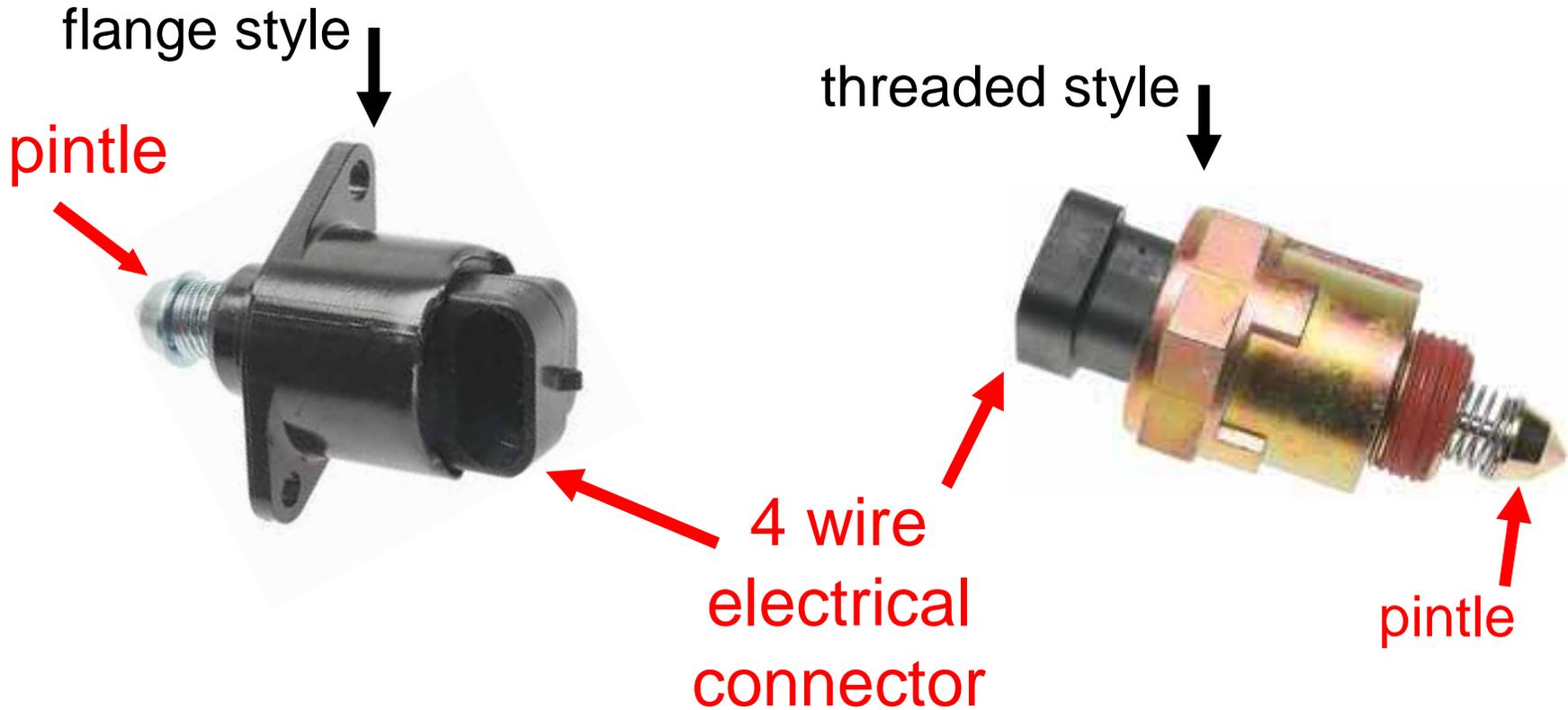
***We are going to check to see what the “minimum idle speed” is. We will see how this compares to what the “target idle speed” is set at in the chip. The “minimum idle speed” must be less than the “target idle speed”, otherwise, during normal operation, the IAC pintle could bottom out on the air passage seat of the TBI, and damage will occur to the stepper motor of the IAC control.***

