# 1. SYSTEM INSTALLATION

The factory computer is located in the front of the passenger's foot well (right hand drive vehicles) to the left of the passenger's left foot. To gain access carefully pull the carpet back. The computer will now be visible. The next step is to disconnect the wiring harness. Remove the wiring harness by undoing the bolt (10 mm spanner) in the connector. Unbolt the computer (ECU) and remove it from the vehicle.

## Board Replacement

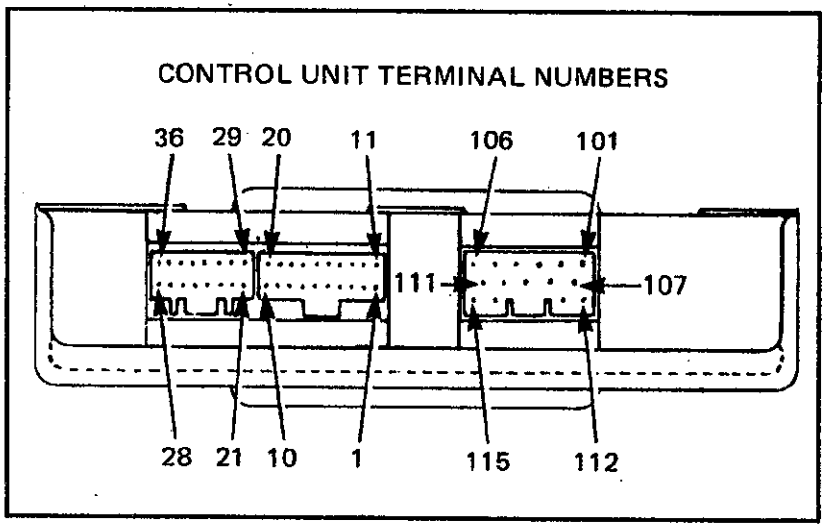
1. Remove the ECU cover by removing the four (sometimes six) screws. These are factory ""Loctited"" and usually difficult to undo.

   Caution

   Static Electricity Hazard

2. Remove the screws retaining the circuit board. Lift the circuit board clear of the aluminium case. Insert the VLLink board and replace the retaining screws. The VLLink board may have transit screws and nuts in these locations. Remove before installation.
3. If any tuning / adjustment is required then do not replace the cover at this stage to allow access to the tuning port on the circuit board. Note that there are several other "devices" that may be plugged in for various functions.
4. Once tuning is complete or if tuning is not required then replace the cover and fit the ECU onto the mounting bracket and reconnect cables. Replace kick plate trim and carpet.

# 9. ECU PIN IDENTIFICATION




## 36 Pin Connector (16 _ 20 Pin Connectors)

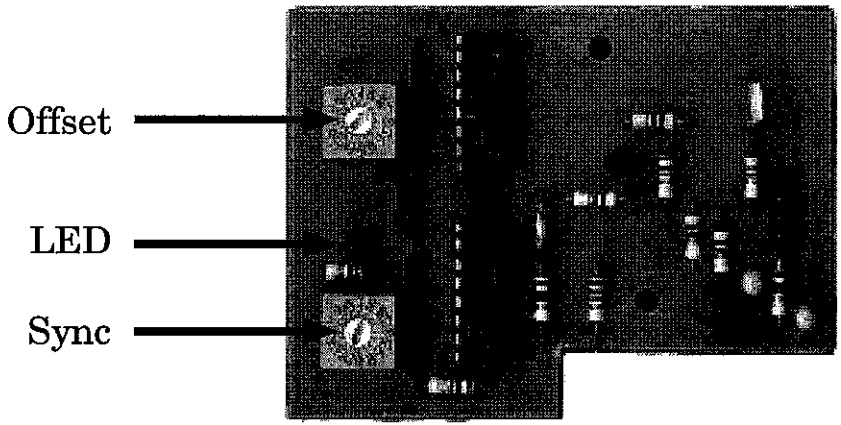
1. Monitor and Check Lamp (red)
2. AAC Valve
3. Ignition Signal Check
4. —
5. Power Transistor (Ignition Coil)
6. Self Shut Off
7. 
8. Crank Angle Sensor (1° Signal)
9. Ignition Switch - Start Signal
10. Neutral Switch
11. Monitor and Check Lamp (Green)
12. Air Flow Meter - self cleaning
13. 
14. 
15 
16. Fuel Pump Control
17. Crank Angle Sensor (120° signal)
18. Throttle Valve Switch (Idle Contact)
19. Fuel Pressure Regulator Control Solenoid Valve
20. 
21. Detonation Sensor
22. Air Conditioner Switch
23. Coolant Temperature Sensor
24. $O_2$ Sensor
25. Throttle Valve Switch (Power Supply)
26. Air Temperature Sensor Signal Earth
27. Power Supply for Control Unit
28. Ground
29. Vehicle Speed Sensor
30. Air Flow Meter Variable Signal
31. Air Flow Meter (Ouput Voltage)
32. 
33. 
34. Ignition Switch ('On')
35. Power Supply for Control Unit
36. Ground for Control Unit

## 15 Pin Connector

101 Injector No. 1
102 Injector no. 5
103 Injector no. 3
104 Injector no. 4
105 Injector no. 2
106 Injector no. 6
107 Ground
108
109 Ground
110
111
112 Ground
113 Ground
114 Injector Voltage Reference Signal
115



Connect a timing light in the normal manner with the trigger clamp around the # 1 cylinder H+T lead. Also connect a Link remote tuning controller to the ECU and start the engine. (It may be necessary to adjust MASTER FUEL to keep engine idling at this stage) select ADVANCE LIMIT on the remote and adjust down to zero. Now check the timing with light and adjust the OFFSET switch to get timing close to 10 degrees BTDC. If necessary, unclamp the distributor and move it slightly to get the exact figure. (The default ZONE ADVANCE LIMIT valves are based on a 10 degree BTDC base value). Remember to set ADVANCE LIMIT back to it's original value.



The following controls may be adjusted to provide the required result. Waste gate actuators, control solenoids and engine configuration all have an effect on the response "ballistics" of the system, and some controls interact to a certain degree. The recommended procedure is to make small adjustments and fully evaluate the result before further changes are made. The suggested starting values are based on the "pressure – bleed" type of solenoid (described earlier) rather than the simpler "bleed only" type solenoid.