***The “target idle speed” is set in a table on the chip. The RPM that the engine is idling at now, is probably what the RPM is set for in the current chip that you have. The only way to be sure of this is to check the chip and verify the “target idle table” .***

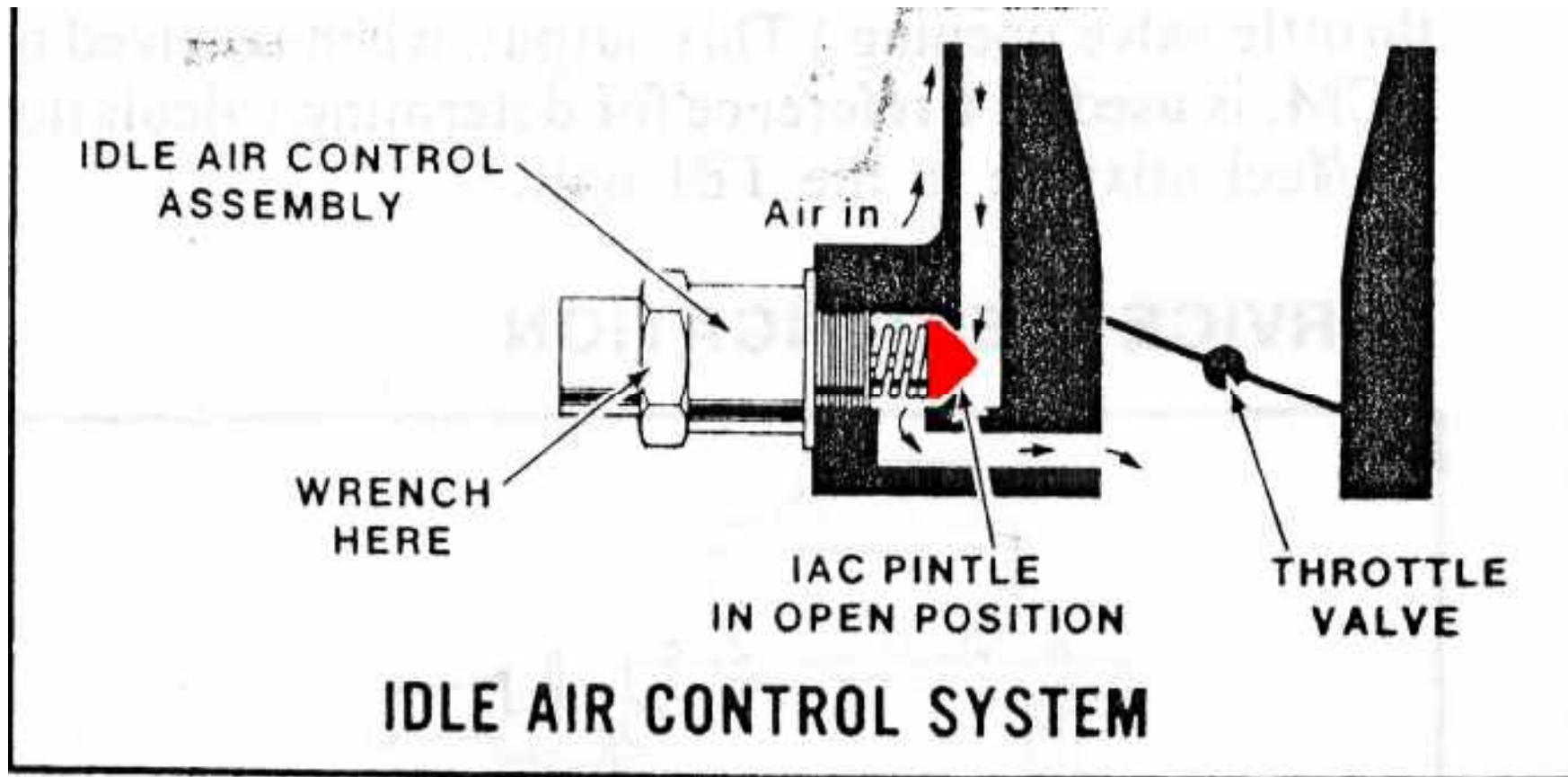
Target Idle RPM Vs. Coolant Temp.

Deg C	RPM
55	725.0
65	700.0
75	700.0
85	700.0
95	700.0
100	725.0
115	750.0
120	750.0
135	750.0

***The ECM controls the idle speed of the engine, both in “open loop” and in “closed loop” mode. This is done by sending signals to the IAC control. The IAC control is a stepper motor that will move the pintle in or out, to regulate the air going into the engine, thus controlling the RPM.***



***The diagram below shows how the IAC control will by-pass the air around the throttle valves when the chip controls the IAC and the idle speed. In doing the calibration, we are going to disable the IAC and move the IAC pintle into the seat, so as to shut off any by-pass airflow. Then we will adjust the throttle plate for “minimum idle”***



## ***Where do we start?***

- ***Make sure the spark timing is set correctly;***
- ***Be sure that you have no vacuum leaks!***
- ***Drive the coach several miles to get every thing up to operating temperature.***
- ***Remove engine hatch & air cleaner.***

## ***What items are we going to work with?***

The items on the TBI we are going to be dealing with are;

**1- IAC** = “idle air control”

**2- The throttle plate adjusting screw**

It is preferred to use a scanner to plug into the **ALDL** connector to read the **RPM**. A dash mount tachometer usually is not accurate enough to get a good reading.

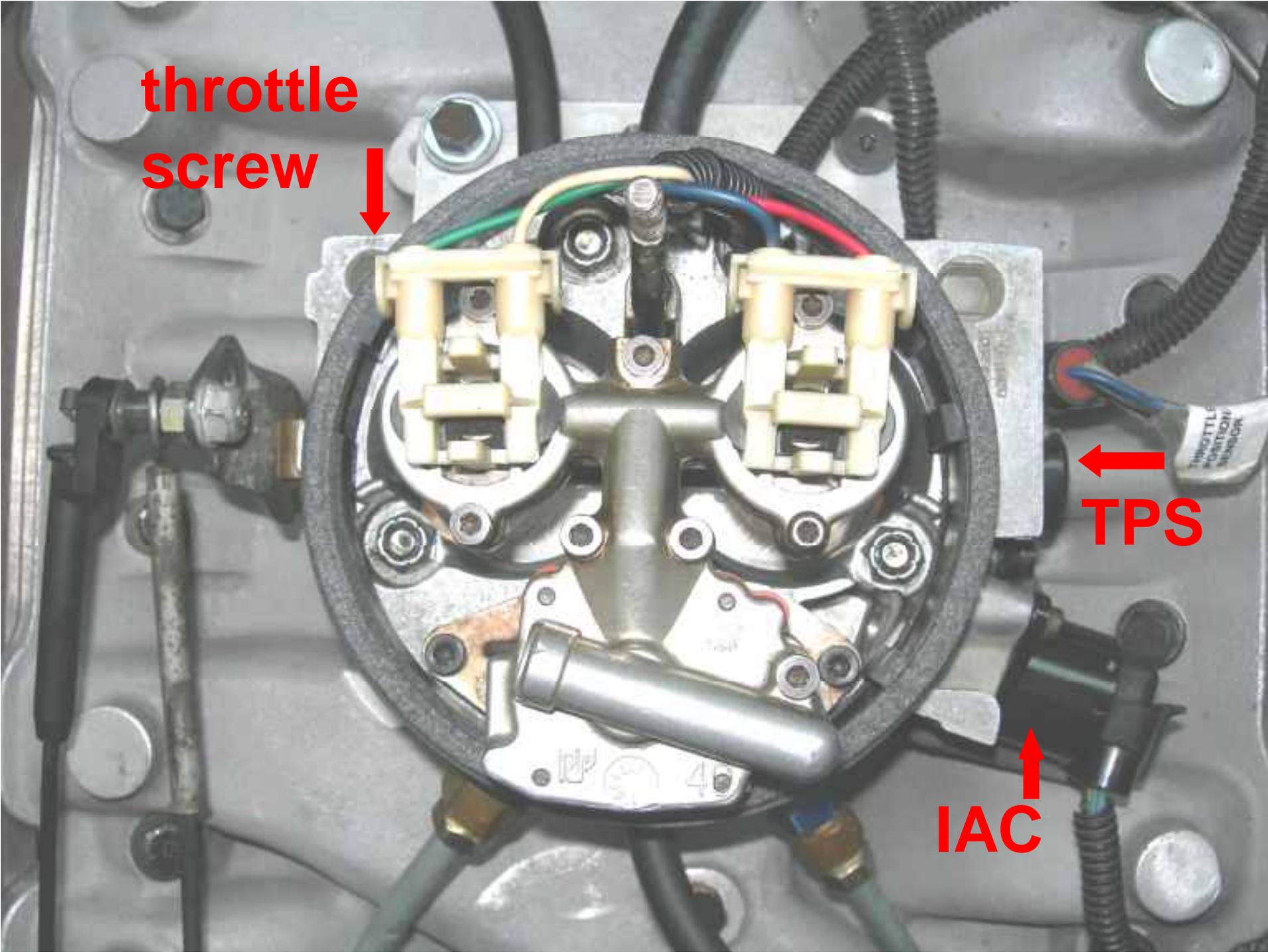
Typical hand-held scanner connected to the ALDL connector from the ECM. This unit will give the RPM, TPS voltage and the IAC counts.