### i) WG BASE

This value is used for calculating a base line duty cycle 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 waste gate setting close to the final (settled) value.

Drive the engine at Mid to high rpm (eg. 5,000 rpm) and snap open the throttle. Watch the boost gauge and as soon as the boost stabilises at the target value read the wastegate duty cycle shown in parenthesis (xxx). Return to 5,000 rpm and again snap open the throttle while watching the duty cycle window (xxx). Use the ADJUST buttons to change the BASE value until the settled duty cycle noted initially is forced into the duty cycle window.

e.g. Settled duty cycle = 75% (at 5,000 rpm).

Adjust WGBASE until a value of 70–75% is forced into the duty cycle window at throttle snap.

### ii) WG SENS

Sensitivity Control: All closed loop (feed back) systems require an optimum sensitivity level which is a compromise between fast response time and overall stability. High sensitivity values produce fast response at the expense of instability



# 2. REMOTE CONTROL FUNCTIONS

☞ Ignition switch (key) must be OFF before installing any device. When the key is switched on, the VLLink will automatically determine which device is fitted and run the appropriate software to support it.

TEST All functions in this mode are "read only" and have no effect on the operation of the system.

TEST RPM is the default display and shows engine RPM. This reading should be stable and in accordance with the engine tachometer.

TEST MAP (Press and hold the ADJUST DOWN switch) shows the currant Manifold Air Pressure (MAP) in kPa. With the engine stationary, the value should show approximately 101 kPa +/-5 at sea level.

TEST ENGT (Press and hold the ADJUST UP switch) shows the current engine coolant temperature in degrees Celsius.

TEST FUEL PUMP (Press and hold EDIT DOWN) Runs the fuel pump at full power for return line flow testing.

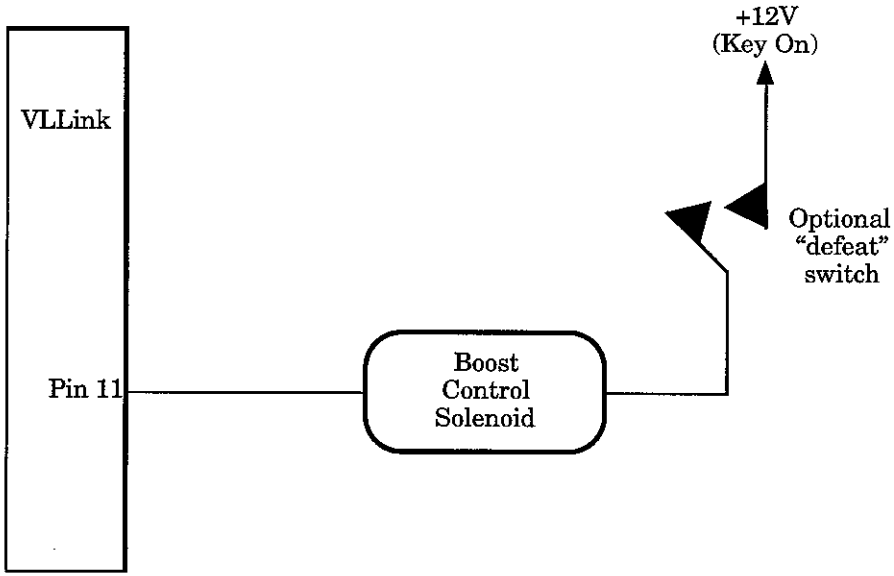
EDIT UP switch shows the software ID and date code for diagnostic purposes.

TPS SPAN Allows the Throttle Position Sensor (TPS) span to be set. The ADJUST switches are used to set the "low" (throttle closed) 10 and "high" (throttle fully open) 100, values. This setting is only used for special applications since the VL engine does not have a TPS sensor as original equipment. Details on it's use will be supplied with the special applications package.

OFFSET control is primarily used for fuel trimming at LOW power (idle). OFFSET adds or subtracts a small amount of injector pulse width which is very effective at idle, but relatively ineffective at high power. By using MASTER to set high

The VL engine does not have any electronic boost control original equipment so requires some form of modulating vlave to be fitted if ECU controlled boost is required.

The boost control solenoid signal is via the ECU terminal #11, formally a diagnostic function. Cut the wire about 50mm from the ECU and run a new wire to the boost control solenoid. Note that this signal is an EARTH sourcing signal so the other side of the solenoid requires +12 volt key-switched supply.






active zone. e.g. Z=2 indicates transient zone 2 (2000..4000 RPM range).

COLD Controls cold start and warm up enrichment by adding extra fuel to the engine. The adjustment value is shown on the right hand side of the display and will gradually reduce to zero as the engine temperature rises towards 70°C. The value shown in parenthesis (xxx) is the actual engine temperature for monitoring purposes.

VOLTS Provides a compensation value for fluctuations in battery voltage caused by heavy electrical loads being switched on and off e.g. headlights, heaters, fans etc. These voltage fluctuations cause the injector opening time to vary, resulting in erratic, surging idle speeds.

Initially set the value to "15" (STORE) and tune the engine with minimum electrical loads switched on. Once a satisfactory tune is found, allow engine to idle and switch on maximum electrical loads. Readjust the VOLTS value to restore the "unloaded" idle quality and STORE the result. The actual battery (VLLink) voltage is also displayed for monitoring purposes.

Note that the adjustable value does not represent actual voltage but is a trim value with no particular units.