## ***Where is the “throttle adjusting screw” ?***

***It is located on the left front corner of the TBI body, just ahead of the throttle arm. By now, most of the TBI bodies have the plug removed that covered the throttle adjusting screw. If not, remove it using a sharp pointed tool. Most screws have a T25 torx head, but they also can be an allen head screw.***





**throttle  
screw**



**← TPS**

**↑ IAC**

## **How to calibrate the TBI**

- 1-** Engine warmed up, key *OFF*, tranny in *PARK*
- 2-** Put a jumper wire from pin “**A**” to pin “**B**” on the ALDL connector (should be the black wire & white wire) A metal paper clip works good for this.



- 3-** Turn key to ON, **do not start engine**, wait 10 seconds. This will extend the IAC pintle and close off the air passage in the body of the TBI. Remove the electrical connection to the IAC by pulling it straight out. Turn the key to OFF and remove the jumper from the ALDL connector.

**4-** Start engine, and let it settle into idle speed. You may need to give it a little throttle to get it running. Connect the scanner to the ALDL and check the engine RPM. You want the engine RPM to be **at least 125 rpm less** than what the “target idle speed” is set for in the chip. Use the throttle screw to obtain the “125 rpm less” idle speed.

**Example:**

***Target idle speed*** in the chip is 700 RPM  
less -125  
**minimum idle speed = 575 RPM**

**5-** Turn engine OFF. Connect the IAC connector.

**6-** Start engine and run for **5** seconds, turn engine OFF and wait at least 30 seconds. This will reset the IAC control.

**7- Start engine, in PARK, let it idle. Idle speed should be close to the “target idle” set in the chip, if the IAC is being controlled by the ECM.**

**Connect the scanner and check the IAC counts. The counts should be in the 10 to 15 count range, but can vary some, and will have a higher count at higher elevation, or for a fresh rebuilt engine.**

**IAC counts are how the ECM knows where the position of the stepper motor is, in relation to fully closed or fully open. When the engine is shut off, the IAC will go fully closed and then open to a pre-determined amount of count steps to prepare the TBI for the next engine start-up.**

**The IAC motor can get dirty and sticky from dirt & carbon build-up, which will interfere with the normal operation of the IAC valve.**

***Now that we have the “minimum idle speed” set, let’s take a look at the “throttle position sensor” voltage. The TPS voltage reading is how the ECM knows in what position the throttle blades are. With the scanner connected to the ALDL, and the throttle closed, see what the voltage reading is. You want it in the .58 to .59 volt range.***



***If the TPS voltage is incorrect, it will be necessary to rotate the TPS sensor to get the correct voltage. Some of the TPS sensors have elongated mounting holes so they can be rotated. The sensors without the elongated holes can be modified by using a dremel tool and bit to elongate the holes, to help in setting the correct voltage. This setting is quite sensitive so proceed with caution when modifying the holes.***

mounting holes



mounting holes



3-wire electrical connector

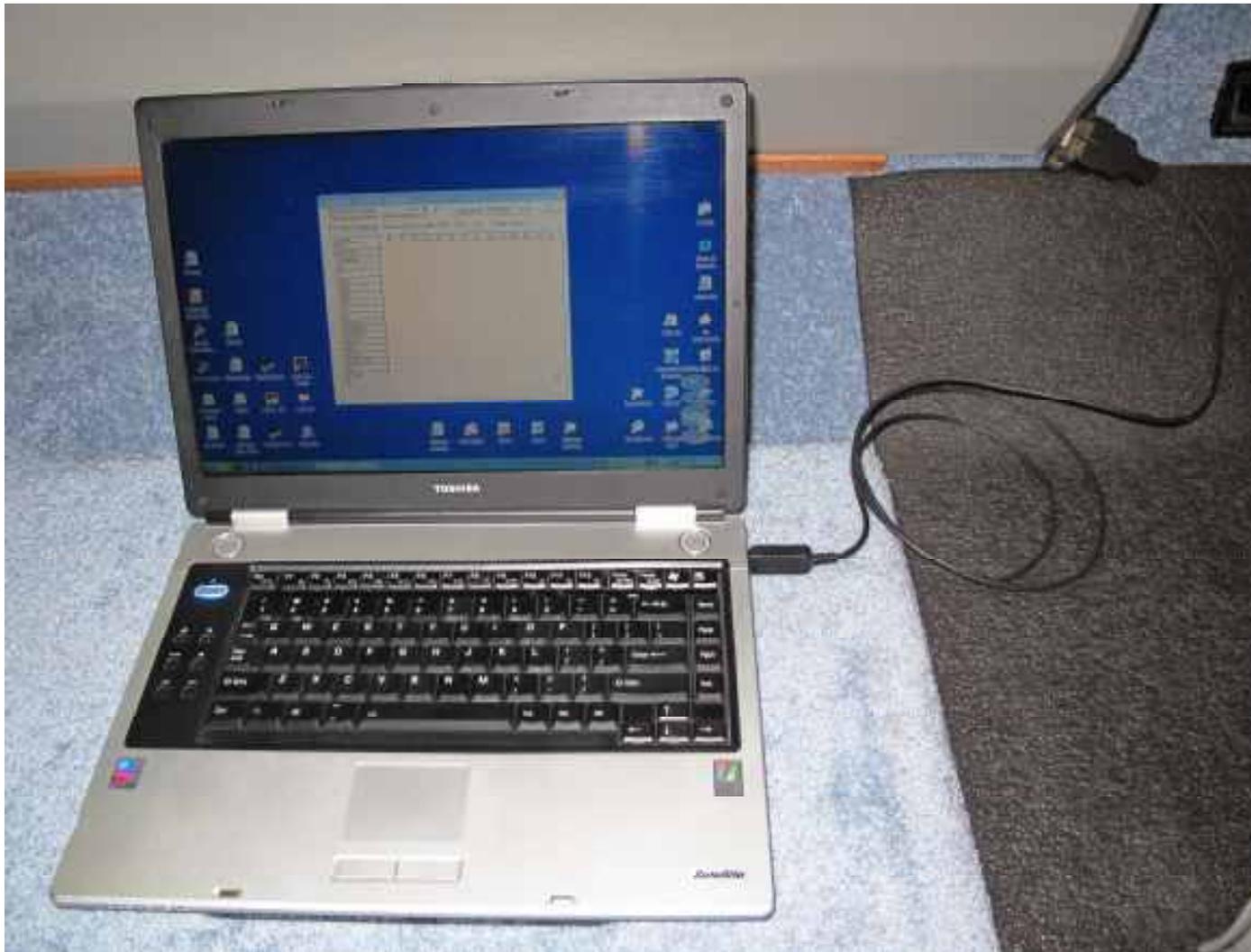
## Data Logging

**Data logging collects 'live data' as you are driving and that data can be saved to a laptop computer and reviewed to help tune a chip. The table below shows just a small amount of the data that is collected during a data logging session.**