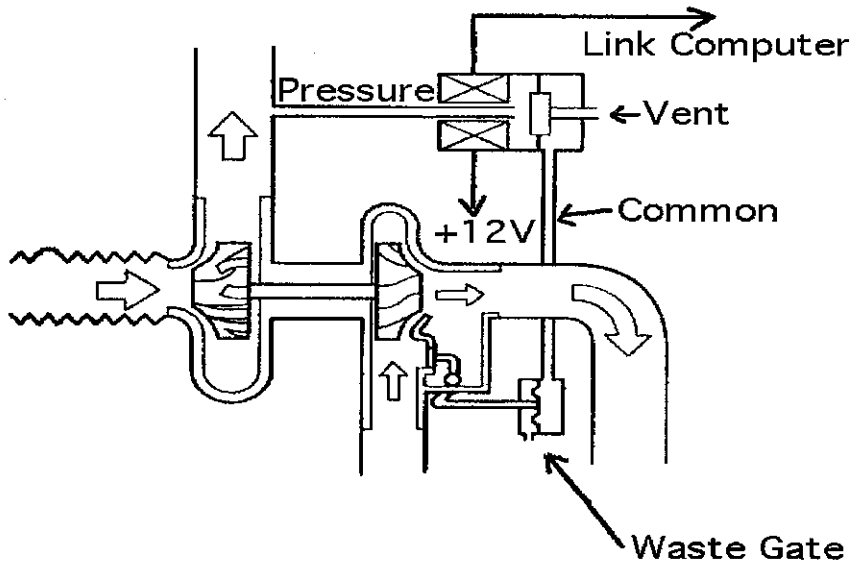
ZONEFUEL There are 96 fuel zones arranged in a rectangular grid consisting of 6 ROWS by 16 COLUMNS. The ROWS progress in steps of Manifold Air Pressure to provide the "load" axis, and the COLUMNS progress in steps of RPM. Therefore, each zone represents a unique engine operating condition allowing fuel changes to be made in small, localised areas. The selection of zones is completely automatic, depending on the actual RPM and MAP values at that instant. The current (active) zone is identified to allow correlation to the zone sheet and to give an indication of where you are in the table. The zone numbering system is not linear, but designed to provide a clearer indication as to effective location. e.g. zone 110 = ROW 1, 1000..1500 RPM zone 255 = ROW 2,

# 8. CLOSED LOOP BOOST CONTROL

## Operation

Boost control is achieved by modifying the pressure signal between the waste gate actuator and the compressor outlet using a solenoid assembly. The valve has three ports arranged as follows:

- common port is connected to the actuator
- pressure port is connected to the compressor outlet
- bleed port is vented to the atmosphere (usually via a filter)




When the solenoid is **de-energised** the common and pressure ports are connected and compressor pressure is allowed to fill the actuator and open the waste gate. The actual boost pressure that results is entirely dependent on the waste gate construction and therefore determines the **minimum** boost for the system.When the solenoid is **energised** the the common and vent ports are connected and the air pressure in the actuator is bled off to atmosphere causing manifold air pressure (MAP) is being measured by the Link computer the boost may be precisely programmed and controlled.



INJ / OXY This is a read-only function which displays the actual injector duty-cycle as a percentage of maximum. e.g. 28% indicates that the injectors are flowing 28% of their maximum volume. The OXY displays shows the output signal of oxygen sensor in volts. Refer to "Closed Loop" information for the significance of these readings.

LAMBDA This control allows the closed-loop oxygen system to be selected on or off. Press ADJUST UP to enable, and ADJUST DOWN to disable the closed loop system. The display will show ON or OFF accordingly, and the change is automatically stored. (no need to select STORE etc.)

**CAUTION**: Do not select closed loop ON unless lambda probe is correctly installed and wired.

See the subsequent chapter "Closed Loop Operation".

IDLE RPM Sets the idle speed in steps of 50 rpm. When the engine is cold, the idle speed is automatically increased and will decay to normal as the engine warms up. The value in parenthesis (xx%) shows the actual duty cycle of the idle speed actuator to assist set-up and diagnostics. A "*" symbol will appear on the far right of the display to show that the throttle is fully closed. Ensure the TPS SPAN is correctly set (10.....100) for proper idle speed control.

Two adjustments (zones 18 & 19) set the default values for the idle system when hot (zone 18 "IDHOT") and cold (zone 19 "IDCLD"). These default values are used by the software to preset the idle speed controller movements and may only be adjusted while in "EDIT Mode". Refer to Chapter 3 "Typical Setup Procedure" for details.

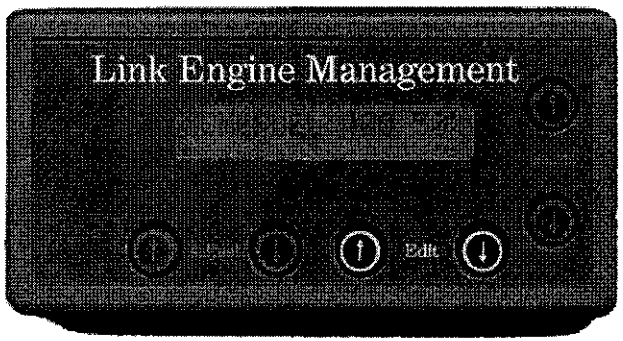
AIRC (ON/OFF) NORML/REVRS allows selection of the correct air conditioning sense. Watch the ON/OFF message while switching the aircon on. The ON message should appear. If not, use the ADJUST buttons to change the sense. (This feature will be removed once the correct sense has been established.)

# 7. TUNING PORT

The fourteen pin connector located at one corner of the circuit board allows connection of various tuning and diagnostic tools to the system. All devices use a fourteen line flat ribbon cable, and connectors are keyed to prevent incorrect installation. The following devices are currently available.

## Link Remote Control

The Link Remote Control allows all aspects of fuel, ignition, boost and utility functions to be adjusted, edited and stored. A security code prevents unauthorised tampering on all adjustments except diagnostic (read only) functions. Detailed instructions are included elsewhere in this manual.






**CAUTION**: RELOAD will over-write all values currently stored in the VLLink memory and should only be used during initial setup or if you wish to restart the tuning procedure again from scratch.

OVER-RUN VACUUM - This is an 'EDIT' only adjustment on zone #21. This sets the value at which the ECU will fuel-cut on trailing throttle, expressed in KPa. Default value = 26 KPa which is about right for unmodified engines, but may need to be increased for engines with large cams and poor vacuum.

## Storing Values

To Store select STORE. Press both ADJUST buttons together until display shows "**********" and then release.

## Sensitivity Adjust

Select the knock sensitivity menu KK SEN (xxx) yyy. The value shows the actual "processed" knock signal fed into the micro-processor. This value should be small at idle (type. less than "10") and increase with RPM and load (boost) as the background noise rises. This value may range from as low as "50" at full power for some engines though to as much as "220" in some cases. (max. =255) The actual level depends on the sensitivity of the actual sensor together with how "rattly" the engine is. (E.G. solid valve rafters generate a fair bit of clatter which adds to the background noise).

The yyy value may be adjusted to set the target value. When the noise signal (xxx) exceeds the target value (yyy) the system will take action.