Time	PROMID	IAC	Temp	SPEED	MAP	RPM	TPS	INT	O2	Volts	Knock	BLM	rich / lean
9.5	9461	67	181.3	57	67.2	2325	31.1	129	0.482	14.6	0	127	23
210.7	9461	67	181.3	58	66.1	2325	30.6	129	0.517	14.6	0	127	61
211.8	9461	67	181.3	58	63.1	2300	28.7	126	0.628	14.6	0	127	94
213	9461	67	181.3	58	62.8	2325	28.2	126	0.725	14.6	0	127	139
214.2	9461	67	181.3	59	62.8	2325	28.2	126	0.72	14.6	0	127	183
215.4	9461	67	182.4	59	62.4	2325	28.2	126	0.69	14.6	0	127	220
216.6	9461	67	182.4	59	62.8	2325	28.2	127	0.619	14.6	0	127	8
217.8	9461	67	182.4	59	62	2350	28.2	128	0.398	14.6	0	127	50
219	9461	67	182.4	60	62.4	2350	28.2	128	0.102	14.6	0	127	92
220.2	9461	67	182.4	60	61.6	2375	28.2	128	0.667	14.6	0	127	139
221.3	9461	67	182.4	61	61.3	2350	28.2	128	0.159	14.6	0	127	177
222.5	9461	67	182.4	61	61.3	2375	28.2	128	0.681	14.6	0	127	223
223.7	9461	67	182.4	61	61.3	2400	28.2	128	0.093	14.6	0	127	8
224.9	9461	67	182.4	62	60.9	2400	28.2	128	0.482	14.6	0	127	46
226.1	9461	67	182.4	62	60.2	2425	27.7	128	0.579	14.6	0	127	93
227.3	9461	67	182.4	62	52.1	2350	22.4	123	0.818	14.6	0	128	97
228.5	9461	67	182.4	62	52.1	2350	22.4	116	0.597	14.6	0	126	130
229.7	9461	67	182.4	62	51.7	2350	21.9	121	0.27	14.6	0	125	141
230.9	9461	67	182.4	62	49.5	2325	20.5	123	0.685	14.6	0	124	172
232	9461	67	182.4	62	49.5	2300	20.5	127	0.451	14.6	0	124	201
233.2	9461	67	182.4	62	49.5	2300	20.5	130	0.548	14.6	0	124	226
234.4	9461	67	182.4	61	49.5	2325	20.5	131	0.088	14.6	0	124	8
235.6	9461	67	182.4	61	70.5	2425	38.8	131	0.044	14.6	0	132	10
236.8	9461	67	182.4	62	86	2650	56.2	138	0.071	14.6	0	133	23

## ***What do we need to do some data logging?***

- 1. A laptop computer***
- 2. An ALDL cable (it can be USB or Serial port style)***
- 3. Data logging software (WinALDL is a free download)***