## Determining the Best Sensitivity

Most retrofit will already have a suitable value set and shouldn't require resetting. This should only be necessary if extensive engine modification or unusual conditions exist. The following methods may be used to determine the best setting,

Simple - Have an assistant monitor the signal level (xxx) on the remote to build up a picture of the noise profile.Look for an ABRUPT INCREASE to build up a picture of the noise profile. Look for an ABRUPT INCREASE in the signal as the engine accelerates toward full power. (The signal will always rise with increasing power at a PROGRESSIVE rate seen if there is no detonation) Obviously, do not ignore audible detonation irrespective of what the display shows. The engine can be damaged just as easily as normal.

Scientific - This involves using a "Serial / PrintLink" to capture (data-log) all the important ECU signals for in-depth analysis. This has the advantage of allowing plenty of time for analysis together with other information (RPM, MAP,OXY etc.) which all interact to some degree. Look for abrupt changes in level to indicate detonation and use these levels to set the SENS value.



See front cover of manual for warranty information.

1. Switch on ignition.
2. If you wish to retune from scratch then - Select RELOAD as per Tuning Module Function instructions in previous section. (Places default table into processor)
3. OFFSET and MASTER will have default values. Do not adjust at this stage.
4. Select RPM LIMIT, and Set Limit as required.
5. Repeat above for MAP LIMIT, ADVANCE LIMIT and KNOCK LIMIT.
6. ACCEL, COLD and VOLTS will have default values. Do not adjust at this stage.
7. Select STORE and press ENTER for one second if you have made any changes (as per Tuning Module Function instructions in previous section).
8. Select MASTER and start engine. Adjust value up or down as necessary to keep engine running smoothly. Allow engine to warm up fully. It is recommended that MASTER is not changed from its default value unless higher flow injectors or some other major change has been made to the engine.
9. Select ADVANCE LIMIT and set advance limit to zero. With engine at idle or low speed, check ignition initial timing is approximately 10° BTDC.
10. Select MASTER. Drive or dyno. load engine until engine is producing approximately 50% maximum power. Adjust MASTER for best running performance. Engine power should now be increased into the higher power ranges. Again adjust MASTER for best performance at highest practical power output. This setting is most important if zone tuning is to be successful (see note in step 8).
11. Select ROWFUEL. Run the engine in each of the six main rows (load rows) and adjust for optimum performance. Refer to the Zone Sheet for explanation of "row" values. (This should

# Operation and setup.

1. The closed loop mode is enabled by selecting LAMBDA on the Link Tuning Module and switching to "ON".

2. The system should first be tuned in open loop mode (LAMBDA = OFF) until a reasonable state of tune is achieved. This step allows the subsequent AUTO-TUNE system to achieve a faster lock-on since it shouldn't have to make major corrections if the initial tune is about right. The system samples and corrects at a rate of twice per second. This rate allows sufficient time to elapse for the fuel correction effect to appear at the exhaust and be measured. (The feedback system is not instantaneous and therefore needs a short stabilising period)

NOTE: All corrections made by the AUTO-TUNE system are temporary until a STORE is carried out. All other Tuning Module functions remain unchanged.

LAMBDA closed loop tuning has been revised for emission purposes and is only active under the following conditions:

a. LAMBDA = ON (as selected on remote)
b. Injector duty cycle less than 5 % (idle / slow cruise max)
c. Engine temperature over 70°
d. Idle vacuum normal (not over-run vacuum)
e. No "acceleration" fuel pending

This target should be set at about the stoichiometric point of the sensor (the abrupt transition zone of the sensor) which is about "60" (0.6 Volts). The system uses a dithering technique to constantly ramp the injector pulse width back and forth across the line to give a "60" average. These lean/rich excursions give the catalytic converter the necessary oxygen/hydrocarbon mix to function correctly thus reducing tailpipe emissions to practically zero. Some experiments with target values may be required for best results. Try values between "40" to "70" while monitoring exhaust gas with a four gas analyser or similar.



a. Cold engine. Select IDLE on the Remote Control and start the engine. Observe the ISC duty cycle (XX%) on the display. After about fifteen seconds make a note of the duty cycle then allow the engine to fully warm up.

b. HOT engine. See above but record the hot duty cycle this time. Using EDIT mode select ZONE 19(IDCLD) and enter the cold duty cycle noted in step a. Select ZONE 18 (IDHOT) and enter the hot duty cycle value.

•Press both EDIT switches together for one second to initiate a STORE.

These defaults are inserted by the idle speed software during transient conditions when the engine is accelerating or de-accelerating to ensure that "reasonable" numbers are present when the idle control resumes operation.

During operation, a number of symbols will appear to show the idle system status as follows,

* = a transient (uncontrolled) condition. This will show at higher RPM and during rapidly changing conditions.

D = Indicates transmission is in DRIVE (not p or n) and causes the system to hold the current duty cycle.

A = Acceleration fuel present. Duty cycle = hold.

\- = Engine speed equals target value.

\- = Engine speed too high. System is reducing duty cycle.

\+ = Engine speed to low. System is increasing duty cycle.

16. Assuming all the above operations are completed successfully, allow the engine to cool down completely. (preferable overnight). Select COLD and restart engine. Adjust as required for clean operation remembering there are six zones which will change as engine warms up. "STORE" after setting.

## Nissan

The Eccs distributor fitted to the VL supplies the ECU with two vital pieces of information,

1.Cylinder identification in the form of a wider-than-normal slot for #1 cylinder. This information used by the ECU to fire the injector groups at the correct time. A 16 position rotary 'Sync' switch is used to detect this wider slot and must be set to the correct value.

2 .A pulse output for each cylinder occurring at about TDC (or shortly before) which the ECU uses to build the ignition advance curve. Normally these pulses occur at about 60 degrees BTDC and therefore require some delay before processing. A 16 position rotary "OFFSET" switch allows the base (initial) timing to be adjusted in steps of 8 degrees per click.

## Setting the sync switch.

After installation is complete, disable the ignition system by disconnecting either the coil tve or coil-ve wires. Set the sync switch (see illustration) to '4' initially and crank the engine. The red LED light next to the SYNC switch should pulse ONCE per distributor rotation. If the LED does not pulse at all, then DECREASE the switch value and try again. Conversely, if LED flashes more than once then INCREASE the switch value.

## Setting the OFFSET switch

Re-connect all wiring etc. so that the engine can be run. Initially set thew OFFSET switch to '7'. (7 x 8 = 56 degrees delay which will give a base/initial timing of about TDC).



# VLLink

| Miscellaneous | | | | | | | | | | TPS | | Wastegate | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Offset | Master | R.Lim | M.Lim | A.Lim | Mode | Cyl | Volt | Idle | | Low | High | Sens | Knock | Base | RPM |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |

| Accel | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cold | Air F | IDHot | IDCold | AirC | O'Run | | | | | Oxy | | | | | |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |

0 2 4 6
RPM x 1,000

## Zone Fuel

| Bar | 0 | 1,000 | 2,000 | 3,000 | 4,000 | 5,000 | 6,000 | 7,000 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.4 | 100 | 105 | 110 | 115 | 120 | 125 | 130 | 135 | 140 | 145 | 150 | 155 | 160 | 165 | 170 | 175 |
| 0.8 | 200 | 205 | 210 | 215 | 220 | 225 | 230 | 235 | 240 | 245 | 250 | 255 | 260 | 265 | 270 | 275 |
| 1.2 | 300 | 305 | 310 | 315 | 320 | 325 | 330 | 335 | 340 | 345 | 350 | 355 | 360 | 365 | 370 | 375 |
| 1.6 | 400 | 405 | 410 | 415 | 420 | 425 | 430 | 435 | 440 | 445 | 450 | 455 | 460 | 465 | 470 | 475 |
| 2.0 | 500 | 505 | 510 | 515 | 520 | 525 | 530 | 535 | 540 | 545 | 550 | 555 | 560 | 565 | 570 | 575 |
| | 600 | 605 | 610 | 615 | 620 | 625 | 630 | 635 | 640 | 645 | 650 | 655 | 660 | 665 | 670 | 675 |

## Zone Ignition

| Bar | 0 | 1,000 | 2,000 | 3,000 | 4,000 | 5,000 | 6,000 | 7,000 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.4 | 100 | 105 | 110 | 115 | 120 | 125 | 130 | 135 | 140 | 145 | 150 | 155 | 160 | 165 | 170 | 175 |
| 0.8 | 200 | 205 | 210 | 215 | 220 | 225 | 230 | 235 | 240 | 245 | 250 | 255 | 260 | 265 | 270 | 275 |
| 1.2 | 300 | 305 | 310 | 315 | 320 | 325 | 330 | 335 | 340 | 345 | 350 | 355 | 360 | 365 | 370 | 375 |
| 1.6 | 400 | 405 | 410 | 415 | 420 | 425 | 430 | 435 | 440 | 445 | 450 | 455 | 460 | 465 | 470 | 475 |
| 2.0 | 500 | 505 | 510 | 515 | 520 | 525 | 530 | 535 | 540 | 545 | 550 | 555 | 560 | 565 | 570 | 575 |
| | 600 | 605 | 610 | 615 | 620 | 625 | 630 | 635 | 640 | 645 | 650 | 655 | 660 | 665 | 670 | 675 |

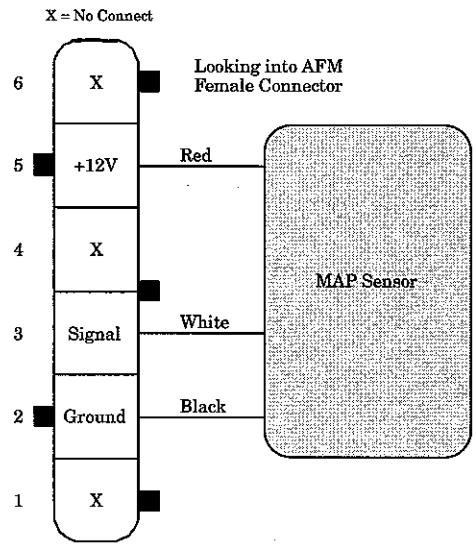
## Boost Targets

| 0 | 1,000 | 2,000 | 3,000 | 4,000 | 5,000 | 6,000 | 7,000 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 700 | 705 | 710 | 715 | 720 | 725 | 730 | 735 | 740 | 745 | 750 | 755 | 760 | 765 | 770 | 775 |

## MAP Sensor

The manifold air pressure sensor is connected in place of the Air Flow Meter (AFM). The AFM may be removed if required since its output signal is not used. Note that at present the correct 5 pin male connector is not available (to emulate the AFM connector) so a three wire terminated lead set is used to connect the sensor. Incorrect wiring will not cause any damage.

Connect the MAP sensor pressure port to a source of manifold vacuum taking care to avoid "single runner" vacuum sources since these tend to be pulsating in nature. A good source is usually found by inserting the plastic "T" in the vacuum tube running to the fuel pressure regulator.




Immediately after fitting, power up the system and select TEST MAP or OFFSET (both display the MAP sensor output and check that the value is about 102 kPa +/- 6 kPa at sea level. If not, test connection with multi-meter to establish that the MAP supply (red wire) is connected to what was the airflow meter power supply (+12 volts), the black is an earth / ground, and the white (output) ultimately runs back to the ECU terminal # 31 (See printout charts at rear of the manual).



(hunting or oscillation around the target value) and low sensitivity may result in slow settling times.

Experience has shown that a "WGATE SENS xx" value of about 5 to 10 is fairly close. Never set the value to 0. Generally ""soft" waste gates require higher numbers especially when operating at high boost levels (> 1,0 Bar).

## iii) WG RPM

WG RPM sets the engine rpm at which the Link Engine Management System will start controlling the boost. At low rpm (about 3,000 rpm) there may not be sufficient exhaust gas to fully spool the turbo thus limiting the amount of usable boost. Under these conditions the control system would attempt to increase the boost by increasing the solenoid duty cycle without effect and when the boost does arrive would grossly over shoot since the waste gate would be fully shut down.

Rpm lock out values typically depend somewhat on the turbo size and match to the application. A typical value usually falls between 3,500 and 4,000 rpm. If boost over shoots at low rpm when driving in higher gears (4th or 5th gear etc) try raising the rpm point.