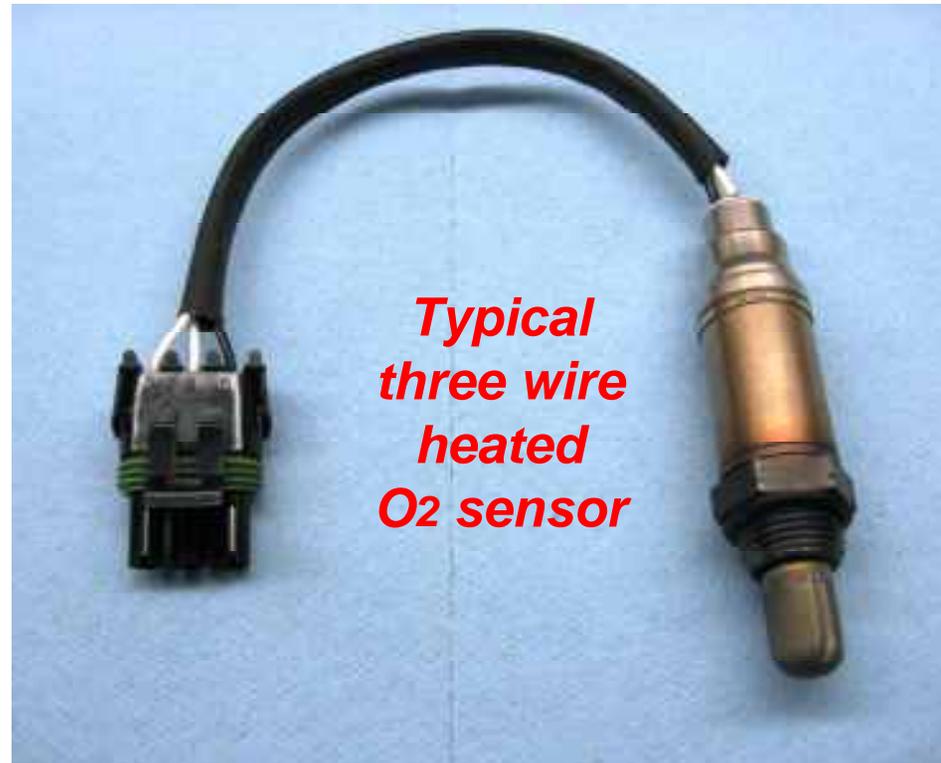
***This is a typical main fuel table. By changing the numbers of a certain cell, it will change the fuel delivery amount for that specific RPM and MAP cell, and this new formula will show as a change in the BLM table. Remember the cell RPM 2000 MAP 70 in the data sheet? Look at that same cell in this fuel table, it is showing a 63.3 value. We need to increase this value in order to increase fuel for this cell, to overcome the **lean** value in the data sheet. Let's multiply  $63.3 \times 1.03 = 65.1$  and enter this value in the cell. This should be close to what is needed to overcome the lean cell in the BLM table.***

RPM	MAP (Kpa)								
	20	30	40	50	60	70	80	90	100
400	23.4	27.3	28.5	32.0	38.3	44.1	52.0	56.6	58.2
800	23.8	32.0	34.0	46.9	53.1	58.2	60.9	61.3	60.2
1200	27.3	39.1	48.0	53.5	60.2	60.2	67.6	65.2	63.7
1600	32.8	44.1	48.8	58.2	58.6	62.9	66.8	67.6	69.1
2000	37.9	45.7	50.0	58.6	63.7	63.3	69.9	70.3	71.9
2400	38.7	48.8	54.3	60.9	65.2	65.2	73.4	75.0	75.8
2800	40.2	49.2	52.3	60.9	65.2	65.6	73.8	75.4	75.8
3200	42.2	52.3	54.7	62.5	68.8	70.7	73.8	75.8	75.8

## Oxygen Sensor

**The oxygen sensor, known as the O<sub>2</sub> sensor, reads the air/fuel ratio of the engine exhaust. The O<sub>2</sub> sensor sends a voltage signal to the ECM and the ECM will determine if the fuel mixture is rich or lean, and will calculate the changes needed for fuel delivery by changing the pulse width of the injectors.**

**O<sub>2</sub> sensors get 'lazy' with age and that effects the speed of the 'cross counts' to the ECM. Sensors will also get contaminated with silicone from gasket compounds, anti-freeze, sooty exhaust or excessive oil usage. The only cure for these problems is to replace the sensor.**



**Typical  
three wire  
heated  
O<sub>2</sub> sensor**