## iv) MAP LIMITING

The MAP limiting function has been re-scaled to kPa (rather than psi) to allow co-relation to the boost "target" values. The limit should be set about 10-15 kPa above the highest target value to allow for some over shoot inherent in closed loop systems.

power the two most important points on the base fuel curve can be set. After that, use ROW FUEL and ZONE FUEL to make the localised corrections as necessary.

MASTER FUEL Controls overall fuel injection scheduling and is effective throughout the entire operating range from idle to full power. The scale ranges from 0..99, the higher the value, the greater the overall fuel.

RPM LIMIT Sets the RPM limit. Fuel injection will be cut off if engine RPM exceeds the Limit Value.

MAP LIMIT Set Manifold Air Pressure limit to prevent over boost. Values are expressed in absolute pressure so all values above 100 kPa represent boost pressures.
e.g..150 KPa = 9 psi boost
200 KPa = 15 psi boost
Upper limit = 254 kPa. No limit 255 kPa.

ADVANCE LIMIT Sets the absolute maximum ignition advance irrespective of any value programmed into the ZONE IGNITION table. Note that this is a numeric limited only and does not invoke any actual ignition or fuel cuts.

KNOCK LIMIT May be switched ON / OFF. Provides some detonation control by reducing ignition advance in any zones where the knock sensor detects detonation. The maximum reduction is six degrees in any one ignition zone. The number in brackets shows the total number of detonations detected by the VLLink since the key was last switched on.

KNOCK SENS Adjusts the sensitivity of the knock retard system. Refer to Chapter 6 for further details.

ACCEL Controls acceleration enrichment during abrupt opening of the throttle. There are 4 zones each covering a 2000 RPM span to allow optimum enrichment figures to be set for varying conditions. Note that ACCEL is only effective during the actual movement of the throttle to cover any brief flat spots occurring at that time. The actual zone is selected automatically, and is shown as Z=x where x = the currently



Control

The compuer software features a number of adjustment facilities for closed loop boost control and may be accessed by plugging in the Link Tuning Module before switching on the ignition.

BOOST Boost target values: An extra Row of sixteen zones has been added to the zoning system to hold s target boost value for each 500 RPM interval between 500 and 8,000 Rpm. This allows the boost curve to be tailored for the application eg. the boost may be held at lower levels throught the Rpm mid range to suppress detonation and then allowed to rise at higher Rpm where detonation is less likely. These target vaues may be changed by using the EDIT mode (for individual adjustment)or by selecting BOOST which adjusts all 16 zones simultaneously (action similar to "ROW FUEL")

The values are shown in KPa (absolute) and may be cross referenced using the following table. The values must always be greater than 100 since below 100 represents vacuum.

| kPa (absolute) | psi (boost) |
|---|---|
| 100 | 0 |
| 120 | 3 |
| 140 | 6 |
| 160 | 9 |
| 180 | 12 |
| 200 | 15 |
| 220 | 18 |
| 240 | 21 |
| 250 | 23 |

## Waste Gate Controls

5500..6000 RPM zone 545 = ROW 5, 4500..5000 RPM etc. Adjustments are made by operating the ADJUST buttons as required, and the actual value is displayed on the right hand side of the display. Adjustment scale = 0..99

ZONE IGN There are 96 ignition advance zones arranged in an identical manner to the fuel zones (see above). The zone identification system is also the same as ZONE FUEL except it applies to the ignition advance table instead. The adjustment value is shown as degrees of advance. NOTE: The ADV LIMIT control has priority over any ZONE IGN value in excess of the limit value. The limiting value does not inhibit entry of ZONE IGN values in excess of the limit, rather it limits the value displayed and actually used at the time.

The ignition values displayed are the value + the static value. I.e. ZONE IGN 27 = 27°+10° static = 37° degrees crank (typically).

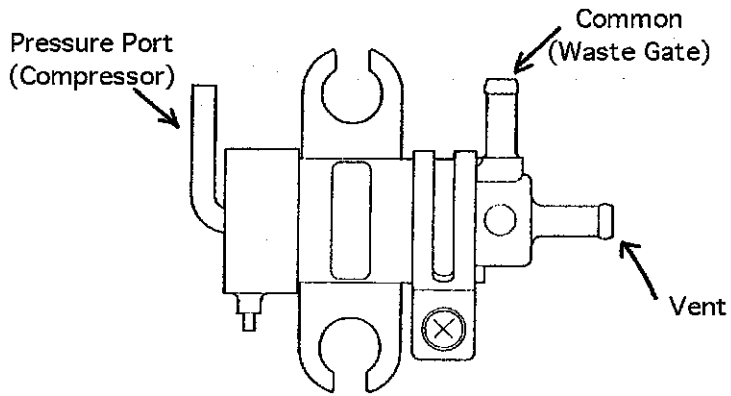
ROWFUEL Allows the ZONE FUEL table to be adjusted a WHOLE ROW at a time. I.e. All values on the current ROW will be adjusted up or down irrespective of the RPM. e.g. current zone = 230 (ROW 2, RPM = 3000..3500), 4 units are added (UP) to zone 230, then ALL zones along ROW 2 (200..275) will have 4 units added to their current values. ROWFUEL is primarily intended as a coarse adjustment to allow broad shaping of the ZONE FUEL table during initial tuning, and would normally be used after MASTER has been set, but before ZONE FUEL is used.

Careful use of ROWFUEL will eliminate the need to spend large amounts of time in ZONEFUEL trying to make major changes overall by wondering about the table making localised corrections. (It is quite difficult to hold the engine in any one of 96 zones while corrections are made even under the most favourable conditions.) The current ROW is displayed in parenthesis to show the currently active ROW, but the RPM information is suppressed since this feature is not RPM dependent.



## Solenoid Types

The correct type of solenoid valve must be used and devices intended for this purpose should be used wherever possible. Some types of plastic bodied units may work satisfactorily but may not withstand the constant cycling imposed upon it and subsequently fail after several hours of service. In either case do check that the "sense" of operation is correct by blowing through the ports with the solenoid both energised and de-energised to confirm correct operation.




## Wiring

Follow the wiring diagram shown below noting the optional "defeat" switch which will force the system into a minimum boost mode. This may be useful if driving conditions are adverse, alternatively a hidden switch may be installed to prevent unauthorised high boost operation.

AIRCN FUEL allows a small amount of extra fuel to be added when aircon is on to help stabilise idle. Also, an idle speed step is introduced at switch on to prevent engine stalling. This step value may only be changed in the EDIT mode by adjusting zone #20. Store any changes (both EDIT buttons for 1 second) before evaluating any changes.

TRANS = AUTO/MANUAL selects either manual or automatic transmission. This is used exclusively by the idle speed system. Select the appropriate case.

EDIT Enables the zone editor function which allows random 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 push buttons to select the appropriate zone(s) and the ADJUST buttons to change the selected zone. The zone is 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 "**********" and then releasing. Alternatively, STORE may be selected and used as normal.

STORE Used to store corrections into the semi-permanent memory. STORE is initiated by pressing BOTH ADJUST buttons together until the display shows "**********" and then releasing. The process will take from 2..30 seconds depending on the number of corrections to be stored.

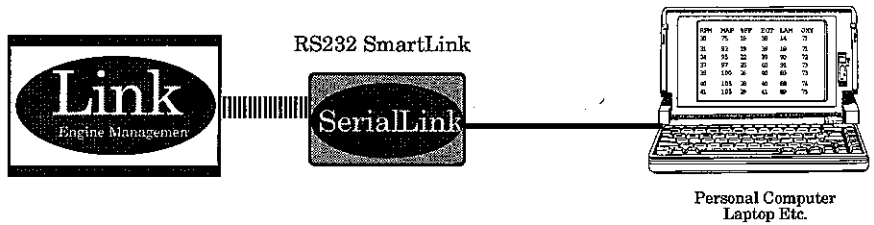
Note that the engine may run a bit rough during STORE so it is advisable to do so only at idle. If engine stops running during STORE, allow the process to finish before turning off key or trying to restart the engine.

RELOAD This process presets all the zones to typical values to allow a base for subsequent tuning. RELOAD is initiated by pressing BOTH ADJUST buttons together until the display shows "**********" and then released.



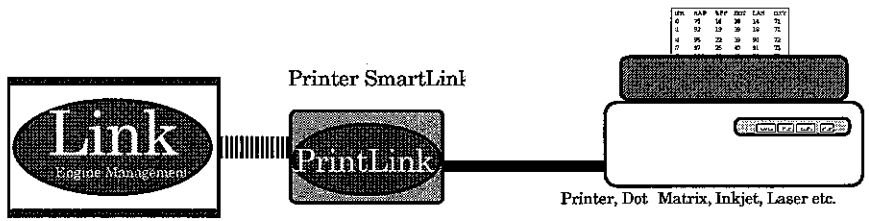
## SerialLink

The SerialLink allows communication between the VLLink and a personal computer via the PC's RS232 serial port for data-logging and downloading of the VLLink settings. While the engine a stream sent to the PC shows all major engine parameters such as RPM, pressures, temperatures and flows. The information may be recorded using the PC' s memory / disk drive. Graphs etc. may be created using spread sheets etc.




## PrintLink

The PrintLink is similar to the SerialLink above except that the PrintLink connects directly to any type of printer for instant hard copy data. An alternative option is to use a battery backed "printer buffer" to store information while test driving and then downloading the buffer to a printer. Typical buffers allow in excess of one hours logging time.



# 3. TYPICAL SETUP PROCEDURE

The following list shows (in order) a typical set of numbers for the engine at idle. This list is useful for quick reference while becoming familiar with the function locations.

| | | |
|---|---|---|
| TEST RPM | 800 | |
| TEST MAP | 38 kPa | (Adjust button up) |
| TEST ENGT | 88C | (Adjust button down) |
| TPS SPAN | 10 | (Throttle closed) |
| OFFSET ( 38) | 40 | |
| MASTER FUEL | 35% | |
| RPM LIMIT | 7300 | |
| MAP LIMIT | 210 kPa | |
| ADV LIMIT | 27 | |
| KNK ( ) | ON | |
| KNK SENS | 150 | |
| AIRC (ON) NORML | + | |
| TRANSMISSION = MANUAL | | |
| ACCEL Z = 1 | 10% | |
| COLD ( 88) | 0% | |
| VOLTS V = 13.8 | 15 | |
| STORE | | (Both Adjust together) |
| RELOAD | | (Both Adjust together) |
| AIRCON FUEL | 0 | |
| ZONEFUEL 105 | 37% | (Row 1, 500 - 1,000 rpm) |
| ZONE IGN 105 | 11 | |
| ROWFUEL ( 1) | 37% | |
| INJ=1% OXY=81 | | (OXY may be varying) |
| LAMBDA | OFF | |
| IDLE (38%) | 800* | |
| BOOST 200 kPa | | |
| WGATE SENS | 5 | |
| WG BASE | 43 | |
| WG RPM | 3500 | |
| EDIT Z 0 | 35 | (Editor @ zone 0 "OFFSET") |

**Do not adjust the VLLink system unless you are prepared to accept the consequences**

**i.e. Possible Engine Damage if you make tuning errors.**



EXAMPLE: This printout is an actual example of a vehicle accelerating through two gear shifts. Note the abrupt level changes (marked *****) in the KNK (knock) column indicating probable detonation. A target value of about "150" would provide fairly "mild" case and would probably not be audible above the road noise etc. Note that in some cases transient detonation like this is very difficult to eliminate completely without seriously affecting the power output of engine. The amount of acceptable detonation is a fairly complex issue beyond the scope of this simple guide.

| RPM | MAP | WG% | OXY | INJ | TPS | KNK | BAT | |
|---|---|---|---|---|---|---|---|---|
| 4511 | 86 | 56 | 0 | 13 | 25 | 43 | 132 | |
| 4617 | 69 | 57 | 0 | 10 | 20 | 20 | 133 | |
| 4623 | 55 | 58 | 0 | 4 | 15 | 14 | 133 | |
| 4583 | 36 | 55 | 0 | 4 | 15 | 14 | 133 | |
| 4500 | 33 | 55 | 0 | 4 | 15 | 16 | 132 | |
| 4484 | 49 | 54 | 0 | 12 | 29 | 32 | 133 | |
| 4363 | 84 | 55 | 0 | 15 | 36 | 26 | 132 | |
| 4623 | 106 | 57 | 0 | 28 | 67 | 41 | 131 | |
| 4857 | 150 | 59 | 0 | 44 | 101 | 53 | 131 | |
| 5181 | 199 | 63 | 0 | 66 | 101 | 142 | 130 | ***** |
| 5720 | 216 | 66 | 0 | 75 | 95 | 78 | 130 | |
| 6034 | 88 | 57 | 0 | 17 | 9 | 37 | 133 | |
| 5117 | 25 | 59 | 0 | 2 | 8 | 32 | 133 | |
| 4338 | 26 | 52 | 0 | 9 | 41 | 18 | 133 | |
| 4980 | 127 | 58 | 0 | 39 | 98 | 45 | 131 | |
| 4669 | 175 | 58 | 0 | 53 | 101 | 79 | 130 | |
| 4987 | 216 | 70 | 0 | 72 | 101 | 158 | 130 | ***** |
| 5268 | 231 | 71 | 0 | 76 | 101 | 115 | 130 | |
| 5509 | 227 | 68 | 0 | 75 | 101 | 113 | 130 | |
| 5818 | 219 | 68 | 0 | 75 | 34 | 53 | 132 | |
| 5306 | 47 | 60 | 0 | 3 | 9 | 48 | 133 | |
| RPM | MAP | WG% | OXY | INJ | TPS | KNK | BAT | |
| 4704 | 161 | 58 | 0 | 46 | 101 | 78 | 130 | |
| 4895 | 205 | 65 | 0 | 64 | 101 | 86 | 130 | |
| 5068 | 228 | 68 | 0 | 71 | 101 | 126 | 130 | |

only be necessary if major changes to the engine or fuel system have been made).

12. Select ZONEFUEL. The engine should now be operated throughout the entire power range and the UP/DOWN switches used to gradually tune the zones as required. (It is advisable that a "STORE" is carried out after this to prevent loss of correction data (if ignition turned off)). Repeat the above as often as necessary until desired result is obtained. Note that the majority of engine tuning will be carried out in ZONEFUEL mode.

13. Select Zone Advance. Repeat step 11 above but this time adjusting ignition advance. Caution should be observed to prevent over-advancing and thus possible detonation action. Use with care! Periodically check the detonation count in the "KNOCK" menu to see if detonation is occurring. Remember that the VLLink will automatically remove up to 6° advance from any zone if the "KNOCK" system is turned on.

14. Select ACCEL. Run engine at idle and snap open throttle. Adjust for cleansed response. Repeat this at higher RPM (four zones which will change as engine RPM increases). "STORE" after setting.

    NOTE: ACCEL is exclusively used to enrich the mixture while the throttle is actually moving. If the engine is hesitant AFTER the throttle has finished moving then the base fuel e.g. ZONEFUEL value is probably too low. DO NOT use ACCEL to cover up lean ZONEFUEL values.

15. Select IDLE SPEED CONTROL. Select the required idle speed by using the IDLE function to set the RPM in steps of 50 rpm. The default values for hot (IDHOT) and cold (IDCLD) should be set as follows:



# 6. CLOSED LOOP KNOCK CONTROL

Knock control uses a block mounted, piezo electric microphone (knock sensors) to "listen" for abnormal engine noise / vibrations which occur when the engine detonates (knocks). The majority of unwanted signals are rejected by analogue filters inside the ECU but a certain amount of discrimination is required by the software processing this signal the preset threshold, the ignition timing is removed from the current ignition zone (1 of 96). The maximum amount of retard is eight degrees from any one zone, although the system will not retard beyond zero degrees (base timing).

E.G. If original zone value was 5 degrees, then at maximum retard the value would be ZERO, not -3 degrees.

NOTE: ALL CORRECTIONS ARE TEMPORARY UNLESS STORED. I.E. THEY WILL BE "LOST" WHEN THE KEY IS TURNED OFF.

This arrangement allows the system to be more adaptive to the current conditions. For example, driving one day with poor fuel will cause the system to make corrections where necessary but with no long term storage. When superior fuel is subsequently used, the ignition timing will have a "clean slate" this will result in system activity for the first few high power applications which will then taper off to inactivity as the system makes the correction.

## Knock Control ON/OFF

The system may be turned OFF / ON by selecting the KNOCK LIMIT menu and pressing either the ADJ DOWN keys. The display will show either KNOCK LIMIT OFF (self explanatory) or KNOCK (xxx) = the total number of "knock events" detected by the system for this current run.

NOTE: Any changes (ON/OFF) are automatically stored.

# 4. ADDITIONAL TUNING TIPS

1. Large steps between zones are permitted since the VLLink System interpolates (i.e.. calculates intermediate values) on all tabled data. The 96 adjustable zones effectively become 32,000 micro zones after interpolation.
2. Always STORE changes before turning off ignition or they will be lost.
3. TAKE NOTES as you go of the various settings and values to enable a logical picture to be built up for future reference. The VLLink System can produce millions of possible combinations so keep trace.
4. The SYNC and OFFSET switches. (on the small top board on the computer) and the TPS span must be set prior to tuning the system. If either of these are not correct then overall tuning will be difficult.



# 5. CLOSED LOOP FUEL OPERATION.

Closed loop operation involves the use of an exhaust gas oxygen sensor (Lambda probe) to provide the computer with a feedback signal indicating the actual fuel/air ratio. This signal allows the computer to make instantaneous corrections to the injector fuel flow until the required air/fuel ratio is achieved. This automatically compensates for all the variables that may cause incorrect fuel scheduling, and has two modes of operation;

1. Automatic programming: (Tuning Module Connected). The computer is able to "tune" itself throughout the entire operating range simply by driving the vehicle and allowing the computer to do all the work. The air/fuel ratio "targets" may be set to any required value depending on the application.
2. Continuous mode: (No Tuning Module) The computer normally operates in continuous mode after Auto or manual tuning is complete and compensates for all the day-to-day variables that cause the air/fuel ratio to drift, resulting in absolutely consistent running and low exhaust emissions.

## System Requirements.

Hardware for closed loop operation is essentially the same as for open loop with the following exceptions;

1. An exhaust gas oxygen sensor (Lambda probe) mounted in the exhaust manifold as close as possible to the cylinder head (rather than down the tail-pipe) to ensure fast response. The probe temperature must exceed 300 degrees Celsius for normal operation, and most types have a built-in electrical heater to assist with this requirement. The heater also allows the system to come on line faster after a cold start and ensures that temperature is always adequate during prolonged idle running.